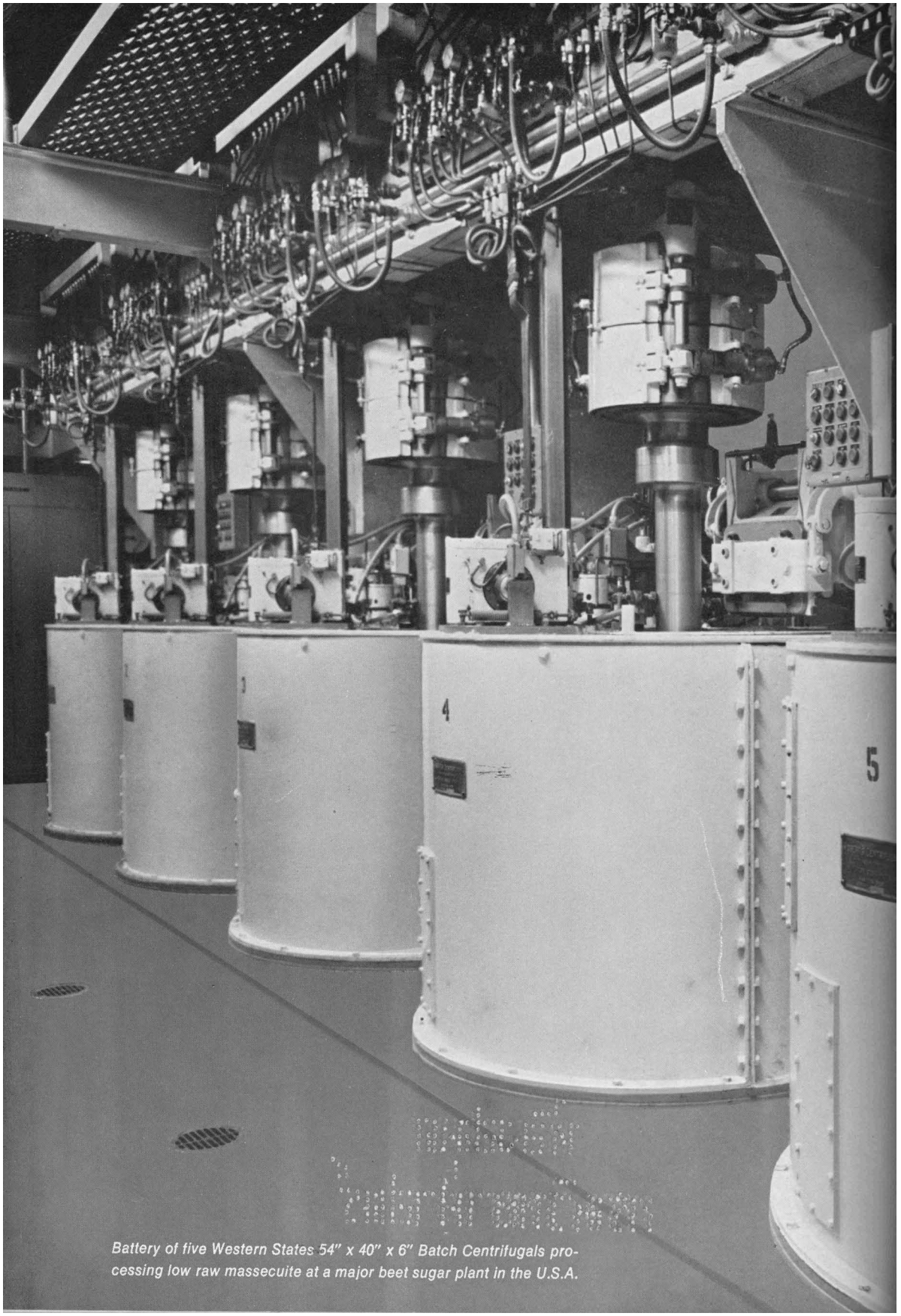
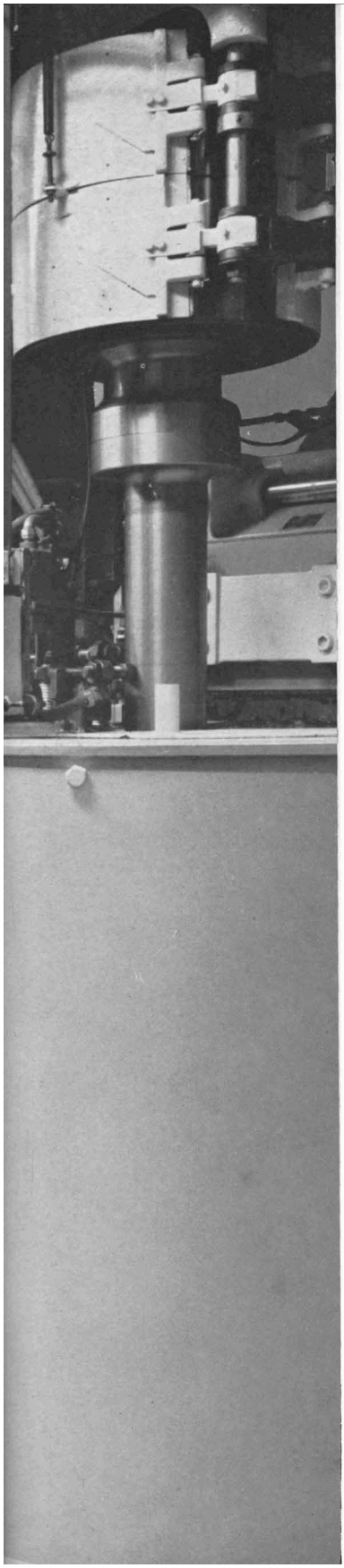
THE International Sugar Journal

NOVEMBER 1970



Battery of five Western States 54" x 40" x 6" Batch Centrifugals processing low raw massecuite at a major beet sugar plant in the U.S.A.



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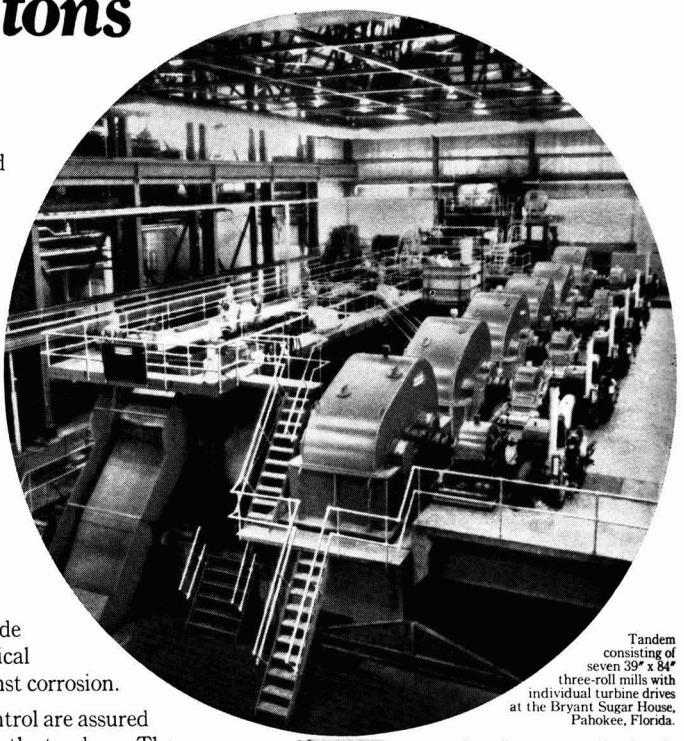

Tandem consisting of seven 39" x 84" three-roll mills with individual turbine drives at the Bryant Sugar House, Pahokee, Florida.

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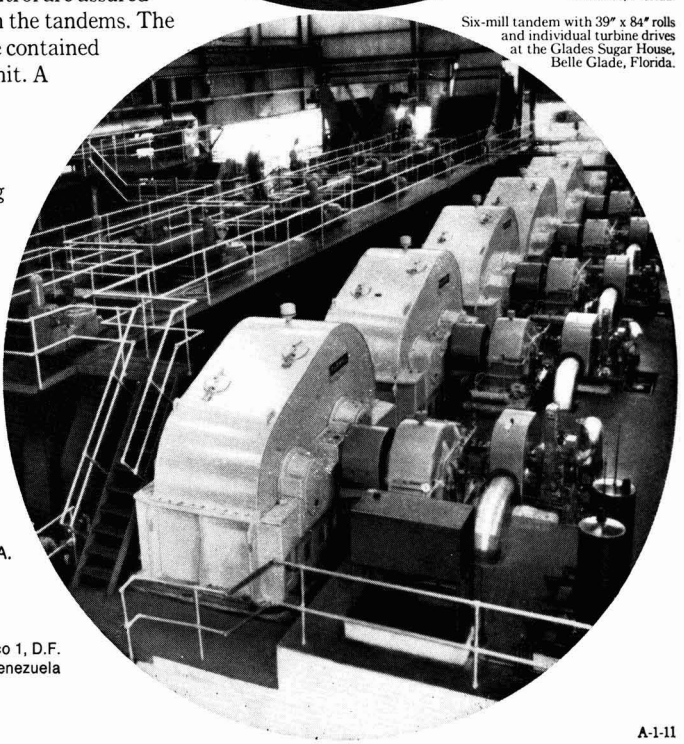

Six-mill tandem with 39" x 84" rolls and individual turbine drives at the Glades Sugar House, Belle Glade, Florida.

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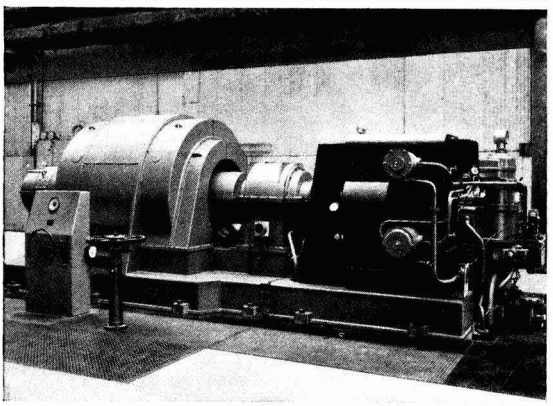

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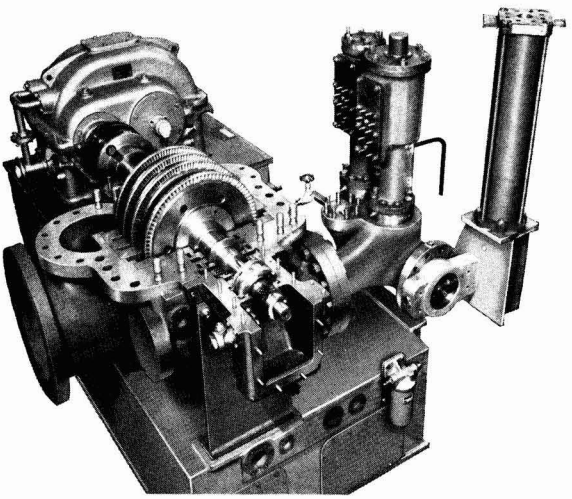

An Allen type SLC standard multi-stage, back-pressure turbine during course of construction.

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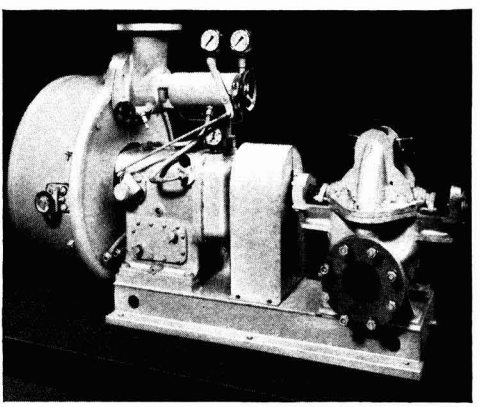

Allen-KKK type BF4/125 single-stage turbine direct-coupled to an Allen-Gwynnes centrifugal pump.

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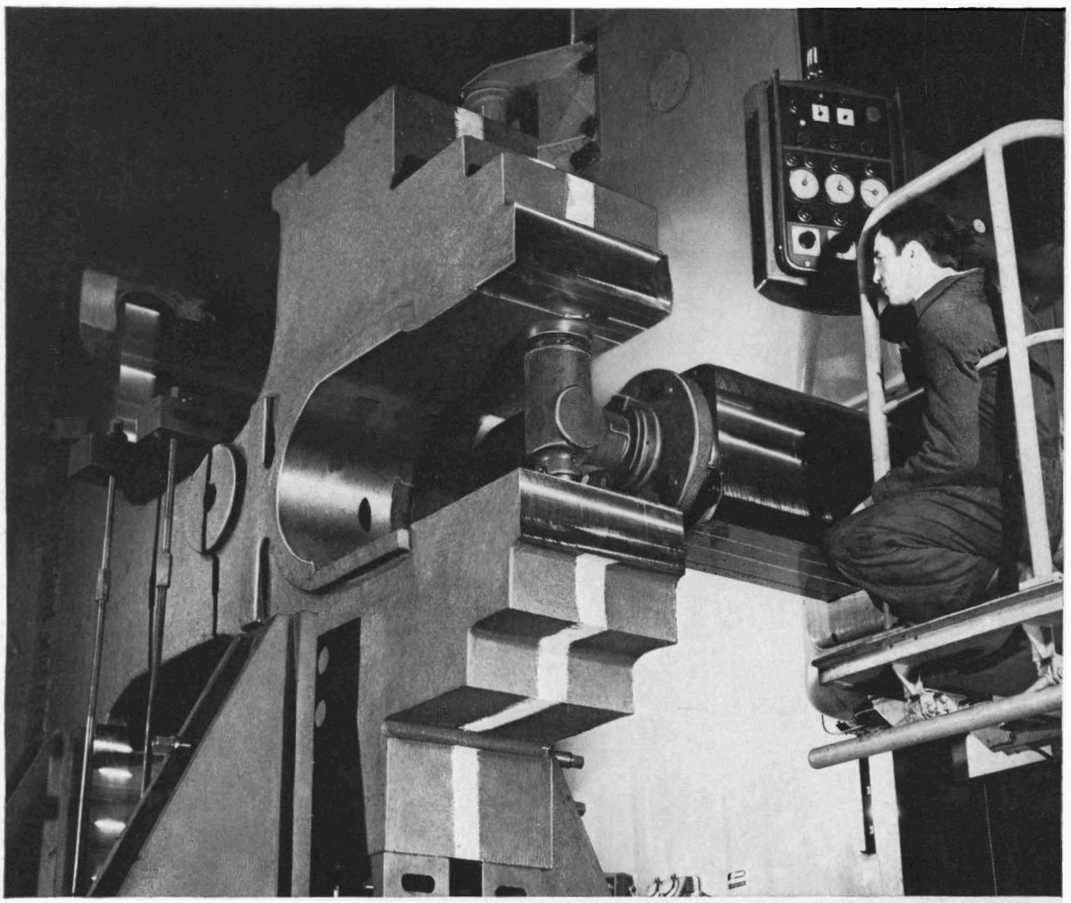

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November 1970

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Contrôle du pH du sirop par échange cationique. 1re partie. J. F. T. OLDFIELD, M. SHORE et M. SENIOR. *p.* 323–327

Dans le but de maintenir le pH du sirop dans les limites 6,5–8,0, valeurs jugées souhaitables dans les usines de la British Sugar Corporation afin d'éviter une chute dans la qualité du sucre blanc (si le pH est supérieur à 7,5–8,0) ou d'éviter une perte excessive en sucre par inversion (à un pH inferieur a 6,5), on a développé une méthode pour remplacer le contrôle de pH par l'addition de carbonate de soude ou de HCl. Dans la première partie de cet article, les auteurs discutent de la balance acide-base dans le jus et de la possibilité d'éliminer de façon contrôlée les composés basiques au moyen de résines échangeuses de cations. On rapporte les résultats de tests au cours desquels les résines furent ajoutées de façon continue au jus, et ce en termes du temps requis par une quantité donnée de résine pour éliminer une quantité donnée de composés basiques.

* * *

Extraction de la canne par broyage—approche moderne. 2e partie. W. R. CRAWFORD. *p.* 327–334

On considère les facteurs principaux impliqués dans le fonctionnement de l'unité de broyage No. 1 et qui affectent l'extraction, à savoir, l'uniformité de la vitesse de broyage, l'alimentation de la couche de canne au moulin et la charge hydraulique du moulin de sorte que les rouleaux flottent librement à chaque instant. L'auteur se réfère à des données expérimentales et d'usine pour montrer les effets de la préparation de la canne, de la vitesse du rouleau et du rapport entre les extractions du rouleau d'alimentation et du rouleau de sortie sur l'extraction totale.

Einstellung des pH-Wertes von Dicksaft durch Kationenaustausch. Teil I. J. F. T. OLDFIELD, M. SHORE und M. SENIOR. *S.* 323–327

Um den pH-Wert von Dicksaft im Bereich von 6,5 bis 8,0 zu halten, der von den Fabriken der British Sugar Corporation zur Vermeidung einer Verschlechterung der Weisszuckerqualität (wenn der pH-Wert 7,5 bis 8,0 überschreitet) oder aber zur Verhinderung eines übermässigen Zuckerverlustes durch Inversion (bei einem pH-Wert unter 6,5) für angebracht gehalten wird, wurde eine Methode entwickelt, welche die pH-Einstellung durch Zusatz von Soda oder Salzsäure ersetzen soll. Im ersten Teil dieser Arbeit diskutieren die Autoren das Säure-Basen-Gleichgewicht im Saft und die Möglichkeit einer gesteuerten Entfernung von Basen mit Hilfe von Kationenaustauschharzen. Die Ergebnisse von Versuchen, bei welchen die Harze dem Saft kontinuierlich zugegeben werden, sind in Form der Zeiteinheiten mitgeteilt, welche zur Entfernung einer gegebenen Basenmenge durch eine bestimmte Harzmenge erforderlich sind.

* * *

Zuckerrohrextraktion mit Hilfe von Mühlen—die moderne Arbeitsweise. Teil II. W. R. CRAWFORD. *S.* 327–334

Die Hauptfaktoren, die bei der 1. Mühleneinheit die Extraktion beeinflussen, werden behandelt, nämlich die Brechgeschwindigkeit, die Zuführung des Rohrfilzes zur Mühle und die hydraulische Belastung der Mühle in der Weise, dass sich die Walzen jederzeit frei bewegen. Die Autoren teilen Fabrik- und experimentelle Daten mit, um den Einfluss der Vorbehandlung des Rohrs, der Walzengeschwindigkeit und des Extraktionsverhältnisses zwischen Zuführ- und Austragswalze auf die Gesamtextraktion zu zeigen.

Control del pH de jugo denso por cambio de cationes. Parte I. J. F. T. OLDFIELD, M. SHORE y M. SENIOR. *Pág.* 323–327

Con el fín de mantener el pH de jugo denso entre los limites de 6·5 y 8·0, observado en la British Sugar Corporation como deseable para evitar una caída en la calidad del azúcar blanco (si el pH rebasa 7·5–8·0) y para evitar una perdida excesiva de sacarosa por inversión (si el pH es menos de 6·5), un método se ha desarrollado para el sustituto del control del pH por adición de ceniza de soda o de ácido hidroclórico. En parte I del artículo los autores discuten el equilibrio ácido-base en el jugo y la posibilidad de la separación controlada de base por medio de resinas para cambio de cationes. Se hace un unforme de las resultas de experimentos en que las resinas se adicionan continuamente al jugo, en términos del tiempo requerido por una dada cantidad de resina para separar una dada cantidad de base.

* * *

Extracción de la caña por molienda—et camino moderno. Parte II. W. R. CRAWFORD. *Pág.* 327–334

Se consideran los factores principales implicados en la operación del primer unidad de molienda que afectan su extracción, a saber uniformidad del paso de molienda, alimentación de la capa de caña al molino, y la carga hidráulica sobre el molino para que los cilindros flotan siempre libremente. El autor refiere a dados industrial y experimental que demuestran los efectos de la preparación de caña, de la velocidad de los cilindros y de la relación entre extracciones a los cilindros de alimentación y de descarga sobre la extracción total.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXII NOVEMBER 1970 No. 863

Notes & Comments

European beet sugar prospects 1970/71.

First estimates of beet sugar production in Europe in the current campaign were recently published by F. O. Licht K.G.[1] and are reproduced below together with the final figures for the 1969/70 crop.

	1970/71 (*metric tons, raw value*)	1969/70
WESTERN EUROPE		
Belgium-Luxembourg	585,000	687,174
France	2,550,000	2,781,527
Germany, West	1,970,000	2,114,212
Holland	703,000	781,444
Italy	1,280,000	1,415,554
Total EEC	*7,088,000*	*7,779,911*
Austria	322,000	357,162
Denmark	317,000	311,111
Finland	55,000	55,764*
Greece	183,000	149,422
Ireland	152,000	150,137
Spain	840,000	770,905
Sweden	244,000	210,555
Switzerland	62,000	62,899
Turkey	638,000	557,031
UK	912,000	955,650
Yugoslavia	500,000	533,332
Total West Europe	*11,313,000*	*11,893,879*
EASTERN EUROPE		
Albania	17,000	16,000
Bulgaria	235,000	220,000
Czechoslovakia	770,000	731,500
Germany, East	500,000	500,000
Hungary	350,000	449,371
Poland	1,710,000	1,527,000
Rumania	420,000	438,037
USSR	9,500,000	8,600,000
Total East Europe	*13,502,000*	*12,481,908*
TOTAL EUROPE	24,815,000	24,375,787

* Including 10,020 metric tons from Danish beet

The 1970/71 estimate is some 440,000 tons or 1·8% higher than the 1969/70 figure. Sugar production in Western Europe will be about 580,000 tons down on the previous year's figure, whereas an increase of about 1,020,000 tons is expected in Eastern Europe. A considerable reduction in the EEC production is forecast, the estimated 700,000 tons drop including some 230,000 tons reduction in the French 1969/70 production. West Germany is expected to show a drop of 140,000 tons, while reductions are also expected in Belgium/Luxembourg, Holland and Italy. Decreases are also expected in Austria, Yugoslavia and the UK, while production increases are forecast for Denmark, Finland, Greece, Spain, Sweden and Turkey. The heavy increase of some 1,020,000 tons in the Eastern Europe figure for 1969/70 is a consequence of better prospects in Poland and the USSR, both of which suffered poor crop results last year. On the other hand, a sharp drop of about 100,000 tons is expected in the Hungarian production as a result of a reduced beet area (75,137 ha compared with 97,553 ha in 1969/70) and poorer beet results.

Commenting on the estimates, C. Czarnikow Ltd.[2] write: "The general pattern of the estimates did not bring any great surprises as the market had been well aware of the poorer prospects in Western Europe and had expected that there would be an improvement from last season's very low output in the USSR". They emphasize the difficulty of forecasting the production for the USSR, although they agree on the prospect of an improved performance over 1969/70. They are not so confident in the estimate for the UK, however, about which they say: "Field sampling tests in the UK have shown good progress in recent weeks and from these we would expect the crop to be unchanged or higher than last year. Since (17th September) the official estimate has been increased from 912,000 tons, the figure published by Licht, to 960,000 tons. This is just over last year's final production and is in line with our own views at this stage". The latest available root weights and sugar contents are in fact well up on the corresponding figures for 1969/70.

More recent news from Licht on the initial beet processing in Europe[3] indicates a change in weather

[1] *International Sugar Rpt.*, 1970, **102**, (25), 1.
[2] *Sugar Review*, 1970, (989), 163.
[3] *International Sugar Rpt.*, 1970, **102**, (27), 1–2.

conditions from the warm and sunny weather at the end of September, which was favourable to increased beet sugar content, to rainy conditions in early October which have adversely affected the sugar content and may have hampered harvesting. Difficulties have been reported in Holland and the USSR; in the former, the situation has been somewhat aggravated by the late onion and potato crops, and both Dutch and Ukrainian sugar factories are working at below full capacity.

* * *

US sugar supply quota, 1970[1].

On 13th August, the US Department of Agriculture declared deficits against the quotas of Haiti, Panama and Peru, totalling 135,152 short tons, raw value, and an additional deficit of 80,000 tons in the Puerto Rican quota. No change was announced in the overall quota and the deficits were reallocated by assigning 25,000 tons to the Philippines, 40,000 tons to the Dominican Republic and prorating the balance of 70,152 to Western Hemisphere countries able to supply additional sugar.

Details of the changes in quotas appear below:

	Previous Quotas	*Shortfall Reallocations*	*Revised Quotas*
	short tons, raw value		
Domestic Beet	3,597,000	—	3,597,000
Mainland Cane	1,308,000	—	1,308,000
Hawaii	1,145,486	—	1,145,486
Puerto Rico	440,000	—80,000	360,000
Virgin Islands	—	—	—
Philippines	1,276,020	25,000	1,301,020
Argentina	76,525	1,984	78,509
Australia	206,270	—	206,270
Bahamas	10,000	—	10,000
Bolivia	7,407	192	7,599
Brazil	622,080	16,130	638,210
British Honduras	15,383	399	15,782
British West Indies	211,170	5,475	216,645
Colombia	65,829	1,708	67,537
Costa Rica	73,234	1,899	75,133
Dominican Republic	622,080	56,129	678,209
Ecuador	90,513	2,347	92,860
Fiji	45,265	—	45,265
French West Indies	66,427	1,722	68,149
Guatemala	61,714	1,600	63,314
Haiti	34,559	—8,383	26,176
Honduras	7,407	192	7,599
India	82,508	—	82,508
Ireland	5,351	—	5,351
Malagasy	9,740	—	9,740
Mauritius	18,909	—	18,909
Mexico	636,067	16,492	652,559
Nicaragua	73,234	1,899	75,133
Panama	46,080	—6,580	39,500
Peru	496,180	—40,189	455,991
Salvador	45,256	1,173	46,429
South Africa	60,735	—	60,735
Swaziland	7,448	—	7,448
Taiwan	85,946	—	85,946
Thailand	18,909	—	18,909
Venezuela	31,268	811	32,079
	11,600,000		11,600,000

ISO Executive Committee meeting.

The Executive Committee of the International Sugar Organisation met on 5th–6th October to consider the market situation following the declaration of shortfalls totalling 447,300 tons of sugar by member countries between 15th May and 30th September. These added to the shortfalls announced by 15th May make a total of 823,300 tons. Of this figure, 125,000 tons were redistributed on 17th July[2], leaving 698,300 tons undistributed. After reviewing the market situation and taking into account the apparent balance of supply and demand as reflected in the stability of the price, the Executive Committee decided that there should be no further redistribution of shortfalls at this stage. However, it reaffirmed its previous decision to meet to consider what action might be necessary if the prevailing price were above 3·80 cents/lb and the daily price at the time had been above 3·90 cents/lb for five consecutive market days. At the time of going to press, the ISA price is 3·92 cents/lb and the 17-day average is 3.87 cents/lb.

* * *

Britain and the EEC.

The British Government has told the EEC Commission that it will have to provide its partners in the Commonwealth Sugar Agreement with a satisfactory alternative if it is not able to go on buying their sugar under CSA contracts after Britain joins the EEC[3]. This is stated in a note sent to the Commission which is carrying out a series of studies of problems posed by British entry. The Government says that, although it will not be bound to continue the contract after December 1974, it will have to consult with its partners to seek means to fulfil the objectives of the contract. The two countries most dependent upon the terms of the agreement, which was set up in 1951, are Mauritius and St. Kitts; over 92% of Mauritius exports consists of sugar and over three-quarters of this enters the UK under the agreement. Fifty-eight per cent of all workers in St. Kitts are employed in the sugar industry, and the figure is 38% for Mauritius.

Britain's Common Market negotiator, Mr. GEOFFREY RIPPON, has also assured Commonwealth Caribbean Ministers at a meeting in London on 3rd September that the UK would seek a long-term solution to the problem of sugar supplies from developing Commonwealth countries during negotiations for EEC entry[4].

* * *

UK sugar beet price 1971.

The guaranteed price to be paid to farmers in the UK for beet delivered from the 1970/71 crop has been fixed at £6 19s 0d per ton, basis 16% sugar content, an increase of 2s 6d per ton. The 10s 0d per ton differentials for every 1% above or below the 16% sugar content will remain in force. The price will apply to the 443,000 acres already contracted.

[1] *Lamborn*, 1970, **48**, 134.
[2] *I.S.J.*, 1970, **72**, 225.
[3] *The Times*, 7th August 1970.
[4] *Public Ledger*, 5th September, 1970.

Thick juice pH control by cation exchange

By J. F. T. OLDFIELD, M. SHORE and M. SENIOR

(British Sugar Corporation Ltd., Research Laboratories, Colney, Norwich.)

PART I

Introduction

At some factories in the British Sugar Corporation it is considered that white sugar quality begins to suffer if thick juice sent to the pans is allowed to exceed pH 7·5–8·0, while, to avoid excessive sugar loss by acid inversion, the minimum acceptable pH is 6·5. This paper presents a method of producing thick juice within this relatively narrow pH range when the normal methods of control with soda ash and sulphur dioxide additions cannot be operated.

Acid-Base Balance

The juice in healthy beet is generally about pH 6·2–6·4, which is very close to the minimum acceptable pH in the white pan. Consequently the net removal of acids in the process must be at least equivalent to the net removal of bases.

In the process:

Elimination of acids occurs—

(A) By precipitation or partial precipitation of phosphate, oxalate, citrate, malate and sulphate during liming and carbonatation.

(B) By evolution of carbon dioxide during evaporation.

Acids are gained—

(C) As a result of acidification of diffusion supply water.

(D) By fermentation in diffusion.

(E) By conversion of glutamine to pyrrolidone carboxylic acid in carbonatation and during evaporation.

(F) By degradation of invert sugar in carbonatation and evaporation.

(G) By absorption of carbon dioxide.

(H) By addition of sulphur dioxide.

Elimination of bases occurs—

(I) By precipitation of magnesium during liming and carbonatation.

(J) By loss of the ammonia in the supply water during carbonatation and evaporation.

(K) By loss of the ammonia produced by glutamine hydrolysis.

Bases are gained—

(L) By addition of soda ash.

(M) At those few factories where the lime salts are higher than the natural calcium in the beet juice.

Excess base is required to raise the pH from that of raw juice to that of 2nd carbonatation and base is released again as the pH falls later in the process. As the pH of juice sent to the pans and of beet juice are very similar in the UK, the base required and released are very similar.

The overall effect of the acid—base changes for a typical juice is shown in Table I.

Table I. Acid-base balance for production of thick juice from a typical raw juice of 89 purity

Gain in base or loss of acid

	meq/100S
Ammonia from diffusion supply water	1·5
Loss of phosphoric acid in carbonatation	8.8
Loss of sulphuric acid in carbonatation	2·5
Loss of oxalic acid in carbonatation	9·2
Loss of citric acid in carbonatation	9·5
Loss of malic acid in carbonatation	1·0
Loss of raw juice carbonate in carbonatation	0·6
Soda ash (minimum)	1·9
Carbon dioxide evolved	8·1
Base released to pH 6·5	3·8
TOTAL	46·9

Gain in acid or loss of base

	meq/100S
Mineral acid from diffusion supply water	0·8
Lactic acid in raw juice	2·8
Loss of magnesium in carbonatation	12·2
Loss of calcium in carbonatation	1·2
Loss of ammonia in carbonatation	2·7
Acids from invert in carbonatation	3·2
Base to raise to 2nd carbonation pH	3·8
Carbon dioxide absorbed	8·1
Sulphur dioxide absorbed	6·0
Loss of ammonia in evaporators	5·1
Acids from invert in evaporators	1·0
TOTAL	46·9

1 meq/100S is approximately equivalent to the base contributed by 20 lb of soda ash or the acid contributed by 7 lb of sulphur per 100 tons of beet.

There are quite large changes in acids and bases during processing. For example, in Table I, 31·6 meq of acid/100S are removed in clarification; however, the difference between juice to pans at pH 7·5 and 6·5 represents a mere 0·5 meq/100S and from pH 8·3 to 6·5 represents less than 2 meq/100S. It is clear that minor changes in the individual acids and bases in the beet can have a marked effect on the balance.

It is not merely fortuitous that the change in base shown in Table I is identical with the change in acid. Consciously or unconsciously, the factory management endeavour to balance these two changes in aiming for a pH in juice to pans similar to that in beet juice; having fixed the sulphur dioxide absorption according to the requirement to suppress colour formation, changes in the acid-base balance will be met by a corresponding change in soda ash addition.

In white sugar factories, because of the need to add sulphur dioxide, the gain in acid plus loss of base

commonly exceeds the gain in base plus loss of acid, and so the required acid-base balance is commonly achieved by addition of soda ash. In raw sugar factories using no sulphur dioxide it is quite usual to have a net gain in base so that the pH of juice to pans is undesirably high even without soda ash addition. This situation will also arise in white sugar factories if eliminable acids are sufficiently high relative to the eliminable bases; these circumstances are more likely to occur in some growing areas than in others and the climate in some years may favour this occurrence, as was particularly noticeable in the early months of the 1969 campaign.

An increase of only 10% in the acids eliminated at clarification, for the balance shown in Table I, would remove the need for soda ash addition and give a net gain in base of 1·3 meq per 100S, equivalent to 26 lb of soda ash or 9 lb of sulphur per 100 tons of beet. With extra alkalinity, more carbon dioxide will be absorbed in second carbonatation and the subsequent release of this carbon dioxide will give a pH rise in the evaporation.

In the early part of the 1969/70 campaign this particular situation did arise at Brigg and Spalding factories. The variation of ΔpH throughout the 1969/70 campaign at Spalding, illustrated in Fig. 1, shows that a rise of up to 1 pH unit could occur between thin and thick juice during a period when no soda ash was added to process.

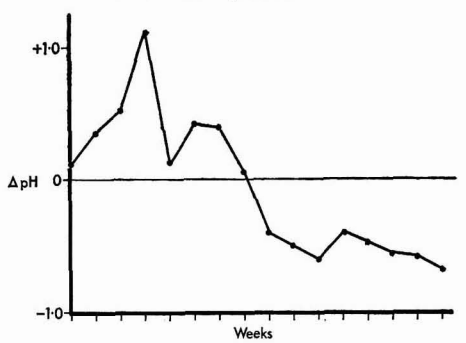

Fig. 1. pH change in evaporation from thin juice to thick juice, Spalding, 1969/70 campaign

Chemical changes occur during evaporation which lead to changes in the buffer curve[1] and to a net gain or loss of acid[2].

Acid is gained by the destruction of invert sugar during evaporation. There is also a loss of base due to hydrolysis of amide and loss of ammonia.

As samples of thick juice contain virtually no carbon dioxide a loss of acid will occur during evaporation equivalent to the entire carbonate-bicarbonate content of 2nd carbonatation juice.

Comprehensive analyses of juices collected at Spalding from each stage of the process showed that the loss of ammonia and gain in acid produced from invert destruction in evaporation was equivalent to a loss of base of 7·25 meq per 100S. The loss of carbon dioxide during evaporation showed an acid loss of 8·97 meq per 100S giving a net gain in base of 1·72 meq per 100S.

With no soda ash addition, and after the absorption of sulphur dioxide, the pH increased during evaporation from pH 8·0 in thin juice to pH 8·46 in thick juice. The buffer capacity of thick juice is much less than that of thin juice, as illustrated by the buffer curves for these Spalding juices (Fig. 2), so that if the excess 1·72 meq of base per 100S were neutralized or removed, the thick juice would have been obtained at pH 7·0 which is more acceptable for white sugar crystallization.

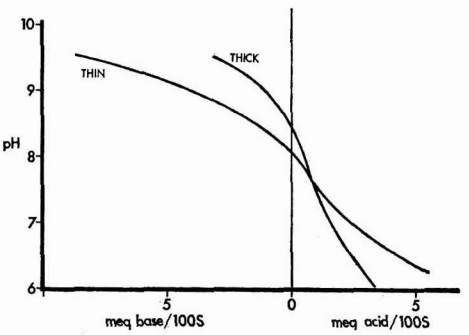

Fig. 2. Buffer curves for Spalding thin and thick juice

This excess base could be neutralized by an increased usage of sulphur dioxide but sulphur dioxide is expensive, amounts in excess of the optimum usage produce little improvement in colour[3], and in extreme circumstances excess usage could produce undesirably high levels of sulphur dioxide in sugar or molasses.

An obvious way to reduce the pH of thick juice sent to the pans is the addition of an acid having a soluble calcium salt. Acid equivalent to 1·72 meq per 100S would require an addition of nearly 7 gal of concentrated hydrochloric acid per 100 ton beet. Owing to difficulties in control of the addition, and possible sugar losses due to inversion, the acid is probably best added to the raw juice even though this will give a reduction in the base available to absorb carbon dioxide for the removal of calcium at second carbonatation.

The addition of 8 gal of concentrated hydrochloric acid per 100 ton beet into raw juice was carried out at Brigg factory. There was no detectable sucrose inversion and the pH rise in evaporators was stopped, allowing a reduction in sulphur dioxide usage and so reducing the sulphur dioxide in white sugar below 10 p.p.m.

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[1] CARRUTHERS *et al.: Paper presented to the 7th Tech. Conf. British Sugar Corp. Ltd.*, 1954; *I.S.J.*, 1954, **56**, 218.
[2] *idem: Paper presented to the 12th Tech. Conf. British Sugar Corp. Ltd.*, 1959; *I.S.J.*, 1959, **61**, 376.
[3] *idem: Paper presented to the 8th Tech. Conf. British Sugar Corp. Ltd.*, 1955; *I.S.J.*, 1956, **58**, 22.

To avoid the risk of inversion, calcium chloride instead of hydrochloric acid may be added to raw juice to give the same reduction in base. The calcium component of the calcium chloride is not transferred quantitatively to 2nd carbonatation juice. The increase in the 2nd carbonatation juice calcium content will be much smaller and exactly equal to that obtained when hydrochloric acid is used.

The substitution of calcium chloride for hydrochloric acid was carried out at Brigg factory and was equally effective in controlling the acid-base balance. If we regard these acid sources as negative soda ash then roughly equivalent quantities are:

Soda ash	10 lb per 100 ton beet (0·5 meq per 100S).
Conc. Hydrochloric acid	2 gal per 100 ton beet.
Calcium Chloride $CaCl_2, 6H_2O$	20 lb per 100 ton beet.
Calcium Chloride (36% Soln.)	3 gal per 100 ton beet.

The addition of 8 gal of hydrochloric acid per 100 ton beet or of the corresponding amount of calcium chloride is equivalent to a non-sugar addition of 32 lb per 100 ton beet, giving an increase in molasses of 100 lb per 100 ton beet (assuming a purity of 60 at 80°Bx).

In general, any addition of non-sugars to the process is to be avoided if possible and it is far more attractive to control the pH by removal of base than by addition of acid. Such removal would decrease the molasses production by an amount equal to the increase shown above. The possibilities of controlled base removal by use of cation exchange resins were therefore investigated.

Removal of Base as a Means of pH Control

Cation exchange resins

Ion exchange resins are insoluble electrolytes which are classified as cation exchangers if the polar groups of the resin matrix are acidic. Cation exchange resins can be further classified as strong cation exchangers and weak cation exchangers.

The exchange reaction is reversible and the equilibrium between a solution of a salt M^+A^- and a cation exchanger H–R may be expressed by the following equation where the symbol R represents the resin matrix:

$$H\text{–}R + M^+A^- \rightleftharpoons M\text{–}R + H^+A^-$$

For strong cation exchangers the equilibrium is displaced to the right in contrast to the weak cation exchangers for which the left to right reaction is suppressed by the free acid H^+A^- at a hydrogen ion concentration of about 10^{-4} g.ions per litre (pH 4).

Strong cation exchangers therefore have the ability to remove cations from neutral salt solutions ("salt splitting") but the quantity of regeneration acid must exceed the amount of resin which can be converted to the hydrogen form. It is therefore generally uneconomical to regenerate strong cation exchangers fully but these resins are allowed to become fully exhausted before regeneration.

On the other hand with weak cation exchangers "salt splitting" of neutral salts cannot be achieved to an appreciable extent, but as the resin has a high affinity for hydrogen ions it is not necessary to use a large excess of acid for regeneration and the right to left reaction in the equilibrium equation is almost quantitative.

In general the total exchange capacity of weak cation exchangers is much greater than that of strong cation exchangers, but to minimize leakage, the approved technique is to regenerate fully and to use less than half of the available capacity before regenerating again. In this way it is possible to remove excess alkali from a solution with a regeneration acid usage which is but slightly greater than that required for direct neutralization of the free alkali.

The most usual type of strong cation exchangers consist of cross-linked polystyrene nuclear sulphonic acids of which "Amberlite IR 120", "Zeokarb 225", "Dowex 50", "Lewatit S100" and "Duolite C 20" are typical examples. The usual weak cation exchange resins consist of cross-linked polyacrylic acid; "Amberlites IRC 50 and IRC 84", "Zeokarb 226", "Kastel C 100" and "Lewatit CNP" are typical examples.

Base removal using cation exchangers

It would be convenient to employ a cation exchanger which was so weak that the resin could not reduce the juice pH to too low a level. In fact the weakest commercially available cation exchangers, if present in excess amount, will remove bases from thin juice until the pH falls below pH 4. Consequently it is not possible to achieve the pH adjustment by a batch column technique treating all the process juice because the juice would fall to an excessively low pH each time a new column came into service.

With some difficulty, the pH control could be achieved by treating only part of the juice stream so that the excess cation removal from this portion was balanced by mixing with untreated juice. Such a procedure would require the percentage of the juice passing through the column to increase continuously as the resin became exhausted. Inversion would, however, occur in the treated juice owing to the low pH and, if a strong cation exchanger were employed, to heterogeneous catalytic inversion in the resin. The use of either type of cation exchanger in the form of a batch column treatment is therefore contra-indicated and the possibility of a continuous addition of resin to the juice was investigated.

Continuous addition of resin to juice

Concentrated hydrochloric acid equivalent to 1·5 to 2·0 meq/100S may be added to juice at 80°C without significant invert production.

It was found that the addition of an equivalent concentration of H^+ ions in the form of a cation exchange resin could be made equally without invert production.

The reaction of hydrochloric acid with juice is virtually instantaneous and is dependent on the

speed of mixing. Strong cation exchangers which are highly ionized are comparatively rapid in action while the weak cation exchangers, which require the making or breaking of a covalent bond, are comparatively slow, and in consequence are much more rate sensitive[4].

The reaction rates of various resins were measured. A bulk quantity of thick juice was diluted to 15°Bx and adjusted to pH 9·5 with sodium hydroxide. Samples of resin, having a total capacity equivalent to about 5·5 meq, were added to and stirred with 1 litre aliquots of the diluted juice at 80°C. The resin was stirred at a rate sufficient to keep it in suspension because the rates were not reproducible if any of the resin was allowed to settle. The rate of change in pH, converted to meq per litre by reference to a buffer curve measured on the same juice at 80°C, is shown in Fig. 3. The experiment was carried out with one strong cation exchanger and four different weak cation exchangers.

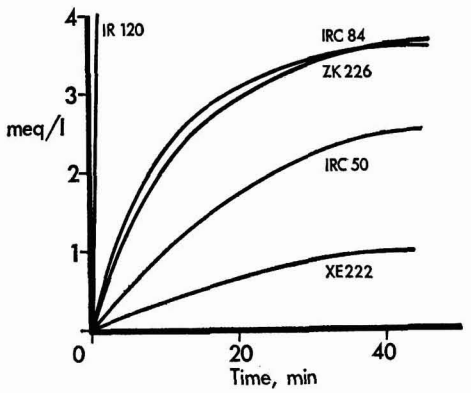

Fig. 3. Cation removal by resins from juice at 80°C by 5·5 meq of resin (maximum capacity) per litre

More than 80% of the capacity of IR 120 was neutralized within 1 minute but for the weak cation resins IRC 84 and Zeokarb 226, which had the fastest reactions for this type of resin, only 70% of the capacity was neutralized after 45 minutes. No change in the invert content of any of the juices could be detected.

For a factory having a flow rate of, say, 1000 gal per minute a retention time of 45 minutes would not be permissible; therefore the addition of weak cation exchangers to juice is not feasible when carried out in this manner.

If we consider the strong cation exchanger, this method of addition is a practicable possibility, but the costs of acid regeneration would be excessive, because a regeneration efficiency of less than 25% is obtained in approaching complete regeneration. The resin would also need to be transferred to a column in order to achieve this level of regeneration.

It was found that an exhausted resin of this type could be regenerated to 10% of its total capacity with a regeneration efficiency of about 90% and 2/3rds of this smaller capacity could still be utilized in 1 minute. The required decrease in juice pH could therefore be obtained by the addition of this partially regenerated resin in an amount at least 12 times greater than for fully regenerated resin. With this procedure, a reaction time of only 1 minute was required and the regeneration acid was only about 10% in excess of that required for direct acidification of the juice.

With a strong cation exchange resin regenerated to a capacity of 0·2 meq per ml, the removal of 2 meq of base per 100S from 2nd carbonatation juice at a flow rate of 1000 gal per minute would require the addition of 3 cu.ft. of resin per minute. The minimum time required for washing and regeneration would be 9 minutes so that the total stock of resin must represent at least 10 minutes supply.

The minimum resin stock for a factory with a flow rate of 1000 gal per minute would be 30 cu.ft. at a maximum efficiency for acid usage of 90%.

Addition of weak cation exchangers to juice

IRC 84 and Zeokarb 226 lowered the pH much more rapidly than the other weak cation exchangers tested in juice. Although the retention time of 45 minutes required to utilize 70% of the capacity of these resins would be unacceptable in factory practice, it can be seen from Fig. 3 that the first 20% of the total capacity was utilized in less than 2 minutes. Consequently it appeared that, if a sufficient excess of resin were applied to juice, it should be possible to obtain the required base removal within the same time scale as realized with strong cation exchangers. This possibility was examined by measuring the rate

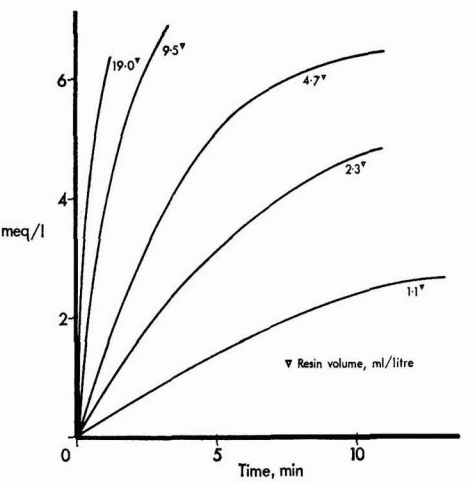

Fig. 4. Variation in reaction rate with concentration of IRC 84 resin

[4] ARDEN: "Water purification by ion exchange" (Butterworths, London.) 1968, p. 46.

of base removal achieved when an increasing excess of the weak resins were added to juice.

Increasing amounts, varying from 1·1 ml to 22·2 ml, of fully regenerated IRC 84 or Zeokarb 226 were stirred at 80°C with 1 litre aliquots of the standard diluted thick juice. The change in pH, measured at 80°C, was recorded at 1 minute intervals and the results are shown in Figs 4 and 5.

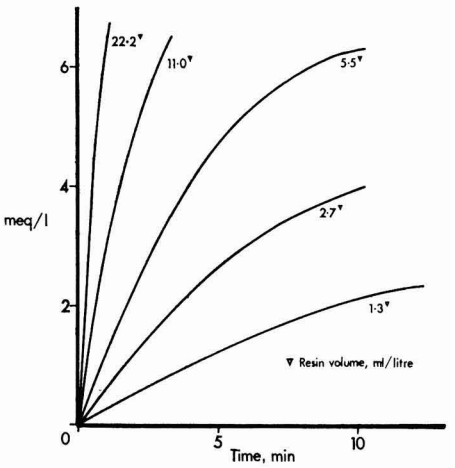

Fig. 5. Variation in reaction rate with concentration of Zeokarb 226 resin

The time required by the different amounts of resin to remove 3 meq of base per litre of juice was calculated from the graphs and is recorded in Table II.

Table II. Time to remove 3 meq/litre of base for different resin volumes

IRC 84		*Zeokarb* 226	
Resin vol., ml/litre	*Time, minutes*	*Resin vol., ml/litre*	*Time, minutes*
1·1	> 12	1·3	> 12
2·3	4·4	2·7	6·0
4·7	2·2	5·5	2·6
9·5	0·8	11·0	1·1
19·0	0·3	22·2	0·3

The removal of 3 meq per litre (2 meq per 100S) of base in 1 minute can be accomplished by the addition of about 10 ml of resin per litre of juice, equivalent to an addition of 1·6 cu.ft. of resin per minute for a factory flow rate of 1000 gal per minute. Weak cation exchangers may be regenerated to approaching 95% of their full capacity with a loss of only 1% of the applied acid. It is clear that more efficient acid usage may be obtained with a weak rather than a strong cation exchanger and this will also be accomplished with a smaller volume of resin.

(*To be continued*)

Cane extraction by milling—the modern approach

By W. R. CRAWFORD, D.Sc., Ph.D., M.Sc., Whit. Sen. Sch.

(*C. W. Murray Award-Winning paper, 1970*)

PART II

The No. 1 Milling Unit

General

Assuming that we have achieved a high percentage of free pol in the prepared cane, we must now examine the chief factors and behaviour in the No. 1 milling unit which affect the extraction at this stage. At first glance this is a formidable task because the variables are many, but after many years of experimental research, both on the pilot plant scale and in the factory, the writer believes that the really important matters which should be understood may be reduced to a manageable number, as given below.

1. The prepared cane must be delivered to the first pair of rollers at a rate which is kept as near constant as possible, and every effort must be made to ensure that the blanket thickness across the width of the feed chute has also a near-constant value. The importance of these two objectives cannot be overemphasized, because it is at this stage that good milling commences.

2. The first pair of rollers must be coaxed to accept the feed blanket with zero—or near zero—slip, in order to avoid roller polishing, and the unpredictable behaviour which arises from the latter. It seems quite clear that a roller can only be polished by relative movement between the roller and a polishing medium, which in this case is the cane and the dirt entering with it. The latter is entering in ever-increasing quantities.

3. The mill should be hydraulically loaded and set in such a way that it floats freely at all times, so maintaining constant load on the blanket and giving an equitable division of load, and hence extraction, between pairs of rollers.

4. If possible, we should have some knowledge of the influence of preparation on extraction, and the influence of roller speed and the ratio of mill settings.

There are, of course, many other aspects which might be examined, but in a paper of reasonable length it is quite impossible to cover the entire field.

We therefore proceed to examine the above matters in a little detail.

Control of uniformity of crushing rate

Although it is customary to speak of crushing in terms of weight per unit time, the feed to a mill is usually gauged by volume using a sensing device which usually, in effect, measures the thickness of the feed blanket. If a feed chute with a closed front is used, e.g. the Donnelly chute, the volumetric rate is controlled by keeping a constant height of cane in the chute.

From time to time it has been suggested that the crushing rate be controlled by measuring the weight entering the feed chute via a weighing conveyor; in fact the writer has made one such suggestion[15]. This method has been used in feeding diffusers.

It is easily shown that, say, a ton of "average" cane containing 10% fibre has a no-void volume of about 32·3 cu.ft., whereas a ton of similar cane containing 17% fibre has a no void volume of around 31·6 cu.ft. This is a small difference, and since juice expression is a volumetric process which is dependent on the no-void density, perhaps we are not far out in using volumetric monitoring systems. On the other hand, feeding ability and crushing rate depend on the bulk density of the feed material.

The automatic control of crushing rate by cane carrier speed control is now well established and many arrangements are available, including variable speed D.C. electrical drives using the Ward-Leonard system, or silicon-controlled rectifiers, as described by DREW and MATSON[16].

Variable-speed hydraulic drives are available and these have similar characteristics to the D.C. drives.

In many cases the sensing device for such control systems takes the form of a finger plate resting on the cane blanket. In order to secure our requirement of constant thickness across the blanket, this type of sensing device should be split up into a number of separate finger plates each of which gives a measure of blanket thickness at a different position across the blanket. These measurements may be averaged mechanically, electrically or pneumatically. At least one manufacturer markets a mechanically averaging finger-plate sensor of this type. The writer suggests that perhaps one of the simplest averaging arrangements is that shown diagrammatically in Fig. 8. The transverse width of the blanket is divided into a number of equally spaced zones—in this case six. In each zone a hinged finger-plate rests on the blanket of prepared cane. Any change in the target blanket thickness proportionately displaces the piston in small hydraulic cylinders (A_1–A_6), placed above each zone. The upper portions of these cylinders and the piping system leading to the master cylinder B are completely filled with oil, so that the displacement of the piston in cylinder B is a measure of the average displacement in cylinders A_1 to A_6. The signal from B due to displacement of the piston is fed to the cane carrier automatic control system. Practical details and construction will readily occur to the interested reader.

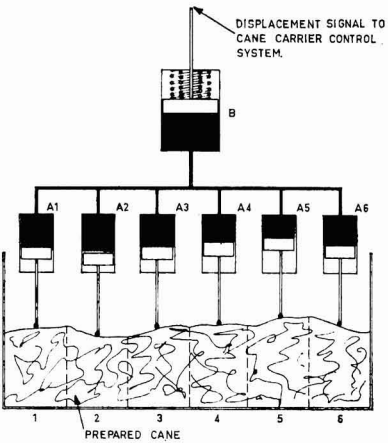

Fig. 8. Averaging feed rate sensor

From time to time it has been suggested that milling rate control could be done by using the rate of juice flow as a sensing measurement. This is not a good idea because it would inevitably result in large variations in crushing rate with change in the type of cane entering the factory, and perhaps its consequent degree of preparation.

The feeding of mills

Fig. 9 shows, diagrammatically, a pair of first rollers receiving a feed blanket of uniform thickness, H. We will use the following notation:

v = mean roller peripheral speed.....ft/min
D = mean roller diameter..... ft
H = depth, or thickness, of feed blanket..... ft
S = mean work opening, or setting.
α = angle at which feed blanket contacts rollers.
ρ = bulk density of the feed blanket....lb/cu.ft.

In an ideal mill with zero slip at the plane of entry to the rolls, AA, the crushing rate may be written, from the geometry of the system, as:

$$\text{Crushing Rate} = \rho v D \cos\alpha \left[(1 - \cos\alpha) + \frac{S}{D}\right]$$

lb/min/ft of roller length.

[15] CRAWFORD: *Proc. 23rd Conf. Queensland Soc. Sugar Cane Tech.*, 1956, 145–155.
[16] *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 209–212.

DDS

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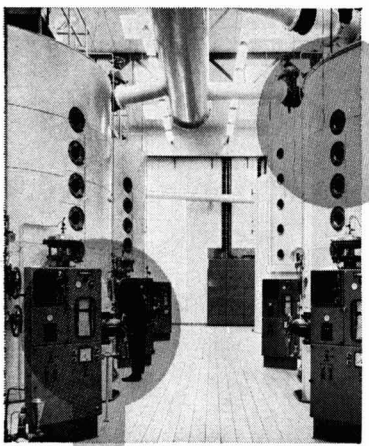
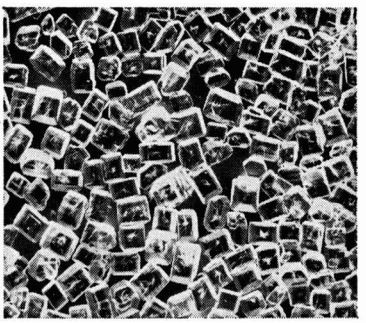
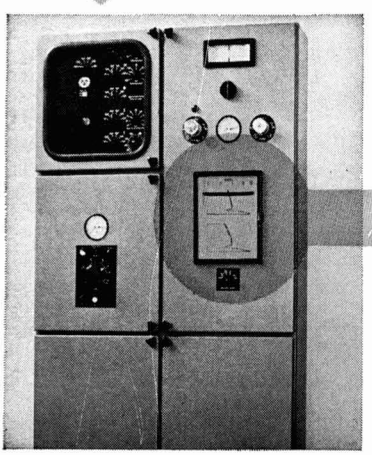
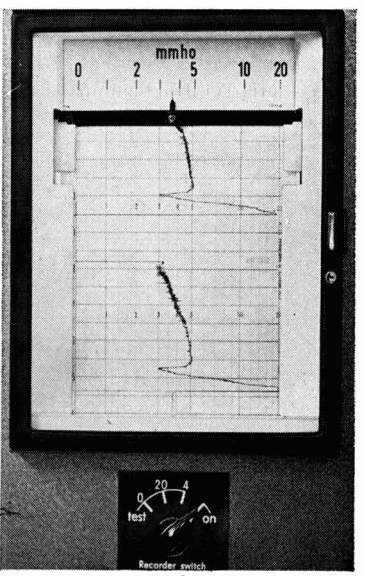
COMPLETE PAN BOILING AUTOMATICS





A low content of conglomerates and a uniform grain size constitute an essential prerequisite for producing the best possible sugar from a given juice. In an existing vacuum pan the best results are achieved by keeping the supersaturation in the mother liquor at an optimum during all stages of the strike. By automizing both graining and final boiling the DDS-Pan-Boiling Automatics meet these demands to their full extent, at the same time considerably reducing the labour costs.





The function of the DDS-Pan-Boiling Automatics is based on a measurement of the conductivity combined with efficient vacuum regulation. The equipment is used for juices with purity up to 97 and works without any use of water. The DDS-Pan-Boiling Automatics have been developed during the last ten years and are of a sturdy and simple construction. They operate successfully in Italy, The Netherlands, South Africa, and Denmark.

LEVERANDØR TIL DET KGL. DANSKE HOF

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In the years since the writer first set down this simple expression it has suffered many vicissitudes, and the portion $\cos\alpha\left[(1-\cos\alpha)+\frac{S}{D}\right]$ has been used in developing theories of mill capacity in the guise of a so-called "capacity number". Use has also been made of this portion in attempts to develop theories of mill feeding. However, whatever the merits, or otherwise, of such theories, the above expression does give us a useful picture of mill feeding, and possibly capacity.

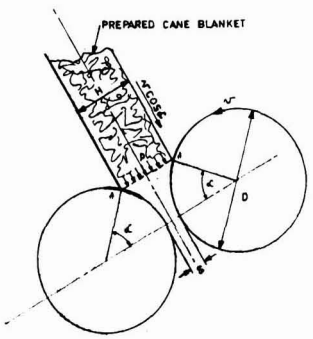

Fig. 9. Ideal mill feeding

Thus it seems evident that to have zero slip at the plane of contact, AA, it is necessary to apply a longitudinal feeding pressure p, as indicated in Fig. 9, so that the friction between cane and roller will be just sufficient to draw the blanket into the rollers. If this pressure is increased above this minimum, then it is possible to increase the angle α, and hence the crushing rate, for a given roller speed.

The object, then, of any feeding arrangement is to supply the feeding pressure, p, and this becomes more important with high cell breakage because the well-shredded cane carries much more free liquid than, say, knifed cane, which lowers the coefficient of friction at the rollers, so reducing the feedability of the material. Consider, for example, a prepared cane of 14% fibre. This fibre contains 25% of its own weight of hygroscopic, or Brix-free water, which is adsorbed in the fibre and cannot be expressed in mill rollers.

Thus the extractable juice in cane is $\left(100-14-\frac{14}{4}\right)$ $= 82{\cdot}5\%$.

If we rupture 50% of the juice-containing cells then:

free liquid % fibre $= \frac{0{\cdot}50 \times 82{\cdot}5}{14} \times 100\% = 295\%$

On the other hand, if we rupture 85% cells, free liquid % fibre $= \frac{0{\cdot}85 \times 82{\cdot}5}{14} \times 100\% = 500\%$, which gives some indication of the feeding problem which may be encountered.

Over a long period many methods of improving mill feeding have been tried, but it would seem that at the present day practical methods are limited to:

(i) the long gravity chute, with or without a closed front,
(ii) the under-feed roller,
(iii) the pressure feeder,

or combinations of these.

A great deal of theoretical analysis, and some experimental work, on the feeding pressures developed in gravity chutes, has been carried out in Queensland. Most of this led to the conclusion that, because the frictional forces on the chute vary exponentially with the length of chute, there is little to be gained in making chutes longer than 10–12 ft, and that the longitudinal pressure at the rollers would then be of the order of 0·84 p.s.i.

In these circumstances it is unlikely that a gravity chute alone could effectively feed the cane, with high cell rupture, to a realistic feed opening on a three-roll mill.

Such experience as we have of under-feed rollers leads us to a similar conclusion, but there is evidence that a combination of the long gravity chute *and* an underfeed roller will greatly improve matters. Whether or not this combination is sufficient for our purpose has, however, not been determined.

The feeding device which is now universally used in Australia and Fiji is the pressure feeder, and it has been proved that this will handle very wet feed material with a minimum of roller slip.

The continuous pressure feeder originated as an outstanding contribution by the Colonial Sugar Refining Company Ltd. to the technology of the sugar industry.

Briefly, a continuous pressure feeder comprises a pair of circumferentially grooved rolls mounted in front of, and somewhat higher than, the feed and top rolls of the three-roller mill, after the fashion of a two-roller crusher. These rollers are connected to the mouth of the mill by a heavily-constructed totally-enclosed chute. This chute has a constant width equal to the roller length, but its transverse depth tapers slightly outwards from the feeder rollers to the mill rollers. The arrangement is shown diagrammatically in Fig. 10.

The feeder is driven through additional gearing incorporated in the mill drive final gearing, and in normal circumstances it is possible to fit a pressure feeder to an existing mill.

The chute is kept as short as possible in order to minimize the frictional forces between the bagasse and the walls of the chute.

In early pressure feeders the feeder rollers had a diameter somewhat less than that of the mill rollers, but the modern tendency is to make the diameter of the feeder rollers at least equal to, and sometimes greater than, that of the mill rollers. This greatly enhances the feeding ability of the pressure feeder

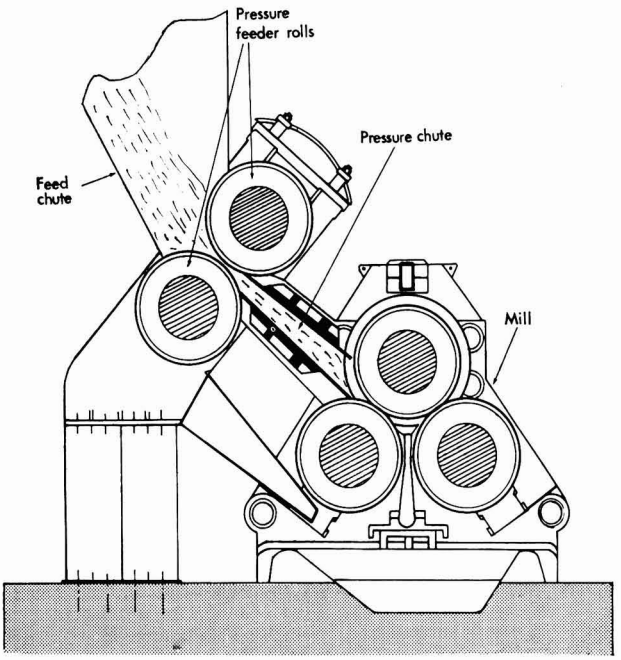

Fig. 10. Pressure feeder attached to a three-roller mill

and, in effect, the combination of feeder and mill becomes a five roller-mill. Because of this, the feed opening of the pressure-feeder rolls may be appreciably greater than that of a three-roll mill which yields the same extraction. Thus feedability is enhanced, and the reduction in liquid content in the pressure-feeder rolls allows the presentation of a compact, partially-dried bagasse blanket, of uniform thickness, to the mill feed opening.

Pressure feeders are not normally fitted with hydraulics.

Table III gives first unit reduced pol extractions for eight large Queensland factories during the 1968 campaign. As before, the values given have been averaged over the entire season.

Table III. First unit extractions

Factory	1	2	3	4	5	6	7	8
Total cane crushed, tons	796,108	561,511	541,553	735,863	652,957	698,049	533,342	602,102
Crushing rate, tons/hr	300·6	253·0	239·2	262·4	253·2	253·3	232·3	238·7
Fibre rate, tons/hr	37·08	33·09	33·12	35·35	36·36	36·2	32·75	34·38
% reduced pol extraction	70·6	75·4	71·1	70·4	75·5	79·8	75·7	76·6

Although all of these factories employed a shredder, pol in open cells was not determined, at least on a planned basis, and hence figures are not available. All factories, however, had pressure-feeder mill units in No. 1 position.

In recent times the Sugar Research Institute has developed a light pressure feeder. A typical example would have 32-in diameter rolls, the top and bottom rolls being driven respectively from the pintle ends of the top and feed rolls. These feeders have a work opening only a little less than the thickness of the entering cane, or bagasse, blanket. They do not express juice and, their purpose is merely to compact the blanket slightly and, through the enclosed chute, present a blanket of uniform thickness to the mill. They are most useful at the bagasse mills, excluding the final, or dewatering, mill.

Floating hydraulic mills

This matter has been considered by CRAWFORD[17], who has pointed out that the three most commonly used mills at the present time are those with:

(*a*) Top roller loading,
(*b*) Delivery roller loading,
(*c*) Top *and* delivery roll loading.

In addition one European manufacturer has introduced a mill in which the top roller is carried in a cantilever housing, which is pivoted on the delivery side of the mill. This was the arrangement of the Sugar Research Institute experimental mill, built in 1955–1956. This substitution of "turning pairs" for "sliding pairs" is a time-honoured method of reducing frictional resistance to movement, and by using anti-friction bearings at the pivots frictional forces can be virtually eliminated, and a completely free floating roller is assured. Nevertheless, on a full scale, the usual problems of roller tilt due to uneven feed, or foreign objects, are still encountered.

Such a mill is virtually self-setting, as is also the mill with both top and delivery hydraulics. Other proposals for self-setting mills have been put forward, but the few which have been tried have not survived.

The pivoted top roller-type mill can be arranged to maintain a constant work ratio as the roller rises and falls, and whether or not this is advantageous, is discussed below.

The author has shown experimentally, many times, that on both pilot plant and factory scales, practical

[17] *Proc. 23rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 163–172.

variations of work ratio, such as experienced with a fully floating top roller, have little influence on the extraction obtained in bagasse mills. This applies equally to the cane mill, provided the preparation is sufficiently fine. To illustrate this, Fig. 11 has been prepared from the results of experiments carried out with the Sugar Research Institute experimental mill in 1960, and previously published by BAGLEY[18]. The extraction is given as juice % juice in feed, and the experiment was carried out with maceration of 450% on fibre.

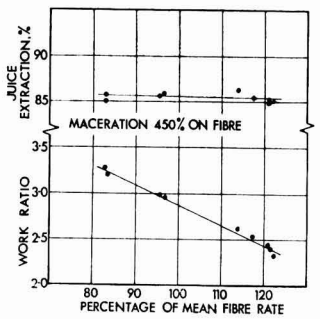

Fig. 11. Work ratio and extraction

It will be seen that despite a variation in fibre rate of $\pm$ 20% about the mean, with a corresponding total change in mill work ratio from 2·4 to 3·25, the juice extraction remained virtually constant. This is a characteristic of top hydraulic mills in which the top roller floats freely, and has been confirmed for full-sized mills in factory experiments. It is evident then that constant mill ratio in a freely floating mill has little virtue of itself.

Another view which is held, though not widely, is that feed and delivery roll loads have the same relationship to one another as the mill ratio. This is erroneous, since it implies a linear load-compression relationship for cane or bagasse, which is not the case. However, it is probably true to say that for given mean settings and a reasonably constant fibre rate, the ratio of the two roll loads will also be constant, although this load ratio would need to be determined on the job.

From his analysis of mill geometry and mechanics the writer[17] concluded:

(i) A constant juice extraction may be obtained with a fully floating top roller, but a modified form of construction is desirable to ensure free float at all times.

(ii) The same result may be obtained with a floating delivery roller only and the modern in-line design ensures float in the simplest possible manner.

(iii) A floating top roll may be considered by some to have the added advantage of providing a safety device against extraneous bodies. This is an erroneous view because although the feed opening may increase sufficiently to pass a foreign body, the maximum delivery opening must always be less than that of the feed, and so safety at the feed may well be followed by disaster at the delivery.

(iv) The only real safety valve arrangement is one where both openings may extend to the same limit. This calls for separate top and delivery hydraulics with large maximum roll travels and a new form of coupling in place of the conventional tailbar to allow for the increased openings.

(v) There is no particular virtue in constant mill ratio constructions although there are also no disadvantages.

(vi) The pivoted arrangement of top roll housing has advantages over the sliding top roll.

(vii) The fully floating pivoted type of self-setting mill provides independent, and constant, loading on feed and delivery nips. This will ensure constant extractions at these points, and since the loading can be varied in a very simple manner, the best conditions for any set of circumstances can be readily obtained in practice.

Preparation, roller speed and No. 1 extraction

A few No. 1 unit figures for pol in broken cells and No. 1 pol extraction are available from the Bingera factory of Gibson and Howes Ltd., by permission of that Company, for the latter end of the 1969 campaign. These are given below.

Table IV. Pol in open cells *vs.* No. 1 extraction

Week ended	*Fibre rate tons/hr*	*% pol in open cells*	*No. 1 pol extraction %*
25.10.69	30·8	72·7	74·4
1.11.69	31·0	73·5	74·6
8.11.69	31·4	71·9	73·6
15.11.69	30·9	72·0	72·5
22.11.69	33·1	72·0	73·7
29.11.69	30·4	67·8	70·2

The factory comments that although the range of cell breakage is not dramatic, the drop in preparation and extraction during the last week is interesting and could be significant. In the meantime it can be seen that even with moderate cell breakage the pressure-feeder mill combination can give a high extraction in No. 1 position.

Clearly, this should be improved by increasing cell rupture.

Few data on full-scale tests are, as yet, available, but it is possible to refer to experiments carried out with the Sugar Research Institute's experimental mill and fully reported in 1958[19].

In these experiments the bulk density method of assessing cane preparation was used, and the results of three pairs of series of experiments, involving one hundred and eleven milling tests, are summarized in Fig. 12. The series were run at roller speeds of 14·6,

[18] *Proc. 28th Conf. Queensland Soc. Sugar Cane Tech.*, 1961, 117–121.

[19] ANON: *Tech. Rpt. Sugar Research Inst.* (Queensland), 1958, (49).

29·2 and 44·5 ft/min, respectively, and one of each pair used commercially-knifed cane, the other using the same type of preliminary preparation followed by shredding in the experimental shredder. The results given are thus not quantitative, but do show clearly the effect of preparation on extraction at different roller speeds. It is seen, over the whole range of testing, in most instances to near ultimate crushing rate, that the percentage juice extraction from shredded cane is about 2 units higher than that from knifed cane.

Now since the pol of the juice expressed in a No. 1 unit is always higher than that of absolute juice, then the pol extraction at No. 1 will always be higher than the juice extraction. In the tests illustrated by Fig. 12, % pol extraction exceeds juice extraction by 3–4 units, so that if the cane were commercially shredded, as in 1958, we may expect an increase in first unit pol extraction of 5–6 units.

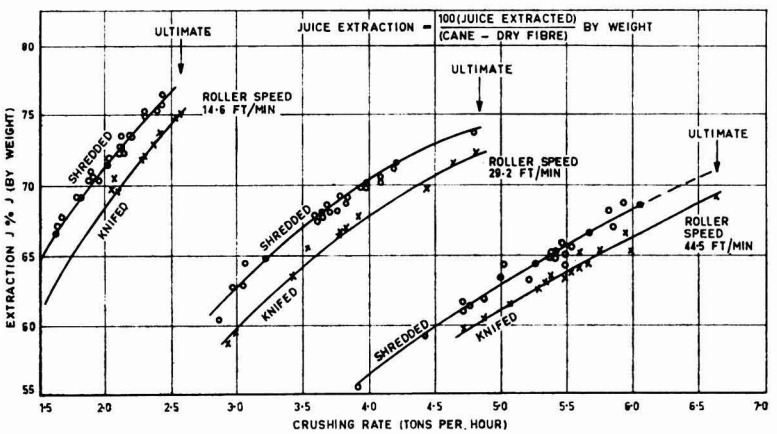

Fig. 12. Juice extraction *vs.* preparation

With the more intense modern shredding more than this should be achieved. However, let us remember that we have been considering pilot-plant scale, and that at the factory level the gain may not be so great. Obviously, however, the potential is there—to be made use of.

Fig. 12 shows also, in a general way, how the extraction and capacity varied with roller speed. Fig. 13 shows this more clearly. It shows the juice extraction results from a similar series of tests, with knifed cane only. On this diagram have been drawn lines of constant overall *compression ratio* which has been defined as

$$r = \frac{\text{no-void volume of cane/min}}{\text{volume escribed by delivery rollers/min}},$$

and which in an ideal mill would determine the volumetric juice extraction. From the results of these tests, which have been condensed into Fig. 13, it is possible to conclude that, if mill roller speed is increased without altering mill settings, the following changes take place:—

(i) At constant compression ratio, extraction decreases as roller speed increases.

(ii) At constant compression ratio crushing rate is directly proportional to roller speed, which is in keeping with the predictions of the ideal capacity equation given earlier.

(iii) The ultimate compression ratio decreases as roller speed increases, and

(iv) It follows as a consequence of (iii) that ultimate (or choking) crushing rates do *not* increase in direct proportion to roller speed.

There is some evidence from factory milling data, and from theoretical considerations, that for factory sized rollers, the reduction in extraction with increased speed is less than that with the experimental mill's 18-in diameter rollers.

In earlier days, in Queensland, the loss of extraction with increased speed tended to keep roller speeds down and tandems short. In other countries using higher roller speeds, the reduction in extraction was countered by increasing the number of units in a tandem. The writer is in favour of this system because it means less load and so smaller stress in the roller shafts, and less likelihood of gear failures.

As regards roller load for high extraction, there are as yet few practical data available for the new-style preparation, although it is expected this will be produced in the near future. It is the writer's opinion that, with high cell breakage, high No. 1 extractions will be obtained with top roller loading not exceeding 50 tons/ft roller length.

Countering extraction loss due to increased roller speed

Since extraction falls at increased speed, although capacity is raised, some means should be found, if possible, to keep the two in step.

A possible means is that suggested by CRAWFORD[20], and the method may be described as one of constant escribed volume.

The original thought behind the idea was that, in a mill crushing at constant rate, a thin blanket at high speed might yield a better extraction than a thick blanket at low speed, because of the shorter drainage path. Blanket thickness is defined as the mean work opening. A series of experiments, to test this idea, was undertaken with the experimental mill, and it will be shown that, while the ultimate extraction is increased by thinning out the blanket, the main increase is not due to improved drainage, but results from an increase in the ultimate compression ratio.

The mill data for these experiments were:

Roller speed (ft/min)	14·6	29·2	44·5
Work Opening (feed)	1·168 in	0·584 in	0·385 in
Mill Ratio		1·735	
Escribed volume (feed)		1·423 cu. ft./min	

Cane preparation for these tests may be described as "coarse commercial", knifed.

In the work reported, the juice extraction is in volumetric terms and is defined as

$$\text{juice extraction} = \frac{100 \times \text{volume of juice extracted}}{\text{vol. cane} - \text{vol. fibre} - \text{vol. of hygroscopic water}}.$$

According to FOSTER the weight of hygroscopic water is 25% of the weight of fibre and the extractions have been computed on this basis.

Juice extractions, based on the definitions, and for the three roller speeds, are plotted in Fig. 14 on a base of apparent overall compression ratio. Remember that these curves, though obtained at different roller speeds, are for constant escribed volume.

It is seen from Fig. 14 that in the three series of tests carried out, the extraction at ultimate rate has increased with roller speed, and the inset to Fig. 14 shows approximately how the ultimate extractions and compression ratios varied with roller speed.

Since in all tests the mill ratio was maintained constant, it follows that the gain in ultimate compression ratio, and so extraction, can be due only to improved feeding of the mill. This will be obvious, since in these experiments the crushing rate is very nearly proportional to the compression ratio.

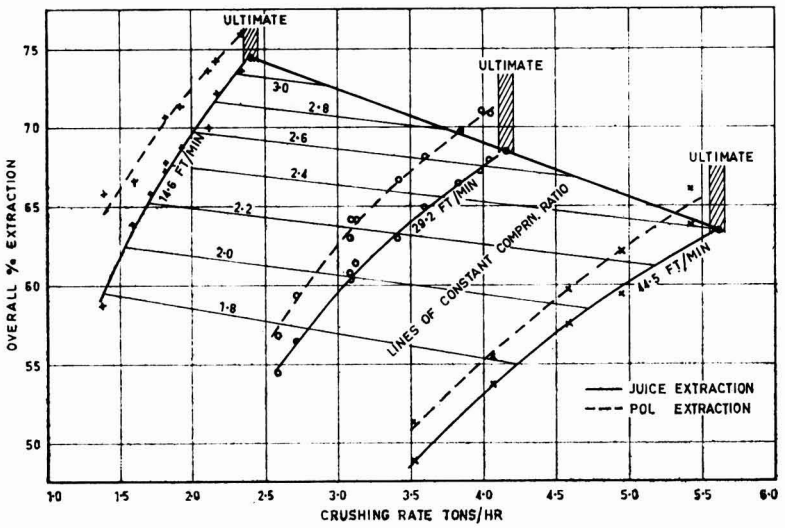

Fig. 13. Overall extractions

It may be said, then, that increasing the roller speed while maintaining the escribed volume constant is a powerful method of increasing crushing rate, which is naturally accompanied by increased compression ratio and increased feed roller extraction. The gain in feed roller extraction is greater than the additional loss at the delivery roller due to reabsorption.

Now the improved feeding ability at higher speeds with constant escribed volume is not due to any increase in frictional grip or the like; it is due to the fact that, if, for example, the work opening be

[20] *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 89–103.

halved by reducing it by 0·584 in as in the case of increasing speed from 14·6 to 29·2 ft per min, then the ultimate thickness of the feed mat is not halved, but is only reduced by an amount somewhat more than to increased speed, the feed roller at the fixed opening did more work. Up to 44·5 ft per min, there is no suggestion of an optimum value of this ratio for which extraction might be a maximum.

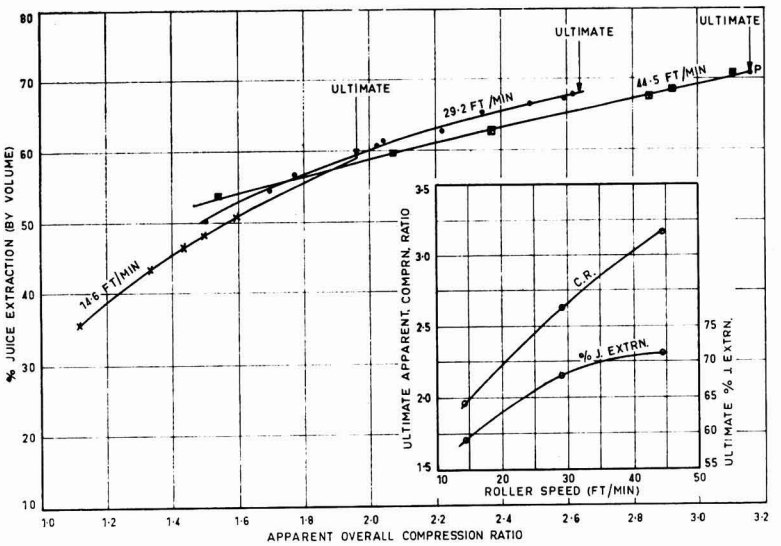

Fig. 14. Constant escribed volume tests

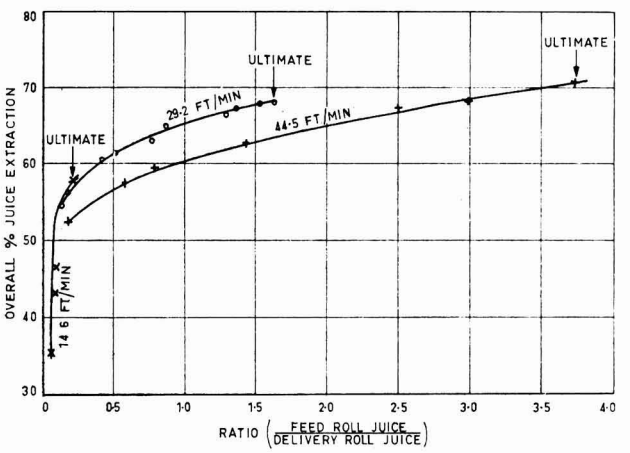

Fig. 15. Overall juice extraction *vs.* ratio feed roll juice:delivery roll juice

the actual reduction in work opening. Hence, with the doubled speed the rollers will accept an appreciably greater amount of cane in unit time. The manner in which the overall juice extraction changed with the ratio of feed to delivery roller extractions is shown in Fig. 15, and it will be seen that for all three speeds the extraction increased continuously with the juice ratio. In other words, as the rate went up, owing

Nevertheless, it is also clear from both Figs. 14 and 15 that there are practical limits to the use of this method because ultimate extraction appears to approach a constant value at high speeds. In other words, the gain in extraction may not be worth the cost of increasing the speed after a certain value is reached.

(To be continued)

Sugar cane agriculture

Field drainage for sugar cane. F. Y. PANOL. *Sugarland* (Philippines), 1969, **6,** (8), 16–23, 34, 38.—It is considered that in the Philippines too little attention has been given to the question of adequate drainage, far less than has been given to such matters as irrigation and other agronomic practices. Drainage problems in general are discussed and mention made of the notable increases in yield in a recent experiment where sugar cane was planted over mole drainage lines. An increase in yield of 75 piculs (about 5½ short tons) of sugar per hectare was obtained compared with adjoining areas without mole drainage.

* * *

The danger of exchanging seed cane. M. ABARCA. *Bol. Azuc. Mex.*, 1969, (235), 4–9.—A warning is given of the danger or risk of obtaining seed cane from growers in other areas. A map shows clearly the cane growing areas of Mexico.

* * *

Biosynthesis of sucrose and factors affecting its yield in sugar cane. J. A. BONNET. *Sugar y Azúcar*, 1969, **64,** (11), 42–45, 65.—The physiology of sucrose production in the sugar cane plant is discussed, along with the various factors that are concerned with it. These include climate and edaphic factors, low temperature, lack of nitrogen, age and variety. As far as Puerto Rico is concerned, the writer states that to reverse the trend of declining yields the country must adopt a reliable method for verifying the ripening of cane cut before harvest as a supplementary scientific aid in making good the decrease in yield from 12·12% to 9·23% sugar on cane in the 16-year period between 1950 and 1966.

* * *

Iron clads in operation in Queensland. ANON. *Producers' Rev.*, 1969, **59,** (10), 11–13.—The advantages of iron-clad catchment areas to feed dams, via concrete channels, are discussed. The cladding consists of sheets of galvanized corrugated iron attached to one another and suitably sloped towards the channel. With a grass catchment area at least two inches of rain may be required before there is any run off.

* * *

Preliminary observations on a fungus that attacks sugar cane froghoppers in the region of the river Papaloapan. M. ABARCA RUANO and H. RODRÍGUEZ. *Bol. Azuc. Mex.*, 1969, (236), 4–9.—Field observations are recorded on a fungus, *Metarrhizium anisopliae*, which will attack the sugar cane froghopper.

Some varietal characteristics of the more important commercial varieties. ANON. *Sugar Bull.*, 1969, **48,** 34.—The variety C.P. 52-68 is the most widely grown in Louisiana and is used as the basis of comparison in considering other varieties. It is a good yielder on both light and heavy soils, very erect and with good ratooning and milling properties. It is resistant to red rot but susceptible to mosaic. The other varieties discussed are C.P. 48-103, L. 60-25, C.P. 61-37 and L. 62-96.

* * *

The use of chemicals for sucrose control in sugar cane. A. G. ALEXANDER. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1968, 43–57.—What it is hoped will one day be achieved in this field is discussed at some length. In Puerto Rico intensive research work on enzyme-chemical relationships has been highly rewarding under conditions where conventional screening methods are either not possible or provide insufficient fundamental information. The key to effective chemical sugar control lies in prolonged basic study and intensive research. The extent of sugar control will be proportional to our knowledge of sugar-enzyme reactions.

* * *

Mechanical harvesting in Puerto Rico. F. D. FONT *et al. Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1968, 58–85.—The experience of various sugar estates in Puerto Rico with their "earlier days" of mechanical harvesting are separately recorded.

* * *

White top borer control. S. HATMOSOEWARNO. *Berita Akademi Gula Negara* (Indonesia), 1969, **1,** 92–102. Results are given of experiments carried out to test the suitability of five different host plants for the controlled or laboratory breeding of the pest. The plants were: sugar cane (the chief host plant of the pest and used as control), lemon grass, maize, elephant grass and *Chlorophytum bichetii*. Elephant grass (*Pennisetum purpureum*) proved to be the best host plant for the purpose required.

* * *

Early application of "aqua ammonia". ANON. *Australian Sugar J.*, 1969, **61,** 283.—This nitrogenous fertilizer is usually applied when cane is well advanced and perhaps two or three feet high. Several northern cane farmers in Queensland contend, after their own experiments, that application before planting and immediately after harvest gives the best results, the cane getting the benefit of the nitrogen in its early stages of growth.

Cane haulage at Mossman. ANON. *Australian Sugar J.*, 1969, **61**, 289–294.—After successful trials Mossman mill is to extend the use of its 9-ton bins for cane haulage. Details are given about the bins and the equipment that is to be used in conjunction with them.

* * *

A note on sugar cane "settlings" as seed material. K. K. P. RAO. *Indian Sugar*, 1969, **19**, 407–408.—The term "settling" has been invented or is used for a rooted sett. It was found that with June planting, under prevailing conditions, "settlings" always gave higher yields than setts. The methods used for raising the "settlings" (in a nursery near a stream) are discussed. When planted in the field the "settlings" were usually 4–6 weeks old. Too long a period in the nursery led to excessive rooting or yellowing of the leaves.

* * *

Influence of seed rate on yield and quality of cane under Tarai conditions. A. NATH and J. BAJAJ. *Indian Sugar*, 1969, **19**, 411–417.—The recommended seed rate in Uttar Pradesh is one three-budded sett per running foot of row length, with rows 3 feet apart (45,000 setts per acre). Experiments were carried out for two seasons with low (25,000), medium (45,000) and high (65,000) seed rates, results being analysed and presented. Cane yield and available sugar per acre were greater in the high seed rate treatment, but the differences were not significant.

* * *

The sacadas of Sugarland. V. L. MERCADO. *Sugar News* (Philippines), 1969, **45**, 472, 537.—A Jesuit priest worked incognito as a sacada (itinerant sugar cane labourer) to study at first hand the lot of the sacada. His findings do not make pleasant reading: "Betrayed by indifferent and oftentimes corrupt government officials, cheated at every turn by labour bosses, a number of sacadas have been goaded to the point where some of them today toy with the idea of killing their bosses."

* * *

R.S.D. Do you control it or does it control you? B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 40–41.—Ratoon stunting disease is the worst cane disease in Queensland, causing greater tonnage losses than any other disease. In the 1969 harvest it probably caused greater losses than did all other cane diseases put together. The disease is important in all mill areas. Greater attention to the established remedial or control measures by growers is urged, especially regular hot water treatment and proper sterilizing of cane knives and cutters.

* * *

Army worms. B. E. HITCHCOCK. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 42–46.—The main army worms that attack sugar cane in Queensland and the damage they may do are described. One (*Spodoptera exempta*) is a day feeder and there are three night feeders. Information is given concerning the parasites that attack them and on chemical methods of control with BHC dust and DDT.

* * *

Successful crop of mixed legumes. L. K. IZATT. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 47.—This was a mixed crop of *Dolichos lablab* and Reeves' cowpea grown by a Queensland cane farmer. It was up to 4 feet deep and estimated at 15 ton/acre in spite of a dry season. As a cover crop and nitrogen source it was highly rated.

* * *

The acute stage of leaf scald. C. G. HUGHES. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 52.—This disease is regarded as potentially one of the most dangerous of sugar cane diseases and in recent years has appeared in cane growing countries where it was not known before. It is unusual in that it causes damage in two distinct ways. It may produce the characteristic chronic symptoms of leaf streaks, leaf scalding, side shooting and chlorosis or it may strike in another manner, i.e. stools approaching maturity will suddenly die and wilt, this being known as the "acute phase". Recent inspections have revealed fresh outbreaks of the "acute phase".

* * *

The significance of arrowing. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 57–58.—The drawbacks of cane arrowing or flowering to the grower and to the cane mill operator are discussed. One of the main evils of arrowing is the cessation of terminal growth and production of side shoots, which reduces sugar yields. The significance of light in connexion with arrowing is discussed.

* * *

How long can soldier fly live in bare fallows? B. E. HITCHCOCK. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 58.—Field and laboratory tests with both the black and the yellow soldier fly led to the conclusion that bare fallow without cultivation is quite effective in reducing the numbers of soldier fly larvae, but it does not completely eliminate them.

* * *

Major weeds of southern districts and their control. J. ANDERSON. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 60–61.—Notes on the major weed pests and their control in Queensland are given. Weeds discussed include nut grass, wild sorghum, blue heliotrope, common reed, summer grass, Gambier pea, billygoat weed and vine weeds such as bell vine, Cupid's flower and prickly cucumber.

* * *

Grass control by chemicals. C. M. MCALEESE. *Cane Growers' Quarterly Bull.*, 1969, **33**, (2), 68–69.—In northern Queensland prolonged wet periods prevented mechanical weeding of cane, and grass weed growth became excessive. How it was successfully controlled with "Paraquat", without undue damage to young cane, is described.

Sugar beet agriculture

Mechanical equipment in the treatment of pests in sugar beet cultivation. A. G. GALLARATE. *Ind. Sacc. Ital.*, 1969, **62,** 266–278.—The writer reviews the present state of mechanization in Italy in the application of dusts or sprays in the treatment of sugar beet pests and diseases and in the control of weeds. Special attention is given to the use of aircraft and multi-row jet nozzle sprayers. It is pointed out that the wide range of suitable chemicals now available calls for the exercise of great discretion in their use if full benefit is to be derived from them.

* * *

Bolting in early sown sugar beet. L. A. WILLEY. *British Sugar Beet Rev.*, 1969, **38,** 65–66.—Tables for early bolters and total bolters from early sown bolting plots for the years 1967, 1968 and 1969 are given. The varieties Maris Vanguard and Sharpe's Klein E had the lowest number of bolters in 1969. The latter is regarded as the best choice among multigerm varieties where bolting resistance is of prime importance. Among the monogerm varieties Bush Munro had fewest bolters and continues to show a fairly good resistance to bolting. When choosing varieties for early sowing close attention should be paid by growers to bolting resistance as shown in the tables.

* * *

Official report examines labour saving techniques. ANON. *British Sugar Beet Rev.*, 1969, **38,** 75–79.—This is an abridged version of the official report to the Sugar Beet Research and Education Committee on the demonstration which took place near Caythorpe in Lincolnshire in the spring of 1969. The event itself was based on the belief that mechanization of the spring work in sugar beet had reached a stage when major interest was centred on methods of growing the crop and the effect of cultivations on harvesting efficiency. The soil type was a Lincolnshire limestone with extensive areas of stone.

* * *

The growth, pests and diseases of sugar beet in Belgium in 1968. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1969, (11), 35–54.—The spring weather was dry and seedling emergence slow, but summer conditions were favourable. Average yields were estimated at 18·34 tons/acre. Restricted sunshine was responsible for low sugar content—the lowest this century. The dry spring resulted in little damage from millepedes and soil pests. Some mangold flies were recorded and there was damage from black aphids during the summer. There was less damage from virus yellows (9%) than in 1967 (11%). Work continued on soil treatment to combat beet nematodes.

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Residual organochlorine insecticide contents in beets and their by-products. L. VAN STEYVOORT, P. H. MARTENS and A. J. PLASMAN. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1969, (11), 55–63.—Gas-liquid chromatographic analysis showed that the roots of beet grown in insecticide-treated fields contained less than 0·1 p.p.m. of "Aldrin", "Dieldrin", Heptachlor" and "Heptachlor-Epoxide" when harvested. The contents in the leaves and crowns and in the sugar products were below 0·001 p.p.m.

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Sugar beet cultivation in Algeria. ANON. *Hautes Etudes Betterav. Agric.*, 1969, **1,** (3), 8.—An account is given of sugar beet cultivation in Algeria where some of the problems that have to be faced are similar to those with sugar beet in other Mediterranean countries such as Morocco and Tunisia, drying winds being one of them.

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Simultaneous fumigating and planting of sugar beets. R. C. JOHNSON. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15,** 379–383.—Experiments on elimination of the normal waiting period of 10–14 days between soil fumigation (for nematodes) and planting are reported. "Telone" (manufactured by the Dow Chemical Co.) at 20 gal/acre was the fumigant used. It was applied with a chisel applicator at a depth of 6–8 inches. There was never a delay of more than half a day between fumigant application and seed sowing. Results were satisfactory but it was considered that caution is necessary in applying the method. It was concluded that the fumigants "Vidden D" and "Vorlex" should not be used without a waiting period.

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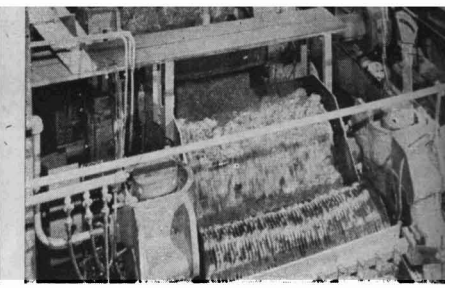
Virus yellows-infected sugar beet varieties: effects of harvest dates and nitrogen fertilization. R. T. LEWELLEN, J. S. MCFARLANE and I. O. SKOYEN. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15,** 403–415.—The purpose of the experiments discussed was to determine (*a*) when sucrose losses occur in yellows-infected lines (*b*) how yellows affects a moderately resistant line in comparison with a more susceptible parental variety, (*c*) how yellows infection influences purity constituents and (*d*) how the level of nitrogen fertility affects sucrose loss. Results are discussed. There were great differences in the way different varieties or lines reacted.

Cane sugar manufacture



Bagasse saving. K. R. PUNDIR. *Indian Sugar*, 1969, **19**, 515–524.—Bagasse is becoming an asset as a raw material for paper-making, etc., and saving it is thus economically desirable. Aspects of heat economy are considered for various parts of the cane sugar factory and sample calculations presented of savings which might be achieved at various stations.

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"Hodag VAP-99" evaluation. R. MALONEY. *Sugar News*, 1969, **45**, 596–598, 600–601.—See *I.S.J.*, 1969, **71**, 202–205.

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Electrical reheaters. J. R. HAREL. *Rev. Agric. Sucr. Maurice*, 1969, **48**, 231–236.—The basic principles of electrical resistance heaters are discussed as well as conditions to be observed during their installation. Advantages are listed and a calculation made of the economic benefit derived from their use which shows that an installation pays for itself in four years under Mauritian conditions.

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Problems of stress corrosion in centrifugal baskets. L. LINCOLN. *Rev. Agric. Sucr. Maurice*, 1969, **48**, 237–241.—Experience with stress corrosion in stainless steel centrifugal baskets in 1968 focused attention on the properties of the many kinds of stainless steel and their liability to general, inter-granular, pitting and stress corrosion, as well as the action of corrosive materials—air, salt water, acids, alkalis and various salts. In the sugar industry the conditions favour stress corrosion rather than other forms and its occurrence in sugar factory plant is briefly surveyed.

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Casting of cane mill rollers. R. HARDY. *Rev. Agric. Sucr. Maurice*, 1969, **48**, 242–245.—Casting of iron is discussed in relation to its carbon content. Desirable characteristics in the cast iron are specified and account given of foundry practice in Mauritius, especially the casting of mill rollers at Forges Tardieu.

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Filtration of cane muds in filter presses. F. PLASENCIA G. and J. A. GARCÍA G. *Bol. Azuc. Mex.*, 1969, (240), 35–39, 41.—During the past nine seasons in the USA there has been a trend to use filter presses for cane mud filtration instead of vacuum filters. A number of reasons are advanced for this, including the higher sucrose losses in mud, which, for one factory in Georgia, averaged 0·252% with vacuum filtration between 1945 and 1952, compared with 0·140% for the filter presses which were replaced. A battery of new Shriver filter presses was installed and data from their operation in 1953 are tabulated, showing a loss reduced to 0·176%.

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Clarification studies. *Ann. Rpt. Research Dept.* [Sugar Manufacturers' Association (of Jamaica) Ltd.], 1968, 68.—Of five methods of clarifying juice from a number of cane varieties, the most efficient as regards settling rate was one in which the juice was heated to boiling, treated with 1 p.p.m. "Zuclar" synthetic polyelectrolyte, then with 500 p.p.m. phosphate and finally limed to pH 8–8·5 while hot. The clarification pattern varied considerably between varieties.

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Multiple effect evaporator control system. J. J. QUINTERO. *Sugar J.*, 1970, **32**, (9), 9–11.—An automatic control scheme for a multiple-effect evaporator is considered in which five control loops are incorporated. These control loops, including juice supply tank level, flow and/or pressure of steam fed to the 1st effect, juice level in each effect, absolute pressure in the last effect, and Brix of thick juice leaving the last effect, are described separately in detail. Control of the Brix of the thick juice leaving the evaporator by means of a Brix-measuring chamber, transmitter and recorder/controller is illustrated by two diagrams. The need to draw-up a heat balance of the evaporator before considering a control system is emphasized, since care is needed in determining the pressure drops when sizing the control valves.

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Use of sulphuric acid for the regeneration of cationic resins used for neutralization of cane juice defecated with magnesium oxide. O. MIAGKOY, L. IVANOVA, P. ZAJAC and M. ALVAREZ. *Sobre Deriv. Cana Azúcar*, 1968, **2**, (2), 2–16; through *S.I.A.*, 1970, **32**, Abs. 70–404.—Optimum conditions for regeneration of sulphonated polystyrene resins with H_2SO_4, after use in the above process, were studied. The maximum H_2SO_4 concentration which could be used without precipitation of $CaSO_4$ on the resin was measured, and the effects of H_2SO_4 concentration, flow rate, temperature and ratio of the resin bed depth and diameter on the degree of regeneration were investigated. The following scheme is recommended: the cationic resin is back-washed to remove fines. Regeneration is carried out in 2 stages. In the first, 2 equivalents of H_2SO_4 are used, one equivalent as 0·4N H_2SO_4 and the other as 1·0N H_2SO_4. The regenerant is discharged to drain. In the 2nd stage, the resin is regenerated with 2 further equivalents of

1·0N H_2SO_4. This solution is re-cycled to the 1st stage of regeneration. The resin is washed free from acid with condensate; the effluent is used to dilute the regenerant. The complete regeneration scheme thus requires only 2 equivalents of acid per unit of resin.

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Operation of Silver ring diffusers in the Western Hemisphere. H. B. MOSER. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1968, **46**, 34–42.—Operating data from Silver ring diffuser installations in Hawaii, Mexico, Venezuela and Peru are tabulated and discussed, as are the arrangements of the diffusers. It is concluded that extraction is increased and overall recovery also raised to a greater extent, indicating the higher quality juice; maintenance and repair costs are reduced while operation is easier and more uniform.

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Scales in sugar industry juice evaporators. O. ARGUDÍN. *CubaAzúcar*, 1968, (July/Aug.), 18–41, 55–73.—The variability of scale composition and crystal structure are discussed as is the dependence of scale formation on many factors—juice pH and quality, lime used, non-sugars composition, equipment characteristics and operation, etc. Variation in scale from body to body has been studied and experiments on evaporation of filtered and unfiltered juices have shown a definite reduction in scale formation with the former; these studies are the bases of ideas propounded on the mechanism of scale deposition, and the importance of the microstructure of the surface within the tube. The importance of proper cleaning is emphasized and the deficiencies of the usual acid-soda cleaning method used in Cuba are pointed out. A method is recommended where the calandria is sprayed for 3 hours with a 40% solution of caustic soda at 120°C at a rate of 0·5 litres/min/sq.m. of heating surface using a recirculating system and a total of 2 litres NaOH solution per sq.m. h.s. Cleaning time is reduced, cleaning efficiency increased and costs are lower.

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Comparative study of three-massecuite boiling systems. J. A. CLARK G. and F. GARCÍA L. *CubaAzúcar*, 1968, (Sept./Oct.), 2–19, 40–53.—Four 3-massecuite systems are compared as to the polarization of the sugar produced, capacity of the pan station and steam requirements. In the first system (the maximum polarization process) the *A*-strike of 86·2 purity is made up from syrup of 85 purity and most of the double-cured *C*-sugar (of 96 purity). Most of the *A*-molasses (71 purity) is sent to the 75 purity *B*-strike which also receives part of the *C*-sugar and part of the syrup feed. The remaining *A*-molasses and the *B*-molasses, together with the *C*-sugar washings, make up the *C*-strike which produces final molasses of 33 purity. In the second system (the traditional minimum polarization process), the *A*-strike is of 80 purity and receives part of the 85 purity syrup, single-cured *C*-sugar of 85 purity and part of the *A*-molasses which is recirculated. The *B*-strike of 70 purity is made up of syrup, *A*-molasses and the remaining *C*-sugar, while the *C*-strike, of 60 purity, is boiled on a mixture of the remaining syrup and the 50 purity *B*-molasses. System No. 3 (the low polarization process) involves strikes of 85, 75 and 60 purity with syrup feed to all three, no recirculation of molasses, and return of single-cured *C*-sugar to both *A*- and *B*-strikes. The fourth system (the high polarization system) enploys strikes of similar purities but the proportions of syrup to each is different from system No. 3 and *A*-molasses is used as part of the feed to the *C*-strike. Quantities and proportions are calculated and tabulated; these show that Systems 1, 3 and 4 all produce sugar of higher quality than the traditional No. 2 System, with lower steam consumption. Lowest steam consumption is found with System No. 4, while System No. 1 produces the highest proportion of *A*-sugar in the commercial products, and consetently the highest overall sugar quality.

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Evaporator plants designed by the Ministry of the Sugar Industry and installed in factories of the Republic of Cuba. A. KOSIAVEVICH. *CubaAzúcar*, 1968, (Sept./Oct.), 31–38, 61–68.—The Cuban Ministry of the Sugar Industry (MINAZ) has produced a number of evaporators, similar to those of Honolulu Iron Works Co. design which have been used for a long time in the country. The new MINAZ units have 25–30% greater heating surface in the first 2 or 3 bodies (out of 4 or 5) and operate at high evaporation rates. Efficiency is expected to be increased further by adoption of vapour bleeding.

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Rise in purity during evaporation. R. C. BHANDARI. *Indian Sugar*, 1969, **19**, 637–639, 649.—Reasons given in the literature for a rise in juice apparent purity during evaporation are examined, including non-sucrose and sugars decomposition and non-sugars removal, change in the glucose:pol ratio, and change in the optical rotation of non-sucrose sugars. The question of drop in pH (which should not exceed 0·5 units, it is suggested) is also considered. Tabulated data presented refer to both cane and beet sugar factories.

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Bridge cane system in mill yard handling. E. M. HAHN. *Sugar J.*, 1970, **32**, (10), 24–25.—The handling capacity and costs of a travelling bridge crane system for cane unloading, storage and feeding to the factory during night-time operation, when no cane is being brought into the yard, are discussed and the storage capacity requirements considered.

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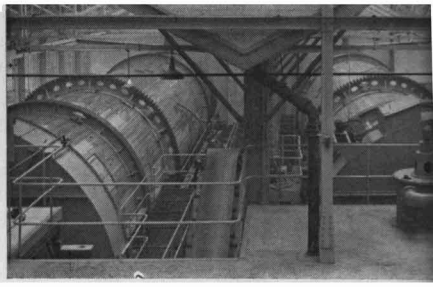
Factory application of hydraulic drives. A. F. ASHDOWN. *Rpts. 1969 Meeting Hawaiian Sugar Tech.*, 19–22.—Advantages of hydraulic drives in a cane sugar factory are discussed and two examples are examined in detail: the 25 hp pan stirrer drives at Pioneer and the 40 hp drives for the first cane carrier at Oahu. Hydraulic drive efficiency is briefly mentioned and guidance given on correct operation of this type of drive.

Beet sugar manufacture



The water economy in the Hungarian sugar industry. K. HANGYÁL. *Cukoripar*, 1969, **22,** 216–222.—The water economy of the 11 Hungarian sugar factories is discussed with the aid of data obtained for 1968. The question of waste water treatment is also dealt with, and the measures being adopted by the industry to improve water usage are described.

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Unit prevents sugar concentration causing possible boiler breakdown. *Process Eng.*, 1969, (April), 148.—A sucrose detector supplied by Bailey Meters and Controls Ltd. can detect sucrose concentrations down to 0·5 p.p.m. and the unit installed at Tirlemont sugar factory sounds an alarm if the sucrose content of boiler feed water exceeds a pre-set limit.

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Culture of azotobacteria in press water with carbonatation mud. O. VEJBORA, D. SOKOL and V. JOZEFY. *Listy Cukr.*, 1969, **85,** 288–290.—In experiments, intensive growth of *Azotobacterium chroococcum* in beet pulp press water with carbonatation mud considerably reduced the sugar content (and thus B.O.D.). Details of the tests are given.

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Production costs of the kWh in the sugar industry. H. HUBER. *Zucker*, 1970, **23,** 65–72.—The costs of power production by a hypothetical plant in which the boiler pressure is 65 atm at 500°C and back-pressure is 2 atm are calculated for a sugar factory with a daily beet slice of 6000 tons. Three methods of calculating the fixed costs are compared, and preference shown for the method whereby they are related to the steam and power generation in terms of effective heat. The production costs per kWh are shown to be lower as the steam consumption and power production rises, provided all the steam passes through the turbines. The patterns indicated by the calculations are found to be comparable with those in actual sugar factories.

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The heat economy of a beet sugar factory. III. Make-up steam. P. FREUND. *Zucker*, 1970, **23,** 72–75—Fluctuations in steam consumption in a sugar factory must be eliminated so that there is no loss in exhaust steam. The use of make-up steam to fulfil this task is discussed and factors affecting the fluctuations (periodic operation of the pan station, factory operation at below nominal slice) and the quantity of make-up steam (boiler steam variables and turbo-generator efficiency) are examined.

Supplement to the article by D. Schliephake and A. Wolf: Model calculation on the non-homogeneity of diffusion in beet cossettes. G. V. GENIE. *Zucker*, 1970, **23,** 81–82.—Anomalies in diffusion attributed to differences in cossette thickness[1] are considered by the author of the present article to be merely apparent. The discrepancy is explained as the result of a misapplication of FICK's law in the basic equation. Correct use of the law will show that the findings of BRÜNICHE-OLSEN, mentioned in the earlier article, are quite logical.

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Polish equipment for beet piling at sugar factories. J. STRZERZYSZ. *Gaz. Cukr.*, 1969, **77,** 297–301.—A survey is presented of Polish beet piling equipment, the specification of each model being listed, together with its price.

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Tests on preventing rotting of sugar beet. J. TRZEBIŃSKI. *Gaz. Cukr.*, 1969, **77,** 304–306.—Tests on the prevention of rotting of piled beets have indicated the way in which phenolic compounds and phenolic oxidase in the beet root create an antiseptic barrier at any wounds that may occur.

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Purification of beet sugar solution by means of a continuous ion exchange process. M. SUGAWARA and K. YAMAMOTO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21,** 8–17.—The fixed-bed ion exchange treatment of beet juice has been improved by modification in which middle juice from the second evaporator effect, at about 30°Bx, is used instead of thin juice; XE-252 cation exchange resin is used instead of "Amberlite IR-120B", and the process is made continuous. Redesign of the juice outlets ensured more uniform contact with the resin and increased the reaction rate so that treated liquor purity, and nitrogen and colour removal were all increased. Heat economy in the subsequent evaporator bodies was improved and the new resin was found to be stronger, requiring only 4% of make-up per 100 cycles as compared with 10% for the old resin.

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Effect of purification methods on the thermal stability of carbonatation juices. V. A. KOLESNIKOV, V. A. MAKSYUTOV and L. N. DOBROVOL'SKAYA. *Sakhar. Prom.*, 1970, **44,** (1), 18–22.—Of the carbonatation schemes compared in tests, that in which raw juice containing some recycled 1st carbonatation juice was

[1] *I.S.J.*, 1970, **72,** 148.

treated with 2·5% of lime for 15 minutes at 55°C and then 15 min at 85°C gave the best results as expressed by carbonatation and thick juice colour, reducing matter and thermal stability. The filtration and settling properties of 1st carbonatation juice were about the same as with conventional carbonatation, while the 2nd carbonatation juice amino-N and colloid contents were lower than in conventional 2nd carbonatation juice and the ash content about the same.

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Apparent and true pH and pOH of thick juice in the evaporator. V. A. PRONINA and S. Z. IVANOV. *Sakhar. Prom.*, 1970, **44,** (1), 23–25.—The need to determine the pH and pOH of thick juice at the process temperature in evaporation in order to get an accurate value is emphasized, since determination at room temperature will not allow for the inversion of sucrose, which in turn will affect the values. Tabulated pH and pOH values are given for thin and thick juice and in the individual effects of evaporators at two Soviet sugar factories.

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Effect of massecuite crystal content on sugar crystallization rate at different crystal sizes. I. K. POPEREKA and YU. D. KOT. *Sakhar. Prom.*, 1970, **44,** (1), 25–27. Laboratory tests showed that the specific crystallization rate at a given cooling rate fell with increase in crystal content but increased with crystal size at constant solids content. Over the crystal content range of 20–55% the mass crystallization rate rose with fall in crystal size (over the range 1·5–0·25 mm) at a constant amount of crystallizable sugar. Application of these findings to factory processing is discussed.

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Beet slicing knives. V. N. SHCHEGOLEV. *Sakhar. Prom.*, 1970, **44,** (1), 28–31.—The types of beet knives available in the USSR and their advantages and disadvantages are discussed.

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Optimum campaign length. S. I. PODGAETS, Z. N. PANTELEEVA, A. I. KHIZHNYAK, G. V. SHEVCHUK and N. N. DOTSENKO. *Sakhar. Prom.*, 1970, **44,** (1), 38–43. The problem is discussed from the processing and economics standpoints, reference being made to practices in beet-growing countries other than the USSR.

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The capacity of a beet sugar factory and the length of the campaign. M. S. SABANSKII and M. P. PRIIMAK. *Sakhar. Prom.*, 1970, **44,** (1), 43–48.—Sugar outputs from factories in the Krasnodar region over a 5-year period are used to show the extent of reduction in yield to be expected as the campaign is extended from 70 to 140 days. Production costs are also worked out for factories having a daily slice of 3000-5000 tons of beet and these and other factors compared for campaign lengths of 80 and 140 days at a given yield reduction in the range 0·2–1·6% for a 140-day campaign.

Experimental determination of the dynamic characteristics of a sugar factory evaporator. A. P. LADANYUK, L. I. KORNIENKO and D. I. SKOBLO. *Sakhar. Prom.*, 1970, **44,** (1), 55–58.—From data obtained for a number of parameters in a particular sugar factory evaporator a number of differential equations and corresponding transfer functions have been derived which can be used to work out a mathematical model for automatic control purposes.

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Perfecting of boiling apparatus—New concept of operation at constant level. A. R. GRANDADAM. *Ind. Sacc. Ital.*, 1969, **62,** 299–305.—With a massecuite at a fixed chosen level above the upper tube plate of a calandria, heat transfer may be kept at the optimum during the whole of the boiling, and a number of pan designs are illustrated and described which allow this. In all examples this involves the use of a chamber holding the massecuite which may be quite separate from or mounted below the boiling chamber which holds the calandria and which is provided with overflows to return the massecuite. The massecuite is pumped from the storage chamber to the boiling chamber and feed may be supplied to either or both chambers through the pipes and valves provided. Advantages of the system are discussed.

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Test on the FPAKM filter. V. A. ZAMBROVSKII, YU. V. ANIKEEV, V. A. TSYS' and I. L. MUKHIN. *Sakhar. Prom.*, 1970, **44,** (2), 22–27.—The FPAKM is a vertical plate-and-frame batch filter with up to 25 sq.m. filtering surface in which the plates are connected in pairs. Operation is automatic and sweetened-off mud is squeezed by rubber diaphragms between the plates and dried by compressed air. In tests at a flow rate of 8·8 litres/sq.m./min for the whole cycle the filtrate was almost transparent with an insoluble solids content of 0·16 g/litre and a colour content of 11·3°St, compared with the initial juice colour of 10·7°St and a clear juice colour from the clarifiers of 20·3°St. Filter cake of 33·3% moisture content had a sugar content corresponding to 0·68% at 50% moisture. Filtration of 2nd carbonatation juice gave a mud of 16% moisture and a sugar content corresponding to 0·16% at 50% moisture. However, flow rate was lower at 29 litres/sq.m./min than in pre-coat filters such as the candle type. Thick juice filtration tests were carried out at 60–68°Bx using a pre-coat; at 4 atm pressure an average filtration rate of 8·5–8·9 litres/sq.m./min was achieved. Perlite proved preferable to kieselguhr as a pre-coat.

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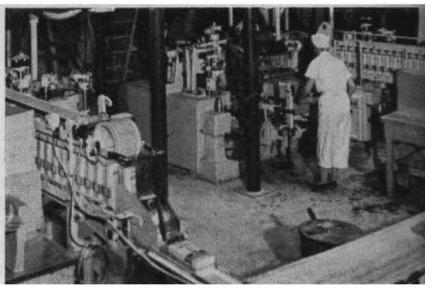
Boiling low-grade massecuites. I. N. AKINDINOV. *Sakhar. Prom.*, 1970, **44,** (2), 31–34.—Calculations are made of various boiling parameters as a guide to low-grade massecuite treatment, where the aim is to obtain a massecuite non-sugar concentration before purging which is approximately the same as that of standard molasses. The recommendations of SILIN to boil to a Brix of 94–95° is used as standard.

Sugar refining



Use of active carbons in the sugar industry. J. DONNAT. *Ind. Sacc. Ital.*, 1969, **62**, 306–312.—Characteristics of active carbons are discussed with their classification by structure. Physico-chemical properties for their control are listed and a brief account given of adsorption, measurement of the iodine index, specific surface measurement, and activation of carbons. Use of active carbon in the sugar industry is discussed, with special reference to column decolorization with granular carbon.

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Boiling pan control. S. HONDA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 1–7.—A new automatic control system developed for boiling in a pan with natural circulation involves a level control which opens the steam valve when syrup feed reaches a desired level. The level, vacuum and steam pressure are maintained at preselected values until the supersaturation reaches a required value when seed is admitted, under the control of a seed valve timer. The supersaturation then follows the preset programme in which it causes the vacuum and steam pressure to be adjusted; during the initial stages of growth of the seed crystals (30–60 min) sugar liquor is fed constantly and balancing water added. After this stage the level in the pan is increased to a new set point and feed control then transferred to a mobility controller in the form of a pilot mixer mounted in the bottom of the pan. The level rises to other points as permitted by the mobility controller and, when the pan is full, the feed is shut off and the massecuite tightened until the mobility reaches a level defining the end of the boiling, after which the pan is struck and washed out ready for the next boiling.

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Development of a new resin having high decolorization capacity. I. K. SUZUKI, T. IWAKURA, T. KAGA and Y. UTSONOMIYA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 18–27.—Development and characteristics of a new gel-type resin for sugar liquor decolorization are described. The resin is physically and chemically stable and possesses a divinylbenzene-styrene matrix with quaternary ammonium functional groups.

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Optimum conditions for carbonatation. K. MURAOKA, K. ABE, R. TOYAMA and U. KIKUCHI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 28–39. There are many factors influencing the quality of carbonatated liquor but at the Osaka refinery of the Taito Co. Ltd. it was found most important to maintain the optimum pH of 8·0 and a temperature under 75°C in the third (and last) saturator while, with certain raws, e.g. from Australia, it was helpful to add 0·02% of phosphoric acid on raw sugar. The Osaka refinery uses 1% $Ca(OH)_2$ on raw sugar and a gas containing 50% CO_2, and it is emphasized that other conditions may be optimum for other refineries.

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Improving the massecuitecharging method with a vertical-type automatic centrifugal machine. T. KAJIYAMA and A. YAMAGUCHI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 40–48.—According to the new method, the centrifugal starts to accelerate to a median speed of e.g. 500 r.p.m. as massecuite is admitted so that part of the molasses is separated during the charging process, providing space for 10% additional massecuite per charge. Charging at the higher than usual speed presents greater hazards but these may be overcome: (i) by using a controller which measures the basket speed and, if charging is not completed within the set speed range, applies electrical braking, closes the gate valve and sounds an alarm, (ii) by a massecuite consistency detector which measures the consistency as a function of the time for the massecuite to pass from the gate valve to detector location and in the case of improper consistency changes the charging system to that at conventional speed, and (iii) a level control in the massecuite supply tank which also causes the charging system to revert to the low-speed system if the supply level is low, which might cause variation in massecuite flow to the centrifugal.

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Test working report on the Herreshoff char kiln. Y. OYAMA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 49–59.—An account is given of the satisfactory operation of the kiln which was installed as part of the new Kawasaki refinery plant in 1965.

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The detrimental effects of impurities occluded in affined sugars on the sugar refining processes. T. YAMANE, K. SUZUKI, T. KAGA and Y. TAKAMIZAWA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 94–99.—See *I.S.J.*, 1969, **71**, 279.

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Ion exchange resin and refined sugar quality. N. K. KVACHEVA. *Sakhar. Prom.*, 1969, **43**, (12), 36–37. Spectrophotometric measurements of refined sugar solution showed that the use of AV-16GS anion exchange resin for syrup decolorization does not

result in incorporation of pyridine in the sugar[1], although non-volatile compounds, e.g. polyethylene-polyamines, from the resin do enter the molasses and can make it unsuitable for use as a feed. The refined sugar after ion exchange treatment was found to have a lower non-sugar content than refined sugar from syrup not treated by ion exchange.

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The use of paper sacks for white sugar packaging. V. S. GRYUNER, L. I. MIRONOVA, I. A. ANANIN, R. S. KNYAZEVA, G. D. SELEZNEVA, N. A. KOZLOVA and O. I. PANKOVA. *Sakhar. Prom.*, 1970, **44**, (1), 34–35. Tests with various types of paper bags for white sugar packaging under Soviet conditions are briefly discussed and mention made of other practices in sugar packaging and transporting.

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Decolorization of refinery remelt with ion exchange resins. T. IONESCU and F. DOMSA. *Bol. Azuc. Mex.*, 1969, (237), 26–33.—See *I.S.J.*, 1970, **72**, 181.

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Technical diffusion. General processes for making refined sugar. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1969, (238), 6–11.—A brief account is given of sugar refining with notes on the importance of affined sugar purity, melt liquor characteristics, phosphoric acid addition and treatment with lime, clarification and filtration with carbon, trap-filter operation, refined sugar quality, conglomerates, method of mixing refined sugar, and standard refined sugar specifications.

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Making wider use of bulk storage and transport of granulated sugar. M. SABANSKII and A. ROGACHEV. *Sakhar. Prom.*, 1970, **44**, (2), 34–36.—The advantages of bulk storage and transport are listed and a call made for greater use in the USSR.

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Application of macroporous ion exchange resins in the sugar factory. II. Factory decolorization tests. K. ČÍŽ. *Listy Cukr.*, 1970, **86**, 17–19.—Under identical process conditions, decolorization tests were conducted on 1st liquor at Skrivany refinery with "Wofatit EA 60" macroporous anion exchange resin and "Wofatit ES" standard anion exchanger. Considerable differences were found in individual cycles between the quantity of colorant adsorbed by "Wofatit EA 60" and the quantity of colorant desorbed from the resin. However, over the whole 81-day period both resins gave approximately the same average decolorization, i.e. a reduction from 2·92°St to 0·84°St ("Wofatit EA 60") and 0·82°St ("Wofatit ES"), and the amount of colorant desorbed in regeneration was about the same.

* * *

Technical diffusion. Operation of clarifiers in sugar refining. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1969, (239), 14–16.—The equipment and method used for clarification of refinery liquor by the Williamson process (liming, neutralization with phosphoric acid, and separation of impurities by aerating to produce a scum) is described.

* * *

Technical diffusion. Operation of "Autofilters" in sugar refineries. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1969, (240), 46–54.—A diagram of the "Autofilter" is presented with an annotated step-by-step account of its operation.

* * *

Refining scheme at Werbkowice sugar factory. L. RUCIŃSKI and T. DROZDOWSKI. *Gaz. Cukr.*, 1970, **78**, 42–44.—A boiling scheme for production of refined sugar is described in which 1st massecuite is boiled from remelted 2nd and 3rd sugar.

* * *

Technical diffusion. Operation of trap filters in sugar refining. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (241), 30–31.—The function and operation of a trap pressure filter using a diatomaceous earth pre-coat to remove carbon particles from refinery liquor are described with the aid of a flow diagram.

* * *

Simplified description of the refinery process. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (241), 42–47. A large flow diagram indicates the unit processes involved in a granular active carbon refinery, each process being described briefly in turn.

* * *

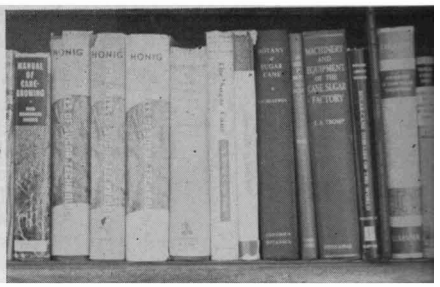
Three hundred degree wedge wire screens. H. M. WALLENSTEIN and H. NORSEN. *Proc. 28th Meeting Sugar Ind. Tech.*, 1969, 19–25.—Experience at Refined Syrups & Sugars Inc. with 300° wedge wire screens is discussed. In these, the wedge wires are shaped like equilateral triangles in cross-section and arranged adjacent to one another with one apex down; the "mesh" is related to the gap between the wires. These fixed screens were tested to replace vibratory screens used for raw sugar liquor and have proved satisfactory at a liquor feed pressure of 40 p.s.i.g. and a total flow rate of 485 gal/min. Of the sizes tested, the 150-mesh screen proved the most suitable. Cleaning with hot water and a small brush is required every two weeks, as otherwise the amount of recycle (normally 25 gal/min) will increase.

* * *

Pilot plant studies concerning Sweetland press filtration of washed raw sugar liquor. S. B. POLLACK, D. E. TIPPENS and E. NABORNEY. *Proc. 28th Meeting Sugar Ind. Tech.*, 1969, 26–60.—Details are given of pilot plant-scale experiments carried out on Sweetland filter-presses used to treat washed raw sugar liquor. The experiments, part of a major project, were aimed at establishing optimum conditions. Equations were developed for calculation of a number of variables, involving, amongst others, filter-aid (applied as pre-coat and admix), flow rates, feed pressure and orifice throttle control. Results, expressed as turbidity (nephelos), are tabulated.

[1] See also KLOCHKOVA *et al.*: *I.S.J.*, 1968, **70**, 88.

New books



Glossary of sugar technology. C. A. MÜLLER. 224 pp.; 5 × 7½ in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1970. Price: 100s 0d.

This book is going to be most useful to sugar technologists wishing to understand the gist of papers published in one of the foreign tongues covered—these include English, French, Spanish, Swedish, Dutch, German, Italian and Danish. The system is that employed in the Elsevier Dictionary of Chemical Engineering, viz. a list of English terms in alphabetical order, numbered and with their equivalents in the other languages. This is followed by alphabetical lists of the terms in these other languages, each giving the number reference to the English term (and hence those of the other languages). It is an excellent system allowing rapid access to the corresponding terms in the eight languages.

However, a dictionary of this type should always be compiled by a panel of experts having the mother tongues included in it, and the defects, at least in the English terms, arising from a single compiler, however gifted, become apparent on examination. There are a few misspellings, terms attributed to the wrong parts of the English-speaking world, and some which are not normally used and which appear to be direct translations of phrases from other languages. The choice of terms is obviously the compiler's prerogative, but we would have preferred to see some terms omitted and others included—too many to detail here. Whether or not such terms would be the same as those chosen by other readers is a different matter, of course.

In spite of our reservations, we believe this new work to be a useful contribution to sugar literature. The price, however, in terms of shillings per ounce of paper, is very high.

* * *

Active carbon. M. SMÍŠEK and S. ČERNÝ. (Transl. J. LANDAU.) 479 pp.; 5½ × 8¾ in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1970. Price: 225s 0d.

This work, No. 12 in the series of monographs published under the title "Topics in inorganic and general chemistry", is a translation from Czech of a book written by the authors after the National Conference on Active Carbon held in Prague in 1958. The 8 chapters are headed: "Introduction", "Manufacture of active carbon", "Structure of active carbon", "Theory of adsorption on active carbon", "Applications of active carbon", "Methods of quality control for active carbon", "Methods of studying the properties of active carbon" and "Dynamics of adsorption". Specialists in certain fields have contributed a number of chapter sections and Chapters, 1, 3, 4 and 7 have been thoroughly revised and updated, while Chapters 2, 5 and 6 have not been substantially changed for the English version, except the section by V. VALTER on the application of active carbon in sugar manufacture. This section covers both beet and cane sugar refining and discusses the use of bone char, powdered and granular carbon in fixed and moving-bed systems. The various proprietary brands of carbon generally used are mentioned and reference made to experiences in a number of countries. References to the literature are given at the end of each chapter and the book concludes with a subject index. Of interest is the quantity of material from the USSR and Czechoslovakia which has hitherto been virtually inaccessible. The book is clearly printed and well presented and is probably the most up-to-date and detailed work on active carbon available. Whether the price is too high is for the reader to consider, although it is probable that refiners would find it a useful acquisition for their research libraries.

* * *

Geschichte des Zuckers seit den ältesten Zeiten bus zum Beginn der Rübenzuckerfabrikation (History of sugar from earliest times to the start of beet sugar manufacture). E. O. VON LIPPMANN. 1041 pp. (Dr. Martin Sändig oHG, 6229 Niederwalluf bei Wiesbaden, Nelkenstr. 2, Germany.) 1970. Price: DM 152.-; £17 10s 0d.

This is a new edition of a book first published in 1929. It has been considerably expanded, containing 217 more pages than the first edition and containing also the addenda and supplements incorporated in an edition published in 1934.

Brevities

Antigua sugar crop, 1970[1].—The 1970 sugar crop came to an end on 30th April with an outturn of 3860 tons of sugar, produced from about 48,000 tons of cane, giving a tons cane: ton sugar ratio of 12·2. Of the sugar produced, 2000 tons will be exported.

* * *

Ghana sugar expansion[2].—Two sugar factories are in operation in Ghana, at Asutsuare and Komenda, but their current production covers only one tenth of the country's requirements. Other sugar factories are in project or under construction at Trito, Kpong, Etisu and Nyakrom.

[1] *Zeitsch. Zuckerind.*, 1970, **95**, 372.
[2] *Sucr. Belge*, 1970, **89**, 357.

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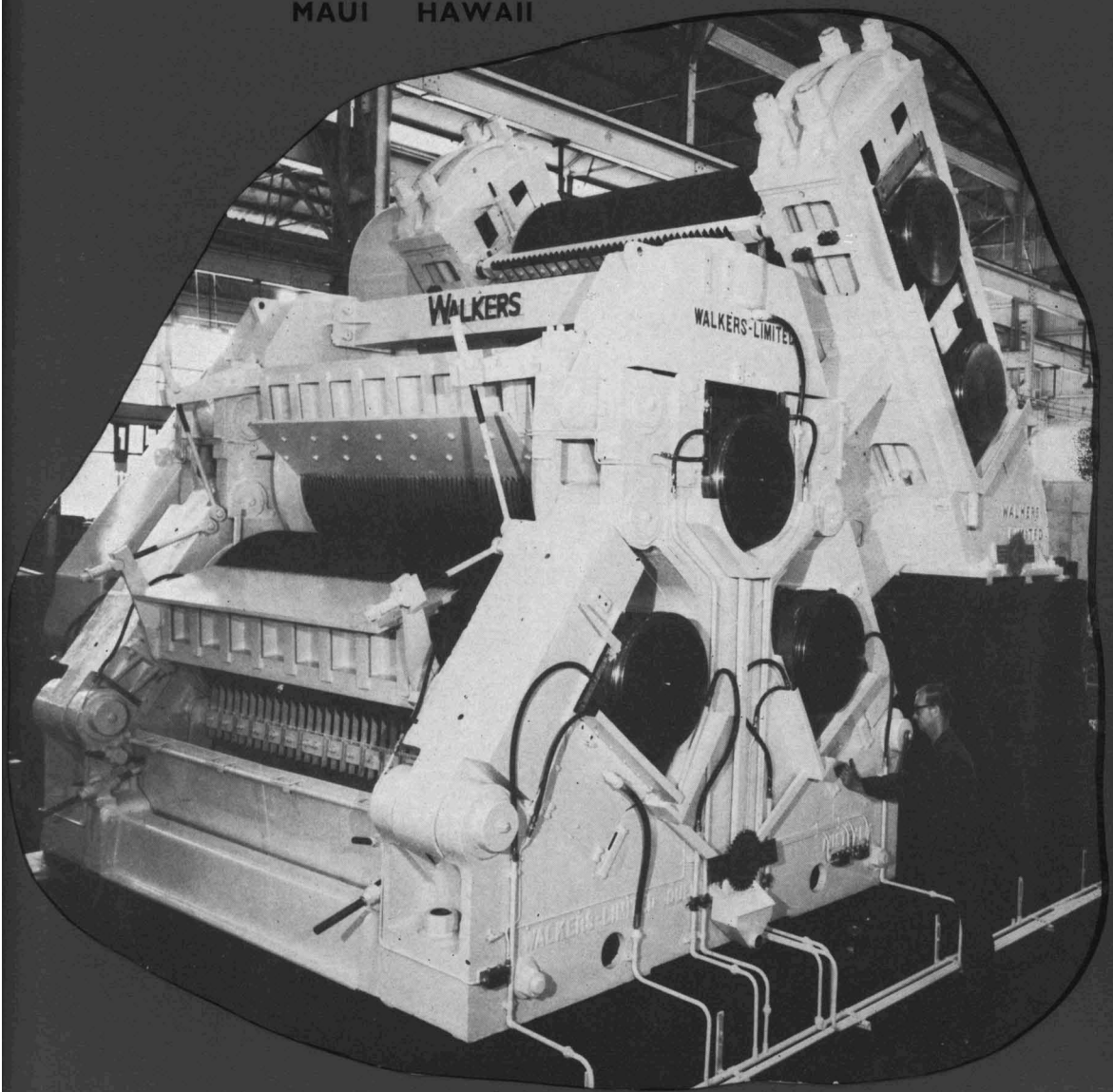

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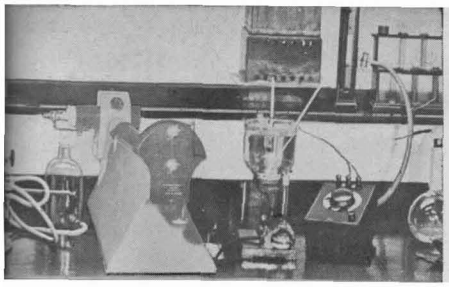


Laboratory methods & Chemical reports

Intramolecular hydrogen bridges in substituted gluco- or fructo-pyranoses and -furanoses. J. BARTSCH. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 90.—The presence and position of intramolecular hydrogen bridges were studied using infra-red spectra of various acetals of gluco- and fructo-pyranoses and -furanoses as well as hydroxytetrahydrofuran and hydroxytetrahydropyran derivatives. Different types of five-member ring hydrogen bridges with a distorted and non-distorted ring in *cis* and *trans* form were found. The bonding energies of these five-member ring bridges were found from wave number displacements to be between 0·5 and 1·5 kcal, these low values explaining the relatively rigid basic structure of sugar, the wide-open structure of the acetal groups and the associated distortion of the pyranose and furanose ring.

* * *

The determination of trace metals in process juices and white sugar. T. D. CARPENTER and S. E. BICHSEL. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 369–378. The fundamentals of atomic absorption spectrophotometry are explained and a description given of a Beckman unit. The techniques used in determination of Fe, Cu, Mg, Ca, Na and K are described; in the first two cases the lower sensitivity requires concentration of the metals using ion exchange resins. Mg and Ca may be determined directly in white sugar but this must be in the form of a dilution (15%) in decationized water containing 0·1% lanthanum to avoid interference and viscosity problems. Process juices and molasses were examined as 5°Bx solutions. Results obtained are tabulated and demonstrate that the methods will give measurements at least as accurate and precise as extraction methods, but directly, with consequent time saving.

* * *

Observations on the absorbancy of sugar solution. K. W. R. SCHOENROCK. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 388–395.—Experiments are described using both a Beckman DU spectrophotometer and a Bernhardt-Phoenix sphere spectrophotometer, and a number of refined beet and cane sugars, as well as a type 50 invert sugar produced by cold inversion. Using a tungsten lamp a peak absorption was found in all cases at 295 nm and the colouring matter responsible was isolated from the invert sugar by an anion exchange technique; it obeyed Beer's law at both 295 nm and the standard colour measurement wavelength of 420 nm, but the degree of absorbence was so much higher at 295 nm that this would appear to be a more suitable wavelength to use for white sugar colour measurement.

* * *

Determination of aflatoxins in mouldy sugar beet pulp. J. I. TENG and P. C. HANZAS. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 438–443.—A technique is described for determining the aflatoxins in beet pulp by a modification of the EPPLEY extraction technique[1], followed by thin-layer chromatography.

* * *

Conductimetric determination of purity. M. KRÁLOVÁ and V. VALTER. *Listy Cukr.*, 1969, **85**, 258–265.—A linear relationship has been established between apparent purity (Q) of a sugar solution and its maximum electrical conductivity (γ_m) at 20°C, expressed in units of S/m, where $Q = 100 - 19{\cdot}3\gamma_m$. The effect of temperature is expressed by the equation $S_m = 26 + 0{\cdot}1t$, where S_m is the Brix at maximum conductivity and t is the temperature in °C. Tests with samples from a number of Czechoslovakian sugar factories showed that sufficient accuracy was obtainable for routine control purposes provided the Brix was maintained constant at 28° ± 1°Bx at temperatures below 30°C and at 28° ± 2°Bx above 30°C. In all cases the temperature should be maintained constant to within ± 1°C.

* * *

Investigation of the rotation dispersion of various quartz samples with reference to their use as quartz modulator plates for saccharimeters. R. BÜNNAGEL and F. SPIEGELHALTER. *Zeitsch. Zuckerind.*, 1970, **95**, 14–16.—The rotation dispersion of 7 quartz samples of various hues and origins were measured in the visible part of the spectrum and compared with the known value of the standard quartz at the Physikalisch-Technische Bundesanstalt in West Germany. Assuming that all the samples gave a reading of 100°S at 546 nm, maximum deviation was less than 3×10^{-3} °S, so that the ICUMSA table for conversion of quartz modulator plates (1966) is applicable.

* * *

Chromatographic and spectrofluorometric determination of raffinose and 6-kestose in sucrose solutions. G. SAGLIETTO and G. MANTOVANI. *Zeitsch. Zuckerind.*, 1970, **95**, 17–19.—Details are given of (i) a two-dimensional paper chromatographic method using 4:1 *iso*-propanol:water and 4:2:1·5:1·5:1 ethyl acetate: *iso*-propanol:*n*-butanol:acetic acid:water, in which the

[1] *J.A.O.A.C.* 1966, **49**, 1218,–1223.

raffinose and 6-kestose contents in a sucrose solution diluted to no less than 0·01% were determined to within ± 3% relative error; and (ii) a spectrofluorometric method using an excitation beam of 420 nm and a fluorescence light of 520 nm, with which the error was reduced to ± 1%. For both methods the sugars are first separated by thin-layer chromatography on "Kieselgel G".

* * *

Thermographic investigation of sucrose crystallization rate. A. V. ZUBCHENKO and S. E. KHARIN. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (6), 117–120.—From the relationship between heat evolved during crystallization and the number of moles of sugar participating in crystallization, curves of total crystallization rate *vs.* time and the number of moles of sugar remaining in solution *vs.* time are plotted. These are intended for use in calculating such kinetic factors as nucleation rate and linear growth rate of crystals. The curve of total crystallization rate *vs.* time has a pronounced peak, the position of which coincides with the maximum in the crystallization thermogram which is also reproduced.

* * *

Formation and composition of beet molasses. X. Effect of the cations of bivalent salts on the optical rotation of sucrose. G. VAVRINECZ. *Cukoripar*, 1969, **22**, 231–235.—See *I.S.J.*, 1970, **72**, 282.

* * *

Studies on beet sugar and cane sugar. I. Quality of commercial beet granulated sugar and refined granulated sugar. II. Changes of the properties of commercial beet granulated sugar and commercial refined granulated sugar by heating. S. HASE, T. MIZUMOTO, A. MIZUSHIMA and S. SUZUKI. *J. Food Sci. Technol.* (Tokyo), 1968, **15**, 192–198, 399–407; through *S.I.A.*, 1969, **31**, Abs. 69–1202.—Detailed analyses were performed on 14 samples of beet granulated sugar A, 6 samples of refined sugar B and a sample of "1st white" cane sugar; values are tabulated for Brix, moisture, reducing sugars, colour, turbidity, pH, conductivity, sulphated ash and its components, amino N, crystal size, and some physical properties of solutions. The A samples were generally more impure than the B ones, more hygroscopic and of larger crystal size; they had higher pH, giving less inversion and colour on heating. Relations between inversion, colour, acidity and pH are shown in graphs for 2–6 hours' heating at 60°Bx and 100–180°C or 1–2½ hr at 92°Bx and 150°C. Of the ash components, phosphorus content gave the best negative correlation with inversion rate.

* * *

Effect of sugar beet cultivation and extent of topping on processing value: Report prepared by the I.I.R.B. Commission. J. JORRITSMA and J. F. T. OLDFIELD. *Inst. Int. Rech. Bett.*, 1969, **3**, 226–240; through *S.I.A.*, 1969, **31**, Abs. 69–1204.—Standard methods for the sampling, topping and analysis of sugar beet recommended by the Commission are presented.

Consideration on the distribution of sugar in sugar beet roots. M. EBATA. *Bull. Sugar Beet Res., Supp. No.* 8, *Papers Res. Mtg. Sugar Beet Technol. Coop., Sth. Japan*, 1966, **41**, 20–25; through *S.I.A.*, 1969, **31**, Abs. 69–1205.—Individual beets were sown in June, August or September, harvested in February or March, and dissected and analysed for Brix. Results are shown on cross-sectional diagrams and compared with those obtained by LÜDECKE on spring-sown beet in a cooler climate. Maximum Brix was found in the outer layers of the middle part of the beet, especially near the concave surfaces.

* * *

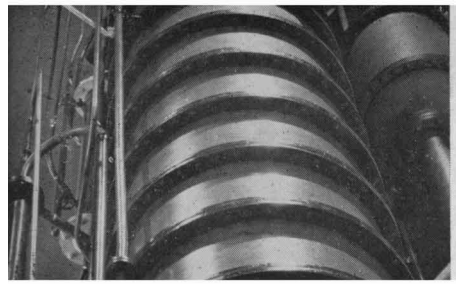
Location of sugars on paper chromatograms by the use of dipping reagents. J. F. CLAPPERTON and I. C. MACWILLIAM. *Lab. Practice*, 1969, **18**, 760; through *S.I.A.*, 1969, **31**, Abs. 69–1212.—Several reagents, conventionally used for location of sugars on paper chromatograms by spraying, have been adapted for use as dipping reagents. Dipping reduces the risk of inhalation of toxic substances and gives more consistent colours than spraying.

* * *

Method for the automatic continuous measurement of purity of intermediate products of sugar manufacture. M. MÄCHLER, H. LÖFFLER. H. SCHIWECK and L. SÜSS. *Zeiss Mitt. Fortschr. Tech. Opt.*, 1968, **10**, 404–418; through *S.I.A.*, 1969, **31**, Abs. 69–1222.—Purity, defined as the ratio of sucrose concentration to that of dissolved substances, may also be expressed in terms of the optical rotation α and the refractive index n of the solution by means of the equation $Q^1 = F\alpha/(n-n_0)$, where Q^1 = purity of the solution, F is a constant for given experimental conditions and n° = refractive index of water. An apparatus for automatically measuring purity is described, consisting of a Zeiss OLD digital polarimeter, a Zeiss Refractograph 2 and an analogue computer. Advantages of the method are that no preparation of the sample is required, and values are independent of sample concentration. The results are at least as accurate as those obtained by conventional methods.

* * *

Fractionation of sugar colorants on a preparative scale by high-voltage electrophoresis. N. H. SMITH. *Abs. Papers presented to 157th Nat. Meeting, Amer. Chem. Soc.*, 1969, CARB 29.—Gel filtration of molasses gave three fractions; of these, the one of highest mol. wt. could not be fractionated further by high voltage electrophoresis (HVE), while the other two fractions yielded several components, which were revealed by fluorescence in U.V. light. Pretreatment of the sugar-containing fraction by adsorption on a nonionic, macroreticular resin gave sugar-free colorant. Multiple HVE separations, followed by elution of the combined similar zones, yielded colorants contaminated with the buffer used; this was avoided by using ammonium borate, which could be removed by conversion to ammonia and methyl borate.



By-products

Extraction of aconitic acid from molasses. M. S. DOULAH and M. BADIUZZAMAN. *Pakistan Engineer*, 1968, **8**, 301–304; through *S.I.A.*, 1969, **31**, Abs. 69–761.—A sample of molasses from an East Pakistan sugar factory contained 3·17% of aconitic acid. The molasses was diluted to 60°Bx, brought to pH 6·5–7·0 by addition of HCl, heated and treated with 0·9 g of anhydrous $CaCl_2$ and 0·6 g of $MgCl_2$ per g of aconitic acid. The precipitate of calcium magnesium aconitate formed was heated at 150°C, treated with a hot $CaCl_2$ solution and filtered; recrystallization from dilute H_2SO_4 gave aconitic acid.

* * *

Influence of the preparation of sugar cane in the mill on the manufacture of pulp and paper. V. GUINART. *CubaAzúcar*, 1968, (May/June), 2–9, 35–39.—Bagasse samples obtained in various experiments were depithed and subjected to a sulphate cooking process to give a pulp which was then evaluated according to the TAPPI standards. The effects of using a double knife set, using one or two crushers, variation of imbibition water, and variation of the pressure in the last mill on the pulp yield and quality were examined; the last two factors had a negligible effect, whereas pulp yield was reduced by use of the second knife set, used in conjunction with two crushers, which also reduced the length of rupture and reduced the burst strength, although the rip strength was raised. This effect of the second knife set was much less marked when a single crusher was used. A slight reduction in yield and pulp mechano-physical properties was found on using two crushers instead of one. The benzene-alcohol extractives content in the bagasse from B 43231 cane variety was higher than that in POJ 2878 bagasse, and greater difficulty was experienced in handling and using the pulp from the former.

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Decomposition of molasses-pulp pellets in bulk storage. J. D. JORGENSEN and R. GADDIE. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 277–281.—At the Idaho Falls sugar factory of the Utah-Idaho Sugar Co. most of the dried beet pulp, after molasses addition, is stored in closed cylindrical tanks in the form of $\frac{1}{4}$-inch pellets, containing an average of 20·6% molasses solids and 9·0% Steffen filtrate solids on pellet solids. After decomposition of the contents of one tank, tests were carried out to determine the cause. These are reported, and showed that decomposition can be prevented by producing pellets of less than 10% moisture content, by cooling to a temperature below 50°C and holding at this temperature, and by eliminating fines from the pellets. Since the pellets will continue to give off moisture during storage, adequate ventilation and/or roof and wall insulation are necessary.

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The BMA "Goldstrap" process. Production of liquid sugar from cane molasses. ANON. *Bol. Azuc. Mex.*, 1969, (234), 4–29.—See *I.S.J.*, 1968, **70**, 382.

* * *

Factors affecting crude fibre utilization in ruminants. I. Effect of the levels of molasses feeding at various D.C.P. intakes on the roughage utilization. N. M. PANDIT and S. N. SINGH. *Indian J. Dairy Sci.*, 1967, **20**, 165–170; through *S.I.A.*, 1969, **31**, Abs. 69–1043. Diets high and low in digestible crude protein (DCP) were fed to adult male buffaloes with or without cane molasses as an energy supplement. Molasses did not significantly affect the dry matter intake of animals on the low DCP diet, but on the high DCP diet, inclusion of 2 or 4 lb of molasses/head per day improved total digestible nutrient (TDN) intake and digestion. Molasses is therefore a satisfactory substitute for maize as a source of TDN in animal feed.

* * *

Selection of food yeast strains for the utilization of vinasse alone and with molasses added. III. Use of the strains *Candida tropicalis* C.t./3 and C.t./2 for the industrial production of food yeast. J. SKIBA and O. ILNICKA-OLEJNICZAK. *Prace Inst. Lab. Badaw. Przem. Spoz.*, 1968, **18**, (2), 93–102; through *S.I.A.*, 1969, **31**, Abs. 69–1045.—*Candida tropicalis* C.t./3 and C.t./2 were cultivated in vinasse alone or with the addition of 10% of molasses, or in molasses diluted in the ratio 1:7. In vinasse, the average yield was 17·8 g of yeast (92% dry solids) per litre of vinasse (10% dry solids). 3·2 g and 3·4 g of molasses (50% dry solids) were utilized per g of yeast produced in the vinasse-molasses mixture and diluted molasses respectively. Industrial-scale tests showed that these yeast strains were suitable for the production of food yeast either in pure or in mixed cultures.

* * *

Cetyl pyridinium chloride as an antiseptic in alcohol production from molasses. T. P. SLYUSARENKO and E. P. VITUKEVICH. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (6), 85–87.—At a molasses wort pH of 5·5–5·8, addition of 0·001–0·0015% of cetyl pyridinium chloride prevented bacterial growth during 14 days. At a wort pH of 5·1–5·2 only 0·0005% was required. The antiseptic had no adverse effect on fermentation, growth and physiological condition of *Saccharomyces cerevisiae*.

Patents

UNITED STATES

Cane harvester. V. P. BROUSSARD, of St. Martinsville, La., USA. **3,481,121.** 19th December 1966; 2nd December 1969.

* * *

Cane harvester. K. T. DRILLER, of East Keilor, Va., Australia, *assr.* MASSEY-FERGUSON (AUSTRALIA) LTD **3,482,690.** 8th March 1968; 9th December 1969.

* * *

Increasing the sugar content of cane. L. G. NICKELL and T. T. TANIMOTO, of Honolulu, Hawaii, USA, *assrs.* HAWAIIAN SUGAR PRODUCERS ASSOCIATION. (I) **3,482,958.** 5th April 1967; 9th December 1969; (II) **3,482,959.** 6th March 1967; 9th December 1969; (III) **3,482,961.** 5th April 1967; 9th December 1969.

The sucrose content of the cane is increased by treating it, 2–10 weeks (at least 2 weeks) before harvest, with an aqueous solution of (I) an acid addition salt of an alkylmercapto-1,4,5,6-tetrahydropyrimidine; (II) 3,6-endoxohexahydrophthalic acid or certain derivatives, in particular dimethyl tertiary amine salts, or (III) a N,N-di-lower alkyl-N-higher alkyl-N-2-hydroxyethyl ammonium salt.

* * *

Method of recovering pure glucose and fructose from sucrose or sucrose-containing invert sugars. K. LAUER, M. WEBER, and G. STOECK, *assrs.* C. F. BOEHRINGER & SOEHNE G.m.b.H., of Mannheim-Waldhof, Germany. **3,483,031.** 1st August 1966; 9th December 1969.—The solution of (up to 60%) sucrose and invert sugar is added [at 50°–70°C and at 0·5–3 (1–2) ml/sq.cm./min] to a cation exchanger column in the form of a cross-linked sulphonate polystyrene resin ("Dowex 50 WX4") which has been fully charged with a calcium salt ($CaCl_2$) solution of pH < 8 so that it still contains (1–30%) free H equivalences. On elution with distilled water, the fractions of eluate contain first pure glucose, then a glucose/fructose mixture, and then pure fructose.

* * *

Evaporator scale prevention in sugar manufacture. J. A. CASEY, of Pepper Pike, Ohio, USA. **3,483,033.** 23rd August 1966; 9th December 1969.—Before juice enters the evaporator it is treated with 1–4 p.p.m. of a hydrolysed polyacrylamide and 1–4 p.p.m. of a protective colloid (sodium alginate or carboxymethylcellulose). The materials are combined as an additive which contains 10–40 (10–30) parts of hydrolysed polyacrylamide and 10–25 (10, 20) parts of the colloid [and 7–15 (5, 10) parts of ethylene diamine tetra-acetic acid, 40–72 (35, 40, 70) parts of sodium triphosphate or sodium hexametaphosphate (and 5 or 10 parts of sodium gluconate)].

* * *

UNITED KINGDOM

Removal of filter cake. SPARKLER MANUFACTURING COMPANY, of Conroe, Texas, USA. **1,179,795.** 28th April 1967; 28th January 1970.—See US Patent 3,447,690.[1]

* * *

Crude sugar liquor defecation. H. E. BODE, of Shaker Heights, Ohio, USA. **1,179,913.** 17th April 1967; 4th February 1970.—Crude sugar liquor (unscreened cane juice, molasses, affination liquor) is heated (to $\geq$180°F) and mixed with a phosphated starch and sufficient alkaline earth defecating reagent (the oxide, hydroxide or carbonate of calcium or barium) to bring the liquor to alkaline pH, causing precipitation of the alkaline earth metal derivative of the phosphated starch. The precipitate is then separated (and the sucrose solution may thereafter be inverted).

* * *

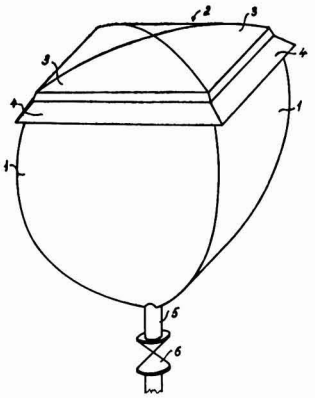
Container for differential pressure filtration. A/S DE DANSKE SUKKERFABRIKKER of Copenhagen, Denmark. **1,179,947.** 24th July 1967; 4th February 1970.

The filtration container, for e.g. bag pressure filtration of sugar juice, comprises four side and bottom plates 1 which are welded together and which all have the form of portions of cylindrical surfaces having the same radius of curvature. The filter cover 2 comprises four plates 3 welded together and also in the form of parts of cylindrical surfaces. The upper part of the container is supported by a hollow conduit 4 which extends around its upper edge and is formed by two plates welded to each other and to the plates 1 to form a triangular cross section.

The conduit may serve as a discharge conduit for filtrate and as a bracket for suspension of the con-

[1] *I.S.J.*, 1970, **72**, 157.

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



tainer. At the bottom is a sludge pipe 5 with a valve 6. Further pipes are provided for introduction of the liquid to be filtered, for discharging the filtrate and for introducing and discharging a purging medium.

* * *

Beet harvester. H. VERHAEGHE, of Oye-Plague (Nord), France. **1,181,886.** 13th November 1967; 18th February 1970.

* * *

Roll screen for cleaning beets. OGDEN IRON WORKS CO., of Ogden, Utah, USA. **1,182,760.** 3rd September 1968; 4th March 1970.—See US Patent 3,451,084[1].

* * *

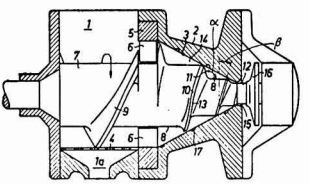
Fermentation process for citric acid production. CHAS. PFIZER & CO. INC., of New York, N.Y., USA. **1,182,983.** 28th May 1968; 4th March 1970.—A citric acid-producing strain of *Candida*, *Endomycopsis*, *Torulopsis*, *Hansenula* or *Pichia* is grown under aerobic conditions in an aqueous medium containing carbohydrate (molasses) [containing $CaCO_3$, at pH 1·5–8 and at 20–30°C, and containing an α-chloro or α-fluoro substituted lower alkanoic mono- or dicarboxylic acid or its water-soluble salt or amide (fluoroacetate or fluoroacetamide)] until the citric acid accumulates to a level of at least 1 g/litre, when it is recovered.

* * *

L-Glutamic acid production. TAKEDA YAKUHIN KOGYO K.K., of Osaka, Japan. **1,183,235.** 8th June 1967; 4th March 1970.—A micro-organism of the genus *Corynebacterium* (*C. sp.* 186), capable of producing L-glutamic acid and not requiring biotin but requiring at least 1 unsaturated fatty acid of 16–22 C atoms (oleic acid, palmitoleic acid, arachironic acid, ricinoleic acid, linoleic acid, erucic acid, or a salt or ester) for its growth, is cultivated in a medium containing [50–1000γ (100–500γ)/ml of] the unsaturated fatty acid, a carbon source (e.g. cane molasses) and other nutrients, accumulating and then recovering L-glutamic acid.

Worm-type press for fibrous or ligneous material (bagasse). MASCHINENFABRIK BUCKAU R. WOLF A.G., of Grevenbroich, Germany. **1,184,728.** 8th August 1967; 3rd April 1970.

The press comprises a worm core 7 carrying flights 9 and driven within a housing 1,2. The core is cylindrical so that feed bagasse is carried by the flights without compression from part 1 of the housing into the closed part 2. Between parts 1 and 2 is a ring 5 the inner diameter of which is the same as the maximum diameter of the conical inner wall 3, while protruding inwardly from ring 5 are inclined guide blades 6, bagasse passing through the spaces between these blades. The bagasse is caught by the screw blade which reduces in height about the shaft surface 8 and becomes a winding pressure shoulder 11, forcing the bagasse into a rapidly decreasing volume and subjecting it to high pressure until it is expressed through the nozzle-like discharge end 15 against the throttle 16. Rotation of the bagasse with the worm is prevented by helical grooves 17 in the inner surface 3 of the conical pressure housing.



Juice in the bagasse is expressed and passes backwardly through the apertures between plates 6 and into the housing 1 where it drains through the perforated screen 4 and into chamber 1a. Considerable axial thrust is developed during operation of the press and may be counteracted by linking two such units so that both are driven from between the two, when the thrust developed by one is balanced by that of the other. This type of operation allows a two-stage pressing with once-pressed bagasse treated with water as it emerges from the first press; the water is rapidly absorbed and on the second pressing extracts further sugar content from the bagasse.

* * *

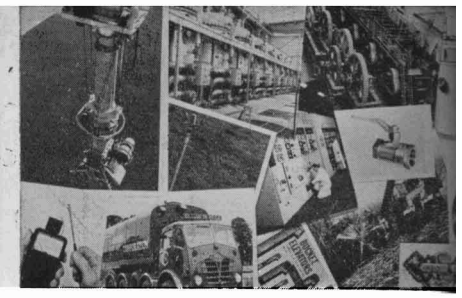
Animal fodder from molasses and vinasse. LESAFFRE ET CIE., of Marcq-en-Baroeul (Nord), France. **1,185,104.** 22nd March 1967; 18th March 1970.—To make the molasses or vinasse more suitable as a cattle feed, the potassium content is replaced with ammonium by heating and concentrating, adding either sulphuric acid and gaseous or liquid ammonia or ammonium sulphate, agitating and cooling the liquor until the potassium sulphate crystals form, and separating these by means of a centrifuge.

* * *

Beet harvester. F. A. STANDEN & SONS LTD. and P. STANDEN, of Ely, Cambs., England. **1,187,571.** 30th April 1969; 8th April 1970.

[1] *I.S.J.*, 1970, **72**, 186.

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.

Alcohol plant. Bennett, Sons & Shears Ltd., Pepper Road, Leeds 10, England.

This company, which has a history dating back to 1796, supplies a wide variety of equipment to the pharmaceutical and food processing industries, including brewing and potable spirits manufacture. A new leaflet describes its range of equipment, available in copper or stainless steel, while another illustrates and describes the evaporators, vacuum pans, fermenting vessels, etc., fabricated by an associate company, H. Braithwaite & Co. Ltd.

Distillation plants have been supplied for a range of potable spirits, among the latest being one for production of arak from crushed dates. As in rum manufacture, a mash is prepared and fermented and the alcoholic wash purified using an installation which includes an analyser column, a heads column and a rectifying column. It produces a high-quality potable spirit containing 96% pure alcohol, free from aldehydes and fusel oils.

* * *

"Teflon" and cube sugar manufacture. Du Pont de Nemours International S.A., 81 Roue de l'Aire, CH-1211 Geneva 24, Switzerland.

A recent release by Du Pont describes the use of their "Teflon" polytetrafluoroethylene finishes for efficient release of cubes from the moulds in cube sugar presses operated by the Swedish Sugar Corporation. The non-stick properties of "Teflon" allow the moist and sticky cubes to slide out without losing their shape by sticking to the moulds. Five other sugar manufacturers outside Sweden are also using the "Teflon" coating process under licence.

* * *

PUBLICATIONS RECEIVED

PNEUMATIC DETECTION. Actuated Controls Ltd., Vale Lane, Hartcliffe Way, Bristol BS3 5RU, England.

Literature has been compiled by Actuated Controls on the subject of pneumatic detection applied to level control, web breakage, filter and heat exchanger blockage, etc., and is available from the address given above.

* * *

HOPPER SCALES. Howe Richardson Scale Co. Ltd., Bulwell, Nottingham NG5 5HD, England.

An illustrated 4-page leaflet, available in English, French, German and Spanish versions, describes the Howe Richardson range of fixed and mobile hopper scales having capacities ranging from 0·1 to 15 cu.m. Included are details of accessories, scale control techniques and level and load cell weight sensing. Illustrations show various applications of the hopper scales.

* * *

FLAT TOP CONVEYOR CHAINS. Rex Chainbelt Inc., P.O. Box 2022, Milwaukee, Wisconsin, 53201 USA.

Catalogue No. 833 gives details of the complete range of flat top conveyor chains available from the Conveyor and Power Transmission Division and the Roller Chain Division of Rex Chainbelt Inc. Included is information on the selection, installation and application of Rex "TableTop" and "FlexTop" chains.

* * *

"METERING PUMPS FOR INDUSTRY". Metering Pumps Ltd., 49-51 Uxbridge Rd., London W.5, England.

An illustrated leaflet (P.17) covering the full range of precision variable-stroke metering pumps and "Atumat" high-press water-jet equipment manufactured by Metering Pumps Ltd. is announced.

* * *

Scapa Group extension in South Africa.—Scapa Group Ltd., which includes P. & S. Textiles S.A. (Pty.) Ltd., makers of industrial cloths and filter fabrics, are to build a felt and filter fabric manufacturing plant in Natal.

* * *

BMA cane diffuser order.—Braunschweigische Maschinenbauanstalt have received an order for a cane diffuser having a daily throughput of 3500 t.c.d. to be supplied to the Dolores/Rivas sugar factory in Nicaragua. Thus, in 1971 there will be three cane diffusers in operation in Nicaragua, of which two will be BMA units.

* * *

John Dore order for glucose refinery.—John Dore & Co. Ltd., of Hainault, Essex, England, have been awarded a contract worth about £20,000 for the fabrication and erection of stainless steel process vessels at Tunnel Glucose Refineries Ltd., of Greenwich, London, as part of a plant modernization scheme.

* * *

Natural gas at UK refinery.—Thames Refinery, of Tate & Lyle Ltd., is to replace coal with natural gas for steam raising in mid-1972. The annual heat demand will be met by some 30 million therms of gas compared with some 100,000 tons of coal. Oil will be used as standby fuel should the gas flow be interrupted at times of exceptional peak demand. Conversion of the existing boiler installation for dual burning will be a major undertaking.

* * *

Bulk transport in France.—Transuvrac, a company set up jointly by Tate & Lyle Ltd. and the French road haulage firm, Royer et Cie., is to handle bulk delivery of sugar in eastern France to customers of Société des Raffineries et Sucreries SAY, in which Tate & Lyle have a substantial minority interest. Eventually, the service will be extended to cover the delivery requirements of other French sugar manufacturers. Transuvrac will also offer advice to prospective customers on the design and construction of bulk installations, based on Tate & Lyle's 20-years of experience in the bulk handling of white sugar.

ISSCT 14th Congress

Dr. J. H. PAYNE, Chairman of the Processing Section of the 14th Congress of the ISSCT to be held in Louisiana during 22nd October–5th November 1971 plans to hold symposia on the following two subjects: (1) Trash and its effect on factory operations; (2) Waste disposal and pollution prevention. Dr. PAYNE would welcome contributions from members on these subjects as well as on the subjects to be included in the general programme, including clarification, evaporation, crystallization and factory control.

* * *

Hong Kong sugar statistics, 1969[1]

	1969	1968	1967
Imports	—— (*long tons, tel quel*) ——		
Australia	21,936	35,122	21,180
Belgium/Luxembourg	9,057	8,125	492
China	48,367	64,700	66,428
Czechoslovakia	9,388	8,815	295
Denmark	1,774	1	—
France	984	—	—
Germany, East	12,378	6,381	5,018
Germany, West	2,370	1,328	—
Japan	1,712	6,539	3,986
South Africa	3,300	9,168	2,474
Taiwan	178	167	1,585
Yugoslavia	8,898	—	—
Other Countries	659	2,467	10,269
	121,001	142,813	111,727
Exports and Re-exports			
Indonesia	6,580	12,966	11,166
Kenya	1,065	1,153	1,429
Malaysia and Brunei	17,899	17,474	12,634
Pakistan	405	7,712	54
Papua and New Guinea	1,489	603	52
Singapore	6,506	6,693	2,433
US Oceania	1,427	1,728	1,287
Vietnam, South	15,010	1,969	199
Other Countries	2,467	2,995	2,768
	52,848	53,293	32,022

Taiwan diversification[2].—According to the US Dept. of Agriculture, because of low international sugar prices and increased marketing difficulties, sugar is being supplanted by other crops in Taiwan. Cane production declined from 10 million tons in 1965 to 8 million tons in 1968 and sugar, which made up 61% of Taiwan's agricultural exports in 1976, fell in 1968 to 18% of the total. Planted cane area dropped from 277,000 acres to 240,000 acres, freeing land for more competitive crops such as mushrooms, asparagus, pineapples, vegetables and sweet potatoes. The diversification of agricultural exports has accounted for an increase from two major products (sugar and rice) in 1952 to nine in recent years.

* * *

Israel sugar imports, 1969[3].—Official statistics of Israeli sugar imports show a total of 43,563 metric tons, tel quel, in 1969, compared with 56,644 tons in 1968. Suppliers included France with 39 tons (3275 tons in 1968), West Germany with 4180 tons (483 tons), Italy with 6998 tons (11,855), Poland with 1400 tons (2820), Rumania with 9057 tons (9653), Turkey with 3935 tons (3060), USA with 215 tons (3799) and Yugoslavia with 9653 tons (11,387). In 1968 suppliers included Hungary with 2719 tons and Holland with 1000 tons. The balance of imports from other countries totalled 8086 tons in 1969 and 6593 tons in 1968.

Brevities

East Germany campaign results, 1969/70[4]. —The beet crop in East Germany was much smaller than planned in 1969/70, with only 4,200,000 tons of beet instead of 6,000,000 tons. The crop was produced from 200,000 hectares and the yield of 21 tons/ha compares with 30·7 tons/ha in the 1968/69 campaign. About 700,000 tons was used for fodder while 3,500,000 tons of beet were processed to give 392,000 tons of sugar, the yield being 11·2% higher than in the previous campaign, owing to the high sugar content and the shorter campaign. This outturn was 63,000 tons less than the sugar production in 1968/69 which was itself the smallest since the end of the war.

* * *

Pakistan sugar exports possibility[5]. —Pakistan is expected to announce a marketing policy for its record exportable surplus of more than 100,000 tons of sugar. The surplus is an infrequent occurrence because domestic consumption usually takes up all output. Government officials are considering possible export incentives such as bonuses or subsidies paid to exporters; barter exports are also being considered.

* * *

Egypt sugar factory plans[6]. —According to reports from Egypt, construction of a new sugar factory is planned by the Egyptian Ministry for Agrarian Reform.

* * *

Bagasse paper in Colombia[7].—A factory is being installed in Colombia for the manufacture from bagasse of paper which will be used for cigarettes. It is supposed that residual sweetness in the bagasse paper might offset some of the bitter taste of the tobacco.

* * *

St. Vincent sugar production possibility[8].—St. Vincent's Premier, MILTON GATO, said in Kingstown that the government was contemplating the resuscitation of the long-defunct sugar industry.

* * *

Sweden sugar exports, 1969[9].—Exports of sugar by Sweden in 1969 amounted to 36,306 metric tons, raw value, as against 19,354 tons in 1968. Principal outlets included Norway (14,555 tons), the USA (7288 tons), Sierra Leone (5299 tons), Nigeria (3533 tons), the UK (2730 tons) and other countries took a total of 2901 tons.

* * *

US beet sugar factory expansion[03].—The Utah-Idaho Sugar Co. has announced plans for a further multi-million dollar expansion of the Moses Lake factory in Washington, USA. The expansion will be equivalent to adding the capacity of a new factory and will allow a 15% increase in the beet area of the state. The factory was originally built in 1953 with a capacity of 2000 tons/day but has since been enlarged so that its 1970 capacity is 6700 tons/day; the first phase of the new expansion programme will provide a slicing capacity of 8500 tons/day for the 1971 crop.

* * *

Mexico sugar production, 1969/70[11].—Mexican sugar production reached 2,210,000 metric tons this year, compared with last year's record harvest of 2,311,000 tons, according to a spokesman of the National Sugar Producers' Union (UNPASA).

[1] C. Czarnikow Ltd., *Sugar Review*, 1970, (973), 101.
[2] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (17), 6.
[3] C. Czarnikow Ltd., *Sugar Review*, 1970, (964), 64.
[4] *Zeitsch. Zuckerind.*, 1970, **95**, 322.
[5] *The Times*, 23rd June 1970.
[6] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (17), 16.
[7] *La Ind. Azuc.*, 1970, **75**, 96.
[8] *The Cane Farmer* (Trinidad), 1970, 179.
[9] *Lamborn*, 1970, **48**, 120.
[10] *Willett & Gray*, 1970, **94**, 271.
[11] *Public Ledger*, 11th July 1970.

Brevities

Mexico sugar exports, 1969[1].—Sugar exports from Mexico in 1969 totalled 625,301 metric tons, raw value, of which 650 tons went to Chile and the remainder to the USA. In 1968 the bulk (574,981 tons) of Mexican exports also went to the USA but 62,014 tons were exported to Chile, 29,015 tons to Japan and 10,311 tons to South Korea, giving a total of 676,321 tons.

* * *

UK sugar surcharge.—The UK Sugar Board surcharge was reduced from 9s 4d per cwt to 8s 0d per cwt on 24th September. This change was made to enable future changes in the surcharge to be reckoned in units of 2s 0d per cwt instead of 2s 4d per cwt (1d per lb) in preparation for the introduction of decimal coinage in February 1971.

* * *

Dominican Republic seeks new quota.—It is reported[2] that negotiations are under way to try and obtain an increase in the ISA quota for the Dominican Republic of at least 59,000 metric tons. The Director of the Sugar Institute said that his country would be able to fill a quota of more than 150,000 tons and that they had already accumulated stocks of 126,000 tons. It is estimated that production in 1971 could exceed the 1970 figure by 100,000 tons and storage space is limited.

* * *

Fiji sugar exports, 1969[3].—Exports of sugar from Fiji in 1969 totalled 336,229 metric tons, raw value, as against 367,207 tons in 1968. The UK received 150,782 tons (168,498 tons in 1968) while other destinations included Canada with 77,885 tons (76,045), USA with 39,938 tons (41,067), New Zealand with 25,637 tons (25,411), Japan with 17,368 tons (19,581), Singapore with 12,439 tons (12,410) and Malaysia with 12,180 tons (24,195).

* * *

Bagasse board production plans for Trinidad[4].—The Economic Studies and Planning Division of the Industrial Development Corporation has carried out a survey of the local market and a technical feasibility study has been made on the manufacture of bagasse board by a German firm supplying board machinery. The studies concluded that it was feasible to invest in a $5 million plant of 30–40 tons/day output, and the Corporation has invited participation in a company to be formed to promote the project. Plans are being finalized for the erection of the plant, and a German firm is providing 30% of the required equity capital.

* * *

Ivory Coast sugar project[5].—The Council of the Ivory Coast Republic is to participate in the establishment of a new agro-industrial sugar complex near Ferkessedougen. The Ministry of Agriculture recently announced that the production capacity of the new plant would amount to 40,000 tons of sugar. The cane plantations will be established at the end of this year, while the sugar factory is to start operations early in 1972.

* * *

Senegal sugar project[6].—A convention has been signed between the Prime Minister of Senegal and the Director of the new Compagnie Sucrière Sénégalaise, for establishment and financing of the company which will have 2 billion francs at its disposal, part of this amount being provided by Swiss and US groups. Cane plantations are to be established in the delta of the Senegal river and will cover 7300 hectares a few years from now. The convention provides for construction of a sugar factory capable of producing 75,000 tons of sugar per year by 1975, which will permit Senegal to cover most of her requirements which are currently estimated at 50,000 tons. In addition, it is anticipated that a distillery will be constructed having an annual production capacity of 5–6 million litres of alcohol, and a paper pulp plant using the bagasse.

Czechoslovakia sugar exports[7]

	1969	1968
	(*metric tons, raw value*)	
Algeria	1	5,978
Austria	641	671
Belgium/Luxembourg	0	92
Ceylon	5,915	2,283
Cyprus	598	2,929
France	43,223	32,146
Germany, West	17,140	24,039
Greece	1,493	1,275
Holland	428	2,193
Hong Kong	4,217	1,739
Iceland	2,361	3,280
Indonesia	0	1,087
Italy	4,277	7,425
Laos	1,743	0
Lebanon	1,518	324
Maldive Islands	4,505	0
Malta	326	326
Norway	14,873	16,980
Saudi Arabia	11	570
Singapore	14,381	18,251
Spain	1,141	0
Switzerland	34,529	29,408
UK	140,424	156,112
Other Countries	6,539	5,330
Total	300,284	312,438

New Morocco sugar factory[8].—A contract has been signed between representatives of the Moroccan Government and a consortium formed by the German firms BMA, Buckau R. Wolf A.G. and Lucks & Co., covering the construction of the seventh sugar factory in Morocco. This factory, to be completed by June 1971, will have a processing capacity of 4000 tons of beet per day.

* * *

Japan beet sugar crop, 1969/70[9].—The Japanese domestic beet sugar industry in Hokkaido produced 297,196 metric tons of sugar in 1969/70, 7886 tons more than in the previous campaign. The 1969/70 beet area amounted to 98,685 hectares, compared with 53,601 hectares in 1968/69, and the beet crop totalled 2,074,613 tons compared with 2,071,924 tons in 1968/69. Extraction averaged 14·56%.

* * *

West Indies Sugar Co. Ltd.—Negotiations have opened between the Jamaica Government and the West Indies Sugar Co. Ltd. for the sale of all the land at present owned by the company, except for that on which factories and ancillary operations are located. The Government's aim is to make land available to local cane farmers, the basis of the negotiations being that until disposal of the lands by the Government the company would remain in occupation under lease arrangements for the growing of cane.

* * *

Indian sugar industry nationalization commission.—The Indian Government has announced[10] the setting up of a commission to examine the case for nationalization of the country's sugar industry. The 10-member commission has been asked to submit its report by the end of August 1971.

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[1] *Lamborn*, 1970, **48**, 120.
[2] *Public Ledger*, 3rd October 1970.
[3] *Lamborn*, 1970, **48**, 96.
[4] *W. Indies Chronicle*, 1970, **85**, 363.
[5] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (19), 6.
[6] *Agence France-Presse*, 2nd July 1970.
[7] *Lamborn*, 1970, **48**, 124.
[8] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (10), 6.
[9] *Public Ledger*, 3rd October 1970.
[10] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (11), **8**.

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I.S.J.

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