International Sugar Journal

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F. N. HOWES, D.Sc., I.S.O.

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Contents

SOMMAIRES : ZUSAMMENFASSUNGEN · SUMARIOS

Extraction de jus à canne dans la sucrerie à Malelane. p. 227–230

On donne des détails sur la diffusion de canne dans la nouvelle sucrerie et raffinerie à Malelane, au Transvaal oriental, dans la République Sud-Africaine. La diffusion De Smet T.S. employée est la plus grande de cet type du monde, et peut traiter 250 tonnes de canne à l'heure avec une extraction garantie de 97,5% de la saccharose totale dans la canne. On donne des informations sur le moulin de 3 cylindres qui précéde la diffusion, comme aussi sur les stations de la préparation de la canne, de l'épuration de jus et de la filtration.

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La raffination de sucre—Remarques sur des procédés individuels. 1ère partie. La carbonatation. F. M. CHAPMAN. p. 230–236

L'auter a écrit cet article, le premier dans une série, sur la base de ses expériences pendant 40 années dans des raffineries. Il a compilé l'article à partir de notes concernant des aspects nombreux de la carbonatation, avec des allusions aux pratiques dans des raffineries variées du monde, surtout dans cettes raffineries avec lesquelles l'auteur avait des relations.

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13ème Assemblée de la Commission Internationale Technique de Sucrerie 1967. p. 236–238

On rapporte sur la 13ème Session de la C.I.T.S. qui s'est tenue à Falsterbo (en Suède) le 5–9 juin 1967 et qui a été consacrée à la thème principale de la cristallisation de sucre aussi qu'aux autres sujets d'une importance dans l'industrie sucrière. On mentionne toutes les communications presentées et leurs auteurs, et donne des informations sur la sucrerie de sucre blanc à Ortofta et la raffinerie à Arlöv, visitées par les participants pendant la Session.

Rohrsaftgewinnung in der Zuckerfabrik Malelane. S. 227–230

Einzelheiten der Rohrdiffusionsanlage in der neuen Zuckerfabrik und Raffinerie Malelane, in Osttransvaal (Südafrikanische Republik), werden gegeben. Der angewande De Smet T.S. Diffuseur ist der grösste seiner Art auf der Welt und kann 250 Tonnen Rohr pro Stunde bei einer garantierten Auslaugung von 97,5% der Gesamtsaccharose in Rohr verarbeiten. Ausserdem werden Informationen über die vorm Diffuseur liegende 3-Walzen-Mühle wie auch über die Rohrvorbereitungs-, Saftreinigungs- and Filtrationsanlagen gegeben.

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Zuckerraffination—Anmerkungen über Einzelverfahren. Teil 1. Carbonatation. F. M. CHAPMAN. S. 231–236

Diesen Aufsatz, den ersten Artikel einer Serie, hat der Verfasser auf der Base seiner Erfahrungen während 40 Jahre in Raffinerièn geschrieben. Der Artikel ist eine Zusammenstellung von Anmerkungen über zahlreiche Aspekte der Carbona'ation, mit Bezug auf die Praxis in verschiedenen Raffinerien und Ländern, besonders in jenen Raffinerien mit welchen der Verfasser verbünden gewesen ist.

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13. Generalversammlung der Commission Internationale Technique de Sucrerie 1967. S. 236–238

Man berichtet über die 13.Generalversammlung der C.I.T.S., die vom 5. bis zum 9. Juni 1967 in Falsterbo (Schweden) stattfand. Das Hauptthema war die Kristallisation des Zuckers, obgleich andere für die Zuckerindustrie wichtige Probleme wurden auch behandelt. Die auf der Tagung vorgelegten Arbeiten und ihre Verfasser werden erwähnt, und man gibt Informationen über die Weisszuckerfabrik Ortofta und die Raffinerie Arlöv, die von den Mitglieden besucht wurden.

Extracción de jugo de caña a la azucarera de Malelane. Pág. 227–230

Se presentan detalles de la planta para la difusión de caña a la nueva azucarera y refinería de Malelane, en el Transvaal Oriental de Sud-Africa. El difusor T.S., marca De Smet, instalado en esta azucarera es el más grande del mundo de esto tipo y puede procesar 250 toneladas de caña por hora con un extracción garantida de 97,5% del sacarosa total de la caña. También se presentan detalles del molino a tres mazas que preciede el difusor, de la preparación de la caña, y de las plantas para clarificación y filtración.

* * *

Refinación de acúcar—Notas sobre procesos unitarios. Parte I. Carbonatación. F. M. CHAPMAN. Pág. 231–236

Este artículo es el primer de un serie de compilaciones de notas hecho por el autor sobre un base de sus experiencias durante 40 años en la industria de refinación de azúcar. Se trata de numerosos aspectos de carbonatación, con referencia a los prácticos en varias refinerías en algunos paises, en particular las instalaciones con las cuales el autor ha sido juntado.

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Commission Internationale Technique de Sucrerie, 13o Congreso, 1967. Pág. 236–238

Se presenta una cuenta del 13o congreso de la C.I.T.S., celebrado a Falsterbo, (Suecia) desde Junio 5 al 9, en el cual la tema principal era la cristalización de azúcar. Se mencionan los informes presentados y sus autores, y información se presenta sobre la fabrica Ortofta de azúcar blanco y la refinería Arlov. Miembros han visitado estas dos instalaciones durante el congreso.

THE

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Notes & Comments

World sugar balance.

The well-known firm of sugar statisticians, F. O. Licht K.G., recently published their estimates of world sugar movements in 1966/67, together with comparative figures for the three preceding years[1]. The balances are calculated for the period September–August in each case.

	1966/67*	1965/66	1964/65	1963/64
		(metric tons,	raw value)	
Production	65,460,689	63,172,825	67,167,787	55,083,976
Imports	20,684,685	20,729,675	20,840,137	18,133,617
Initial stocks	17,975,573	18,338,575	11,320,523	10,115,217
Total	104,120,947	102,241,075	99,328,447	83,332,810
Final stocks	17,505,392	17,975,573	18,338,575	11,320,523
Deliveries	86,615,555	84,265,502	80,989,872	72,012,287
Exports	20,946,950	20,665,211	20,915,939	17,759,639
Consumption	65,668,605	63,600,291	60,073,933	54,252,648
Production change	+2,287,864	−3,994,962	+12,083,111	+3,740,114
	(3·62%)	(5·96%)	(21·93%)	(7·28%)
Consumption change	+2,068,314	+3,526,358	+5,821,285	−296,932
	(3·25%)	(5·87%)	(10·73%)	(0·54%)

* Estimated

These figures demonstrate clearly the principal cause of the depressed sugar market over the past few years. The low level of stocks in 1963/64 gave rise to high prices and consumption stagnated. Expansion programmes stimulated by these prices raised production by almost 22%, raising stocks by 7,000,000 tons, the burden of which caused prices to slump but revived the world's sugar consumption.

More normal changes in production, coupled with steady increases in consumption have brought the two roughly in balance and the market has improved somewhat in consequence. As Licht comments, 1967/68 sugar production will now be of considerable importance as a stagnating world sugar production would, presupposing an increase in consumption, lead to a further reduction of sugar stocks, while if production in 1967/68 were lower than in 1966/67 a considerable improvement of the statistical situation would be the consequence.

In this respect, there is considerable interest in the forthcoming European sugar crop; it is too early to make forecasts but the slight increase in area may lead to increased production. However, because the 1966/67 campaign results were very good in many European countries it may well be that production in 1967/68 will be lower than last campaign.

* * *

World sugar prices.

Following the Middle-East cease-fire the raw sugar price fell on the world market, and reached levels lower than had been stabilized prior to the fighting. It might have been expected that a drop would came because speculators would be anxious to dispose of their hastily-bought stocks.

But a number of factors might have been expected to maintain the level; the Cuban authorities while announcing progress towards a crop of 6·1 million tons—their third highest—were finding difficulty in meeting export commitments and had bought Mexican raws and other sugar to provide these, had cancelled or deferred deliveries to other destinations and had bought back Cuban sugar from France. Again, the market dropped with a report of an Argentine sale to Britain, but did not react when it was announced that the sale had been cancelled because the necessary export licences could not be obtained.

The U.S. Dept of Agriculture has announced that the 1967/68 beet crop in the U.S.A. is likely to be almost 10% less than that of 1966/67 so that a quota shortfall—even up to 400–500,000 tons—is a real possibility. And Licht's predictions concerning the world sugar balance in 1967/68 might also have been expected to improve the market tone. However, C. Czarnikow Ltd. calculate[2] that during recent weeks close on 500,000 tons of raw sugar of Western Hemisphere origin for shipment up to September 1968 have been placed in second hands. "Although consumption next year seems likely to exceed production, there is still for the time being a substantial surplus of sugar and it is understandable that producers should be keen to be assured of the disposal of their own supplies. It is unfortunate, however, that

[1] *International Sugar Rpt.*, 1967, **99**, (15), 1.
[2] *Sugar Review*, 1967, (822), 127.

by so doing they have relinquished responsibility for fixing the actual destination and sometimes even the price. This abrogation by producers of their marketing responsibilities means that once again the future of the world free market for sugar is largely in the hands of international traders."

Last year Brazil wrecked the market by selling about 500,000 tons to operators without fixing destination or price; this left a substantial quantity of free market sugar searching for a home at any price and thereby dragged the general level of prices down. Apparently a fundamental change has been made in Brazil's selling policy this year, in spite of her large surplus, in that she is now fixing the price at the time of sale; operators therefore cannot dispose of it below the purchase price without losing money.

* * *

UNCTAD sugar talks.

The consultative committee of UNCTAD on sugar met in Geneva during the 6th—8th June, when prospects for the conclusion of a new international sugar agreement were again discussed. It is reported that representatives of 22 importing and exporting countries were present. The session closed without any recommendation and no date for a further session was fixed.

An UNCTAD statement said that after the Secretary-General, Dr. RAUL PREBISCH, had made a number of visits during the next few weeks, to consult with sugar exporting and importing countries, he is to consult governments further about the desirability of summoning the second session of the U.N. Conference on Sugar in the autumn of 1967; in the meantime he has been asked to put in hand forthwith the preparation of the necessary documentation for such a conference whenever it may be held.

* * *

The U.K., Commonwealth sugar and the E.E.C.

Consultations were held in London from the 19th to 22nd June between British Ministers and representatives of governments whose sugar industries are parties to the Commonwealth Sugar Agreement, i.e. Antigua, Australia, Barbados, British Honduras, Fiji, Guyana, India, Jamaica, Mauritius, St. Kitts, Swaziland, Trinidad and Tobago, and the East African Common Services Organization.

These discussions related to the special problem that would arise if Britain were to become a member of the European Economic Community, of the exports of sugar from these countries to Britain, under the Commonwealth Sugar Agreement, which for many years has made a positive contribution to the development of the economies of the sugar producing countries and has sustained a marked measure of stability in their marketing of sugar.

There was a full and confidential exchange of views about the likely effect of British entry into the Community on imports into Britain of sugar from those countries which are parties to the Commonwealth Sugar Agreement and about the means of carrying out the British Government's undertaking to safeguard the essential Commonwealth interests involved.

It was agreed that the British Government would remain in close contact with the Governments of the Commonwealth sugar producing countries and that further consultations would be arranged as necessary.

On the 4th July, when addressing the Council of Western European Union, the U.K. Foreign Secretary pointed out that the Commonwealth Sugar Agreement was a contract, at present extending until 1974 (six months before the E.E.C's own transitional arrangements are due to expire), which must be fulfilled. He said that the British view was that sugar imported into Britain under the Agreement could be accommodated within a reasonable production quota under existing Community arrangements and without departure from precedents already established within the E.E.C.

The French Foreign Minister stated on the 10th July, however, that existing E.E.C. members must come to final agreement on farm finance arrangements, scheduled for consideration in 1969, before negotiations with the U.K. can be completed. Referring to sugar, he said that he did not accept that special facilities should be granted to Commonwealth sugar producers. On the other hand, France has continued an arrangement similar to the Commonwealth Sugar Agreement within the E.E.C.; she imports cane sugar in fixed quotas at guaranteed prices from the overseas department of Guadeloupe, Martinique and Réunion.

* * *

U.S. sugar supply quota, 1967[1].

On the 6th June, the U.S. Dept. of Agriculture announced an increase in the 1967 U.S. sugar consumption requirements from 10,400,000 short tons, raw value, to 10,600,000 tons. On the 23rd and 30th June it raised the total quota by further amounts of 100,000 tons, bringing the total to 10,800,000 tons. The quota for the domestic beet sugar area was increased by a total of 190,667 tons, that for the mainland cane area by a total of 69,333 tons and offshore quotas for 29 foreign countries were raised by totals of 70,000, 35,000 and 35,000 tons.

The quota for the Philippines was left unchanged because of that country's inability to supply more than its normal quota this year.

The Department noted that sugar distribution at the beginning of the month was running at about the same level as in 1966, but the seasonal period of heavy demand had arrived when sugar refiners were making commitments for their summer needs, and distribution increased by the end of June, making the quota increases necessary. In addition, a strike at Crockett refinery in California was restricting supplies.

The increases and the new total quotas appear elsewhere in this issue.

[1] *Lamborn*, 1967, **45**, 92, 103,107.

Cane juice extraction at Malelane Sugar Mill

THE new R12 million sugar mill and refinery at Malelane in the Eastern Transvaal was commissioned in April for the Transvaalse Suikerkorporasie Beperk. The mill, which is one of the most modern in the world, is now in production. Designed to process sugar cane at an initial rate of 200 short tons per hour, it will produce 140,000 tons of sugar a year (of which about 110,000 tons will be white and the balance golden brown) from plantings covering 28,000 acres.

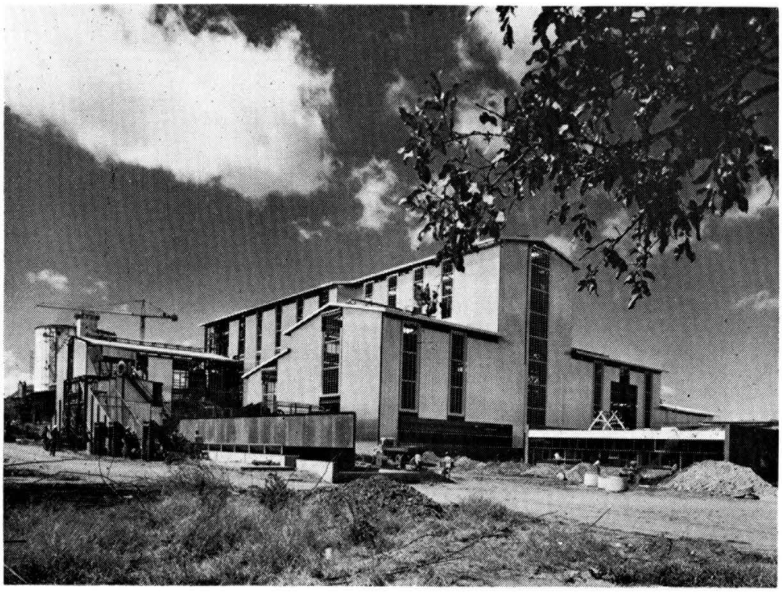


Fig. 1. Malelane sugar mill with the auxiliary cane carriers in the foreground (March 1967)

Contracts amounting to more than R2 million for the cane carriers, the juice extraction, clarification and filtration plants were awarded to the South African firm Patrick Murray (Pty.) Limited who are responsible for the design, supply and installation of all equipment from the cane unloading devices to the inlet of the evaporator. The cane handling, preparation and juice extraction plant, which incorporates a De Smet continuous cane diffuser is, in fact, suitable for a throughput of 250 tons of cane per hour and the clarification and filtration plants have been designed for easy extension to that ultimate tonnage.

Cane carriers and preparation

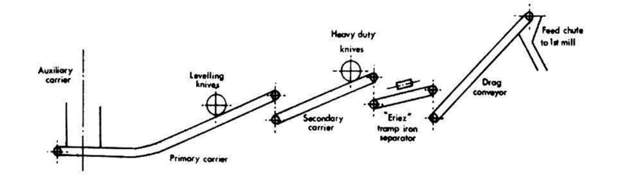
The cane is unloaded from side-tipping trucks and trailers into two 9 ft wide × 170 ft long slat-type auxiliary cane carriers which feed into an 84 in wide "split" main cane carrier. The carriers are driven by means of 150 h.p. Laurence Scott N.S. type variable-speed A.C. motors which are constant-torque machines having infinitely variable speed down to 10% of the maximum speed. The speed control is obtained by varying the supply voltage in the rotor circuit by means of an induction regulator. The position of the regulator is adjusted by means of a small pilot motor and remote speed control is provided in an elevated control room from which the operator overlooks the cane yard and the whole cane carrier system up to the mill. The control panel incorporates push-buttons for starting and stopping the motors as well as for speed increase and speed decrease. Dial tachometers graduated in feet per minute to indicate the actual speed of the carriers and ammeters to indicate the load on the motors are also provided.

A high efficiency Eriez belt-type tramp iron separator with a magnetic head pulley and a suspended magnet is provided in the carrier system between the secondary cane carrier and the drag type cane elevator. Both the primary and secondary cane carriers and also the cane elevator are driven by means of Laurence Scott N.S. type variable-speed electric motors which are controlled by pilot motor-operated induction regulators. The speed of these carriers is infinitely variable down to 30% of the maximum speed.

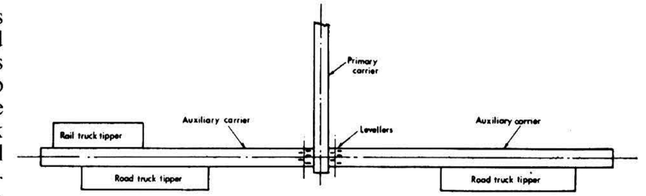
The preparation equipment consists of two sets of knives on the main carrier having 64 and 104 blades. The second or heavy duty set has blades spaced at $\frac{3}{4}$-in pitch and is set at $\frac{3}{4}$-in above the carrier slats. The knives are driven by 600 b.h.p. Laurence Scott "Trislot" motors which have the combined characteristics of high-torque and low starting current and are started by direct switching.

The layout of the cane handling and preparation equipment is shown in Fig. 2.

An interesting feature of this contract is the system used for automatically controlling the speeds of the cane carriers and the cane elevator in order to ensure an even and continuous feed of cane to the juice extraction plant at all times. The control is initiated by a signal from a flap in the feed chute to the 1st mill. The system allows for control of the primary and secondary carrier speeds with respect to the elevator speed and also for individual control of all speeds while the system is operating automatically. Individual manual control is available for all three motors for initial testing and setting up and also combinations of manual and automatic control When operating automatically the speed of the cane elevator is a reference for the two cane carriers.



Layout of main carriers



Layout of auxiliary carriers

Fig. 2.

Speed control of the cane elevator is effected by means of a flap-operated potentiometer. As the cane load increases or decreases, so the position of the flap changes, altering the resistance of the potentiometer and thus the feed-back voltage to the elevator speed control circuit. The feed-back voltage is compared with the output voltage from the tachogenerator to the elevator motor and the error difference between the two is used to operate a polarized relay in such a way as to cause acceleration or deceleration of the cane elevator motor until the required speed called for by the flap potentiometer is obtained. The cane carriers are controlled in a similar manner. The tachogenerator output from the cane elevator is fed back to the secondary carrier control circuit and compared with the tacho-output of the secondary conveyor motor and the speed automatically adjusted to the secondary speed in the same way according to the set ratio. The speed ratio between primary/secondary and secondary/elevator motors (and hence primary/elevator ratio) can be varied whilst the system is operating automatically by means of push buttons controlling a motorized potentiometer in each control panel.

Provision is made for dealing with overloads on the heavy-duty cane knife set, in which case the primary and secondary conveyors slow down, and on the levelling cane knife set, in which case the primary carrier slows down. The speed of the cane carrier motors can be varied by 6 fixed steps in r.p.m. to meet the required conditions of overload as indicated above. A current-operated relay will be used to operate a process timer which would change the speed of the "following" machines in fixed steps. As soon as the overload condition of the knife motor is overcome, the process timer would reverse the return to its starting position, where it would stop itself, unless the overload condition should return.

The carrier control system was engineered by Patrick Murray (Pty.) Limited in conjunction with Laurence Scott & Electromotors Limited of Norwich, England.

Juice extraction plant

The juice extraction plant consists of one De Smet continuous diffuser preceded by one 42 in × 84 in Walkers 3-roller mill equipped with pressure feeder. The mill is driven by means of a 750 b.h.p. Worthington steam turbine with Woodward governor allowing speed variations of up to one-third of the maximum speed. Another mill identical to the first mill is used to de-water the spent bagasse leaving the diffuser.

The Malelane diffuser is the biggest cane diffuser of its type in the world. Its overall length is 110 ft 9 in and it is 22 ft 6 in wide and 27 ft 7 in high. The plant is guaranteed to extract 97·5% of the total sucrose of the cane leaving not more than 1·2% sucrose in the residual bagasse.

The operation of the unit is illustrated in the flow diagram Fig. 3. The prepared cane passes through the first mill which extracts 65% of its sucrose, leaving the remainder to be extracted by the diffuser and de-watering mill. The pressed cane from the mill feeds an inclined belt conveyor which is provided with a continuous weighing scale. The weight of cane as measured by the scale is recorded on the control panel and controls the speed of the diffuser conveyor and the flow rate of imbibition water to the diffuser. The cane is delivered to the scalding pipe through which it is hydraulically fed to the diffuser, using concentrated juice from the diffuser at a rate of about 2·5 parts of juice per part of cane by weight.

The diffuser itself is essentially a continuous conveyor screen of corrugated stainless steel which moves slowly in the diffuser casing and is driven by means of an automatic hydraulic system. The conveyor screens are mounted on heavy structural steel frames supported by two heavy roller chains. These chains are fitted with special high resistance bushings and each roller pin is automatically pressure-lubricated every cycle. The conveyor is thoroughly washed on its return side by part of the imbibition water and this eliminates the possibility of any bagasse particles or impurities sticking to the grids and screen.

The height of the cane in the diffuser is adjusted by means of a damper mechanism situated at the inlet of the diffuser. The optimum height is dependent

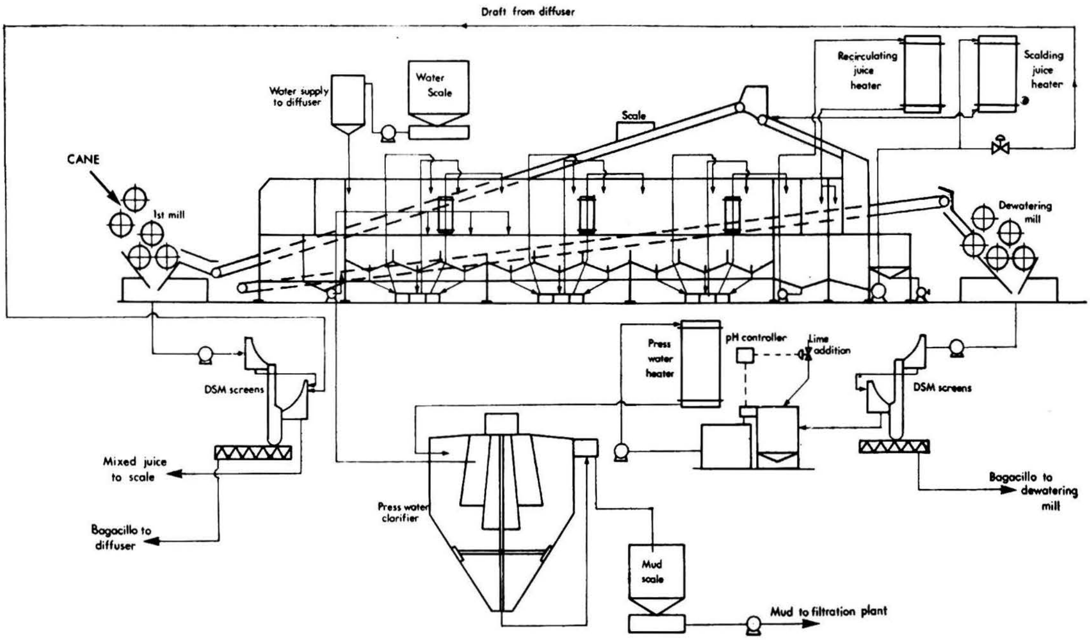


Fig. 3

on the percolation rate which is a function of the type of cane and the cane preparation. It is determined from the sucrose concentration curve throughout the cane bed. If the maximum height is exceeded, the rate of mass transfer is greatly decreased and the retention time increased, resulting in higher sucrose losses. The maximum bed height has been determined by De Smet by analysing cane samples taken at various points in a diffuser and plotting the sucrose concentration against the height. Thus, in the case of a T.S. diffuser, such as the Malelane diffuser, the maximum height of cane bed recommended is 2 metres for normally prepared cane. The cane layer, however, can be adjusted between 1200 mm and 2000 mm.

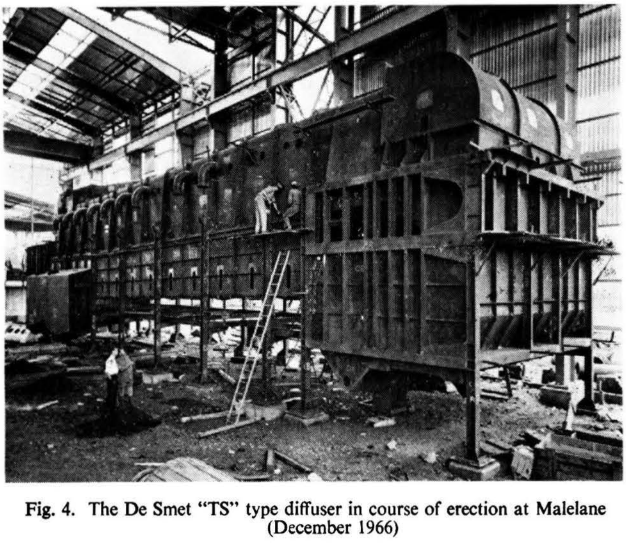


Fig. 4. The De Smet "TS" type diffuser in course of erection at Malelane (December 1966)

Similarly, the optimum length of each hopper has been determined experimentally by De Smet, taking into account the speed of the conveyor, its slope and the height of the cane bed. From these experiments, they have also determined the ideal position of the juice distributors in the diffuser and can estimate the juice retention time which is approximately 25 minutes. There is, therefore, a definite relation between the length of the hopper and the cane height. If the hopper is too long, the percolation efficiency is decreased by "dead" zones. If it is too short, there is a back flow of juice from the next hopper which also reduces the efficiency of the leaching operation. The number of stages or re-circulations has been found to be 11 in the case of a T.S. diffuser which is preceded by a pre-extraction mill. Three triple pumps are used for the first nine stages and individual pumps for the last two. The largest is the last pump which re-circulates the scalding juice and also pumps the diffusion juice to process.

Since the optimum height of the cane bed and the length of the diffuser (number of stages and width of each hopper) are constant, the width of the diffuser is therefore the only variable and is a function of the capacity. Provision is made, however, for varying the cane height and the diffuser speed to cope with variations in the type of cane and preparation and intermittent variations in the feed rate.

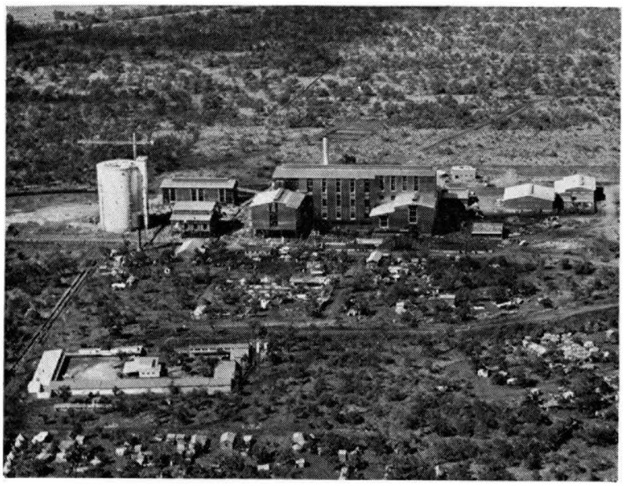


Fig. 5. Aerial view of the mill showing the white sugar silo at the left. This silo is capable of holding some 15,000 tons of refined sugar in bulk. The right wing of the main building houses the juice extraction plant, and in the left wing is the double carbonatation refinery.

The cane in the diffuser is submitted to intensive spraying with juice of progressively decreasing concentrations. The juice is evenly sprayed above the cane mat by a series of over-flowing troughs and the last stage is sprayed with water.

The spent bagasse leaving the diffuser is discharged with the help of a rotating scraper into a drag-type cross conveyor on which is mounted a rake-type leveller. The cross conveyor delivers the bagasse to an inclined belt conveyor which carries it to the dewatering mill. The mill is to "de-water" the bagasse from a moisture content of 83% down to a maximum of 52%, and in that connexion, both feed and delivery rollers are provided with ample juice grooves. The residual juice extracted by the mill is screened, heated to about 80°C, limed to pH 9, settled in a 34,000 gallon capacity clarifier and returned to the diffuser at a point where the Brix of the diffuser juice is equal to the Brix of the clarified press water. The settled mud is weighed and pumped to the mud filtration plant.

The scalding and re-circulating juices and also the press water are heated in six 2500 sq.ft. heating surface vertical juice heaters and there are small heaters in every third re-circulating pipe, so that the juice in the diffuser is kept at a temperature such that deterioration due to micro-organisms is practically eliminated and the starch present in the cane dissolves only slowly and is almost entirely removed by filtration through the bagasse bed.

The diffusion system is operated from a control panel where all motor controls are centralized as well as the indicating and controlling instruments. All heaters are equipped with automatic temperature controls; there are flow meters for the fresh water and press water; there is an indicator and regulator of cane tonnage; there are several ammeters indicating the loads of various motors and tachometers indicating the speeds of the cane carriers. The whole juice extraction plant is completely electrically interlocked so that if one motor fails, all the preceding motors stop automatically.

The diffuser juice is mixed with the first expressed juice at the screens and the amount of mixed juice is equivalent to 100% on cane weight.

Clarification plant

The mixed juice is limed and heated in two stages in five 2500 sq.ft. h.s. juice heaters and the whole process is controlled automatically using Siemens pH, temperature and level controllers. These variables are indicated on a central control panel comprising a mimic flow diagram with alarms and running/stopped indicator lights for all the pumps. All the tanks are provided with diaphragm-type level controllers which actuate air-operated control valves on the pump deliveries.

The hot limed juice is clarified in a Graver "Prima-Sep" 32 ft-diameter clarifier and the clarified juice gravitates direct to a 4000-gallon capacity evaporator via a 2500 sq.ft. heating surface pre-heater.

Filtration plant

The filtration plant consists of two 8 ft × 16 ft "EimcoBelt" filters. The plant, which is the biggest of its type in Africa, delivers filtrate for feeding directly into the evaporator.

The contract for the equipment described was awarded to Patrick Murray (Pty.) Limited in October 1965. Except for the mills, most of the equipment, including the diffuser, was manufactured by the Patrick Murray workships of A. Chalmers & Co. (Pty.) Limited in Durban. Erection started in August 1966 and was completed early in April 1967, less than 18 months after initial instructions were received to proceed with the design.

New sugar factory for Chile[1].—The Ministry of Economy has authorized the erection of a new beet sugar factory by the Industria Azucarera Nacional (Iansa) at Rapaco in Valdivia province. The cost will be 78 million escudos.

[1] *B.O.L.S.A. Review*, 1967, **1**, 270.

Sugar Refining-Notes on Unit Processes

Part 1. Carbonatation

By F. M. CHAPMAN (Chapman-Associates, Vancouver, B.C., Canada.)

FOREWORD

THE notes which will appear in this and future issues of the *I.S.J.* are a condensation of files accumulated over a period of 40 years. No attempt is made to reconcile conflicting views or observations.

Sugar refining, although a small branch of the sugar industry, is important as a pace setter. The best techniques and the best plant available produce the best possible sugar in any assortment required. Some of the philosophy of refining is now spilling over to the beet sugar industry and to the manufacture of raw sugar from cane.

As a young man the writer was fortunate in his teachers, in later life he was fortunate in his associations, and these notes are published in gratitude to an industry blessed with a fine fraternity and a remarkable cooperation. Some paragraphs may seem elementary, but to quote Mr. N. M. THOMAS of honoured memory, "we have always with us learners who may not have had the opportunity to discover these things for themselves."

Corrections, contributions and correspondence will be welcomed and can be addressed to the author at 1855 Rosebery Avenue, Vancouver, B.C., Canada.

* * *

(1) *What carbonatation achieves*

To be valid, comparisons of liquor should be made at the same pH before and after carbonatation. Under these circumstances the process will be found to:

(*a*) remove 10%–90% (average 50%) of the original colour from influent liquor. (The lower the original colour the less is the % removal, while the higher the final pH the greater is the % removal. More lime removes more colour, and colour removal varies inversely with invert destruction. The results are complex and generally a refinery is more interested in producing a liquor of good filtration characteristics than in high removal of colour.)

(*b*) remove turbidity,

(*c*) remove most of the iron, and

(*d*) reduce sulphate (minimum hardness being achieved between 8–9 pH).

(2) *Lime plant—quicklime vs. hydrated lime*

Mechanically, the best lime plant known to the author is in a refinery in Florida, where a self-supporting steel bin in the open air is recharged by a blower truck. Lime feeds by gravity into a tank type slaker, incorporated in which is the lime dosing cylinder. Gravity discharge allows lime to be in the form of not "milk" but "cream", and cream can result in a 1° higher liquor Brix. In addition, there is no need for lime pumps.

In Britain and the U.S.A. quicklime is generally cheaper and gives better results than hydrated lime. Total impurities in English lime are 3–7%, and reports suggest that the $CaCO_3$ content should not exceed 2%.

Lime reburning has long been practised in the sugar industry in California. It has not become general, because the accumulation of impurities limits reburning to about 50% of consumption.

(3) *Lime slaking and dosing*

Slaking is important and is influenced by: analysis of the stone, temperature and rate of calcining, size of lump and porosity. Hydration of 1 lb CaO requires approximately 0·33 lb water, but paste/slurry slakers commonly use 2–4 lb. Residence time in a paste/slurry slaker is 5–30 min. Slaking water should be hot. The heat of slaking is 270 C.H.U./lb CaO and one refinery operates a dilution control on this basis. The specific surface of slaked lime varies tremendously, e.g.:

	Sp. surface sq.cm./g	*Settling rate*
Hydrated lime	9,000–12,000	50% after 2 hr
Quicklime & boiling water	30,000	50% after 24 hr
Rotary kiln lime, boiling water + agitation	50,000	27% after 24 hr

Mr. H. E. C. POWERS in 1948 drew attention to the remarkable variation in viscosity of lime slurries.

(4) *Dosing (proportioning)*

Proportioning can be done with dredge wheels, volume impulsed lime valves or tip buckets, by proportional orifices, or by measuring flasks.

In the author's view, lime usage should be a minimum. More lime needs more gas which uses more power and vents more heat to atmosphere. By producing more cake it increases filter resistance, produces more sweet water and loses more sugar. A refinery must have the *capability* to gas out say 0·8% CaO, but it should normally operate below this extreme. Because of their high inherent accuracy, ease of modulation and basic simplicity, the author is in favour of flask proportioners.

(5) *Gassing-out*

Ducts should, if possible, be pressurized to avoid air infiltration; they should have a slope of 1:100 in the direction of flow, and they should have cleaning points every 100 ft or so.

(6) *Gas requirements*

Other things being equal, gas requirements increase (*a*) directly with lime addition, and (*b*) in proportion to $\sqrt{\eta}$ (if viscosity quadruples, gas usage is doubled).

With normal liquor of viscosity about 14 cp, 0·5% CaO on solids, and gas containing 11–12% CO_2 by volume, it has been found appropriate to allow 150 cu.ft. of gas (at N.T.P.) per 100 lb solids. It should be remembered that flue gas from gas-fired boilers is likely to contain only 8–9% CO_2.

(7) *Gas scrubbing*

First stage scrubbers use cold water, and condensation traps up to 99% of the suspended dust. Plaistow Wharf's scrubber was designed for a maximum open tube velocity (at N.T.P.) of 7 f.p.s.

Second stage scrubbing is done by circulating 5% soda which removes 99·9% of the residual sulphur gases. As the bicarbonate is converted to sulphate/sulphite the pH drops, and at 7·5 some solution is run to drain and the system topped up with 5% soda.

(8) *Gas pumping*

The trend is to use water-ring pumps sealed with (circulating) water containing free soda and sodium bichromate (500 p.p.m.) to minimize erosion.

The beet sugar industry commonly uses (for kiln gas) rotary compressors.

Gas pumping is rather expensive, because any refinery which is thermally efficient has (effectively) to pump gas with purchased power.

(9) *Gas saturation*

When gas bubbles through liquor it saturates itself at the vapour pressure of the liquor. A flow of 150 c.f.h. is equivalent to approx. 12 lb dry gas for 100 lb solids. Between 20°C and 80°C water vapour pick-up is $12 \times 0{\cdot}55 = 6{\cdot}6$ lb vapour, or allowing for recirculation of liquor, 5–6% steam on solids. As steam, this would cost in Britain today some £35,000–£40,000 per million tons melt or, recouped with 1st body vapour, about half this sum. Heat loss increases directly with gas volume, and also rises steeply with increasing temperature of liquor. In short, gassing out at lower pH and at higher temperature can be very expensive both in gas pumping and in heat loss.

Proposals exist for gas economizers in which the water vapour in the exhaust gas can be transferred to the input gas, but the necessary experimental work has not been done. Reportedly, there exists an exchange unit in Australia, the packing in the tower being common bricks.

(10) *Gas distribution*

All gas distributors give trouble with scale, but the amount of incrustation varies with the work done. Tank No. 1 should be acid-cleaned about six times a year, Tank No. 2 three times a year, and Tank No. 3 once a year. In theory gas should be distributed through many small orifices, but these soon choke up. A/S De Danske Sukkerfabrikker have a system in which slots are traversed by oscillating fingers. Breda sugar factory employed prikes and perforated plates. Inverted sawtooth boxes are common. Calandrias with skirted walls are sound in principle, because the tubes increase the "wetted surface". But in gas absorption, the controlling factors appear to be the characteristics of the liquor.

(11) *Efficiency of absorption of gas*

Other things being equal, the most important factors seem to be (*a*) free lime in liquor as indicated by Mr. JOHN MORTON in 1958 (Table I).

Table I

Free lime (%)	0·3	0·2	0·1	0·01
Efficiency of absorption (%)	68	60	47	20

These figures give a straight line log/log plot.
(*b*) Viscosity of liquor. This is inversely proportional to absorption efficiency and it appears that absorption is limited by the rate of diffusion.

(12) *Influence of impurities in liquor*

Reports have drawn attention to the large difference in absorption efficiency when gassing Natal and Jamaica raws. No explanation is advanced, but this finding is of prime importance, because it implies that just when one wants to increase the lime dosage it cannot be done. Melting 100% Natal raws often resulted in catastrophic dilution of liquor. The implication is that carbonatation alone is not suitable for all sugars. In difficult cases it is desirable to be able to add a trace of kieselguhr.

(13) *Arrangement of gassing tanks*

Preliminary trials with tube carbonatation indicated that very intimate contact would deposit chalk rapidly, but in such a fine state of division that it could not be filtered. Similarly, defecation can be very rapid and, in reality, carbonatation on a refinery scale is designed to improve filtrability at the expense of defecation.

Experience in Australia and in England 30 years ago showed that carbonatation could not be satisfactorily conducted in one tank. The problem was and still is gas flow. For best filtration, the final pH should be low (ca. 8·3) and the final temperature high (85°C). These conditions require enormous gas capacity and result in equally enormous heat losses. It has been concluded that the best compromise between filtrability and use of gas was obtained by gassing out 75% of the lime in the first (of two) tanks.

Both Plaistow Wharf and Savannah refineries have *three* gassing tanks, the aim being to gas out 85–90% of the lime in Tanks 1 and 2, and only 10–15% of the lime in Tank 3 (where efficiency is lowest and heat loss is highest). Logically, tank area should be proportionate to gas volume, and the author prefers three tanks of equal size to one large tank followed by a small tank. Experiments in 1961 showed that Plaistow Wharf, using only two tanks, could not gas below 8·6 pH.

(14) *Retention time in tanks*

Including the head pressure tank, retention time at Plaistow is about 1 hr. Liverpool at one time had a maximum 1¾ hours. Others reported that filtrability,

[1] BENNETT: *I.S.J.*, 1967, **69**, 101–104.

good at 1 hr, was optimum at 2 hr. Mr. C. H. ALLEN, in 1956, reported that filtrability seemed to improve up to 2–2½ hr.

(15) *Filtration vs. defecation*

Dr. T. YAMANE[2] showed that the higher the final pH the better was the decolorization (this was observable also in batch carbonatation). But high pH rapidly chokes filter cloths. Others have reported that modifying the gassing procedure might double the filtration rate, but would halve colour removal. The basic problem in filtration is satisfactorily to aggregate the 1 micron particles. It may be concluded that it should be advantageous, from the aspects of ash and colour removal, to work at 8·0–8·5 pH. Good filtering liquor examined under a ×250 microscope should show bright between clusters of precipitate, while poor liquor will be cloudy. The great advantages of continuous carbonatation are better filtration and less solids in sluice water.

Reports suggest that all lime should go into solution and it does seem logical to assume that air-slaked chalk and sucrate-covered lime may be only an impediment to filtration. Thames Refinery in 1965 concluded that the only important variable in their system was the quality of the lime.

Various reports have indicated that—

(*a*) there is no advantage, in terms of ash or colour removal, to recarbonatating brown liquor;

(*b*) filtration could be improved by adding aragonite;

(*c*) the best colour removal and the best filtration rates were obtained by gassing out 0·2% CaO and adding 0·3–0·6% of precipitated chalk, i.e. the process of "gassing" improved defecation but impeded filtration.

(16) *Removal of impurities, destruction of invert, gain of ash and loss of sugar in carbonatation*

Plaistow in 1959 eliminated 0·02 invert, 0·04 ash and 50% colour. On the other hand it has been reported from Australia that:

(*a*) a semi log plot showed straight line relationships between invert destruction and pH and temperature.

(*b*) also ash *gain* could be related to invert loss:

$$Y = 0{\cdot}44X - 0{\cdot}22$$

where Y = ash gain, and X = invert loss on solids.

Comparisons (in 1947 or thereabouts) between Liverpool and Tirlemont refineries indicated that chemical sugar loss increased with lime usage. In 1942 and 1945 it was concluded that sugar loss in carbonatation at Plaistow Wharf was about 0·10%, and at Thames about 0·14% on melt.

(17) *Glass electrodes*

Savannah in 1954 reported that no glass electrode had failed by deterioration; all breakages were due to mis-handling.

Plaistow in 1958, however, reported that glass electrodes lasted 3–6 months while reference electrodes had a life of two months.

APPENDIX*

CARBONATATION OF HIGH DENSITY SUGAR LIQUORS

Introduction

Defecation by carbonatation has been used by some refineries for more than 75 years. It is a robust process which requires no particular skill in operation and the reagents used are cheap. On the other hand, the plant is heavy and bulky, cleaning of flue gas before compression can be troublesome, lime plant is dirty and expensive to maintain, the disposal of the sludge can be a problem, and consumption of filter cloth is relatively high.

Carbonatation, as the word indicates, is a process of precipitating calcium carbonate in a liquor. The process involves two stages—first the formation of a voluminous and gelatinous precipitate with a very large surface on which can be adsorbed colour bodies and a proportion of the less soluble salts, e.g. sulphates. This first stage can be conducted at a temperature of 60–80°C. The second stage involves the conditioning of the precipitate in order to improve its filtrability, and this stage is generally, though not invariably, conducted at a temperature of 80–95°C.

Fundamentals of the process

As is usual in industrial processes, carbonatation involves a succession of compromises between conflicting aims.

Nothing could be easier than to inject at the bottom of a vertical pipe the appropriate proportions of liquor, milk-of-lime, and CO_2. From the top of the pipe (after a residence time of a few seconds) will issue a liquor which is adequately defecated, and this process of "tube carbonatation" was becoming popular in East German sugar factories in 1938–39. But with liquor of 65–68°Bx the precipitate cannot be filtered.

Batch carbonatation of 65°Bx liquor was practised in the Tate refineries in England for 50 to 60 years. Lime cream (0·5% CaO on liquor solids) was added in one or more doses, and the liquor was simultaneously gassed and heated to a final temperature of about 85°C. Maximum decolorization was obtained when all the lime had been added, and colour steadily increased until the finish of gassing, which was normally about 9·1 pH.

The intersection of the curves of rising temperature and decreasing pH was a matter of chance, and filtraiton was variable. A "bad tank" would slime all the presses and result in a great wave of sluice water through the mud press circuit.

Continuous carbonatation did nothing to improve defecation, but because it led to steadier operation and much better control of temperature before pH dropped below 9·6, filtration was greatly improved.

Plant used for continuous carbonatation

Batch carbonatation has nothing to commend it and has long been abandoned in refinery practice.

[2] *I.S.J.*, 1955, **57**, 176.

* Revised version of a paper written in 1958.

There are variations in the arrangement of continuous gassing plants, but these are due mainly to local geography and personal preference. The plant shown in Fig. 1 can be considered as a modern arrangement and incorporates the best features of some recent installations.

If the fuel is natural gas, the soda scrubber is not required, and the gas can be pumped by common piston compressors. When burning oil or coal it is better to use Nash water-ring compressors or their equivalent. The power consumption is higher, but the absence of valves results in more dependable operation.

Rice-size quicklime is a good material to handle and discharges well from hopper cars into bin (101), which should be totally enclosed. Lime pumps and circulating pipes always give trouble, and it seems better to elevate lime dry, slake at high level and run lime cream direct into the first gassing tank.

For proportioning of liquor and lime the main flow of liquor can be measured in a steel flask which is filled and emptied by two poppet valves. These valves work (on a variable time cycle) in unison with the valves on a lime dosing pot attached to the slaker.

Gas washing

Flue gas is taken from the chimney base after the air preheaters and washed by aspiration through cast iron piping to a water scrubber. This unit removes 99% of the fly ash and about 50% of the sulphur gases. The scrubbing water can with advantage contain silt or press mud. After the water scrubber the gas passes through a soda scrubber.

Consumption of soda (for a melt of 4 million lb a day) should be 200–300 lb depending on the sulphur in the fuel. Care should be taken to avoid entraining liquid from the soda scrubber. This is principally calcium sulphate and sulphite.

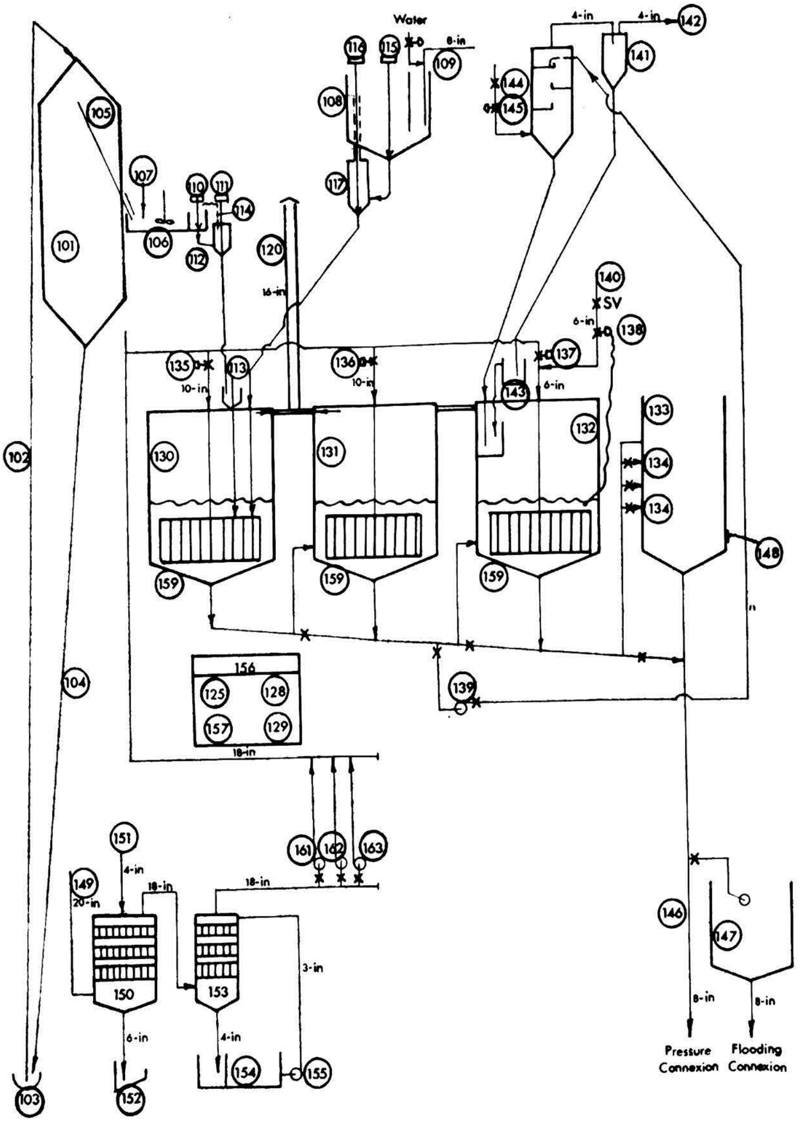


Fig. 1. Diagrammatic arrangement of carbonatation plant for melt of 4,000,000 lb/day (CaO 0·3–0·8%)

Note: The reactants are gas and lime. If the melt rate is ± 5%, the gas flow can be set by modules, and the lime feed adjusted to give the desired pH. This is worth attempting because it reduces the instrumentation. In this case, 108 is small and 117 and 112 are omitted, but tank 110 should be large (1 hour's supply of lime) and care must be taken to keep the lime nozzle clear.

Heat loss

As the gas bubbles through the liquor it becomes saturated with water vapour, and this heat loss (when using 0·5% CaO) is equivalent to about 5% steam on melt. Reheating liquor with 1st body vapour will halve the money loss, but it is nevertheless worth-while to consider an economizer to exchange heat in outgoing gas against incoming liquor. This can be done in a number of ways. The most elegant, but also the most costly method, is to use two packed towers, one in the incoming gas stream and the other in the exhaust gas steam, and through these to circulate water which is used to transfer latent heat from one tower to the other. Alternatively, as in Sweden, the rich hot gas from Tank No. 3 can be re-compressed and injected into Tank No. 1. This is an economical arrangement in everything but power. A simpler but less efficient method is to cascade the incoming liquor through the outgoing gas, which recovers some of the latent heat, but does not strip the CO_2.

Gassing tanks

In batch carbonatation it was customary to use very deep tanks because of excessive foaming in the early stages of gassing. In continuous carbonatation where the pH in the 1st tank is below 10, 5 ft of freeboard is enough. Residence time in tanks should be as short as filtration will permit and, allowing for 30% recirculation in presses, etc., valves (134) allow residence time to be varied from a maximum of 120 minutes to a minimum of 60 minutes.

Because gassing is done at two temperatures, there need be only two tanks, but the writer prefers to have 3 tanks, because this gives a more rational distribution of gas, and 80–90% of the lime is combined before the temperature need be raised.

The temperature of gassing in Tanks No. 1 and No. 2 seems not to be critical, and varies from 60 to 80°C. The lower temperature is thermally advantageous. Liquor usually leaves Tank No. 2 at a pH of about 9·6 and is heated to about 85°C before gassing down to 8·2–8·6. The higher the temperature and the final pH the less is the danger of poor filtration owing to incipient formation of calcium bicarbonate.

Liquor in Tank No. 3 can be reheated with a calandria, but this has occasionally to be cleaned, and the writer prefers to pump the liquor through a condenser against evaporator vapour at about 90°C. In emergency steam may be blown into the gas downstream of the pH controlled gas valves. This is a shockless operation because the bubbles cannot collapse, but only contract.

KEY TO FIG. 1.

101. Bin for rice-size lime—capacity 6000 cu.ft.
102. Elevator or "Airveyor".
103. Hopper to receive lime from cars and for refilling pocket 105.
104. Return lime connexion.
105. Day pocket—capacity 1000 cu.ft. This supplies slaker 106.
106. Slaker produces degritted lime cream of 20–40°Bx.
107. Hot water to slaker.
108. Melt liquor storage tank—capacity 500 cu.ft. (10 min).
109. Brix-adjusting section, control from filter station.
110. Lime doser inlet valve operating in unison with 115.
111. Lime doser discharge valve operating in unison with 116.
112. Lime doser vessel—capacity 3 cu.ft. (varied by submergence of vent 114).
113. Lime measuring pot to control and check discharge of 112.
115. Liquor doser inlet valve operating in unison with 110.
116. Liquor doser discharge valve operating in unison with 111.
117. Liquor doser vessel—capacity 80 cu.ft.
120. Gas vent to atmosphere.
125. Variable-speed timer controlling cycles of valves 110, 111, 115 and 116.
128. pH control for tank 131.
129. pH control for tank 132.
130–132. Gassing tanks, each of 1100 cu.ft. capacity with 7-ft liquor level.
133. Gassed liquor feed tank for filters—capacity to top inlet 1000 cu.ft. Valves 134 at 12-in intervals control level in 130–132 and so vary residence time in the system.
135–137. Gas control valves—rubber-lined. pH is controlled by 128 and 129.
138. Thermostatically-controlled steam valve—emergency heating for tank 132.
139. Circulating pump delivering to vapour heater 140. Capacity 100 c.f.m. at 50-ft head.
140. Contact heater for liquor to 132. Dia. 6 ft, height 18 ft.
141. Separator—18 in dia., depth 30 in.
142. Vacuum pump—capacity 500 c.f.m.
143. Seal tank—capacity 5 cu.ft.
144. Vapour supply (85–90°C) from evaporators.
145. Valve for vapour pressure control—normal setting (from downstream) 14 in Hg.
146. High pressure to liquor filters.
147. Flooding tank—capacity 300 cu.ft., giving 6-ft head to filters.
148. Low level signal to liquor filters.
149. Flue gas to scrubber 150.
150. Flue gas scrubber (water)—wood-packed; dia. 7 ft, height 18 ft.
151. Muddy water supply to 150.
152. "Bosh" seal for easy cleaning.
153. Flue gas scrubber (soda)—4 ft square, 12 ft high (wood-packed).
154. Soda circulating tank.
155. Soda circulating pump—delivery 10 c.f.m. at 25-ft head.
156. Control panel.
157. Brix control for 109.
159. Quick-opening manhole doors with "towel rail" above.
161–163. Gas pumps—Nash or equivalent—each delivering 1400 c.f.m. against 22 p.s.i.a. (2100 c.f.m. at N.T.P.).

Gas distribution

Types of gas distributors are legion, and all are something of a nuisance. The more finely divided is the gas the higher is the efficiency of absorption but the greater is the trouble with choking. Chemical cleaning of tanks has however made good headway in the past decade.

The efficiency of gas utilization with Plaistow's perforated pipes varies from about 30% in Tank No. 1 to about 15% in Tank No. 3. This is lower than the average absorption, which over a good many plants seems to be 30–35%. It was intended, originally, to use ⅛-in perforations, but the prospect of having nine times the number of holes was a deterrent.

Press supply tank (133) is storage to buffer the shock of flooding and draining the leaf filters. Ideally tank (133) should be at such an elevation that the filters can be supplied by gravity, but in most cases the liquor is pumped to presses. Press supply pumps should not have too large excess capacity, since the less the precipitate is churned the better is the filtration.

Filtrability. A reasonable range of filtrability (liquor 66–67°Bx, 85°C, 0·5% CaO) is 15–26 tons solids per 1000 sq.ft. filtering surface per cycle of 120–180 minutes. Decolorization should be 50–60%. Using 1·8% CaO, decolorization can be as high as 85%, but gas requirements, mud production, filtering surface for liquor and for mud, mud press water, etc., all increase the cost of the process.

Accumulation of ash in press cloth used to be a costly problem, and with cotton cloths ash may reach 15% in 4–5 weeks. Polypropylene cloths, however, may reach this ash level only after 4–5 months. The cost of changing leaves is a bad feature of the process.

Instrumentation is simple. One needs duplicate timers to operate the liquor and lime proportioning system, temperature control on the last gassing tank and two pH controllers for the gas valves on tanks 2 and 3. Glass electrodes last 3–6 months. These are water washed daily to remove fibre, and acid washed weekly to remove chalk. Reference electrodes last two months and are refilled with KCl each week.

Disadvantages

The process is not suitable for high invert liquors, gas cleaning and compression can be troublesome, and the build up of ash in press cloths is a handicap. Circulating of ash in mud press water can be serious. There is no royal route to success, each refinery has local problems, both geographical and operational, and each project needs a separate study so that the plant can be tailor-made to suit the local conditions.

Summary

Carbonatation of high density liquor is a rugged process which will show to best advantage on high purity low invert melter liquors, and is a good running mate for bone char. The design and arrangement of plant for the various operations is discussed.

Commission Internationale Technique de Sucrerie 13th Congress 1967

ALMOST a hundred visitors to Sweden participated in the 13th Congress of the CITS in June. Together with some thirty representatives of the Swedish Sugar Corporation, they met in Falsterbo, a small resort on the Baltic Sea, the Congress being held in the principal hotel, the Falsterbohus.

Members from 19 countries assembled during the 5th June and were entertained to a reception by the Swedish Sugar Corporation to which they were welcomed by Mr. E. Dieden, Technical Director of the Corporation.

The Conference proper began with its first working session on the following morning, when Dr. A. Carruthers, President of the Scientific Committee of the Commission, welcomed the members. Under the chairmanship of Mr. O. Wiklund, the first paper —on the kinetics of sucrose crystallization—was read by Professor W. J. Dunning. Considerable discussion arose on the significance of the zero crystallization rate observed with solutions of 1·003 supersaturation and less.

There followed a paper by Professor P. M. Silin of the U.S.S.R., read in his absence by Dr. R. Pieck, and a third by Professor A. VanHook. Professor Silin was concerned with the effect of a number of variables on crystal growth, while Professor VanHook reviewed the activity theory and the mechanism of growth as well as habit modification by dextrose and levulose.

The second morning session, under the chairmanship of Prof. F. Schneider, started with the paper by Dr. S. Hill on the theory of continuous crystallization. Professor VanHook suggested that the "steady state" referred to in the paper might ensure a steady crystallization rate and perhaps a lower coefficient of variation of crystal size. The engineering difficulties in designing a continuous crystallizer were mentioned.

Dr. Vašátko then presented his paper on the crystallization of sucrose, D-glucose and D-fructose from supersaturated solutions in the metastable zone, and Dr. M. C. Bennett described his observations of the reduction of supersaturation as a result of superheating in laboratory boiling experiments. Dr. M. MATIC reported that experiments in temperature measurement in a full-scale pan in South Africa had shown surprisingly small differences owing to the overcoming of hydrostatic head effects by the circulation. The final paper of the morning was that by Professor V. PREY on the effect on sucrose crystallization of the coloured compounds formed by condensation of reducing sugars and albumin degradation products in beet juice.

At the afternoon session under the chairmanship of Dr. VAŠÁTKO, a film was presented by H. E. C. POWERS in which time-lapse photography exemplified the layer growth and dissolution discussed in his paper, while D. SCHLIEPHAKE subsequently discussed the influence of non-sugars on crystallization in terms of the resistance of the surface to growth. C. VAN DER POEL then described experiments on the differential "adsorption" of saponins and inorganic cations during crystallization, and the difficulty of removing the former by washing with syrup. Professor VANHOOK referred to previously observed adsorption of high M.W. surface-active materials, while Prof. G. MANTOVANI mentioned that he had observed only small adsorption of carboxymethyl cellulose and dextran.

With Professor PREY in the chair, a paper was presented by Dr. R. PIECK on the variation of certain physical properties as a result of the partial or complete exchange of cations in Steffen waste molasses, and Dr. H. ZAORSKA then presented two papers, the first dealing with the adsorption on solid sucrose of colouring matter extracted from thick juice and syrups by active carbon and eluted with pyridine-water azeotrope. The second paper by Dr. ZAORSKA described investigations on the relationship between the hindering effect of colouring matter and the crystallization of sucrose, but discussion of the two papers was deferred until the following morning.

On the 7th June, the first morning session started under the chairmanship of Dr. J. GENOTELLE, and Professor ZAGRODZKI described his experiments in which he had found a different rate of crystallization depending on the crystal area present, and had been able to obtain a linear graph of the relationship. In a second paper Professor ZAGRODZKI described investigations on the practical boiling of sugar in a 50-ton vacuum pan in relation to the theoretical crystallization rates which could be calculated on the basis of the conditions applying.

Prof. MANTOVANI then described his investigations on the effect of non-sucrose sugars on the crystal habit of sucrose and confirmed that the effect of raffinose appeared to be associated with its embodiment in the crystal through its sucrose moiety, whereas glucose and fructose are not so embodied. In reply to a question by Professor VANHOOK he was not able to report confirmation of such embodiment by X-ray or neutron diffraction techniques. Dr. A. V. BRIEGHEL-MÜLLER suggested that in practical boiling, the formation of needle grain was more likely to occur as a result of faulty boiling conditions—low supersaturation and slow boiling—than from the presence of raffinose.

After Professor ZAGRODZKI had taken the chair, Mr. P. DEVILLERS described laboratory experiments on the variation of crystallization rate as a function of supersaturation and temperature, pH, and the presence of some non-sucrose and ionizable impurities. J. F. T. OLDFIELD and J. V. DUTTON then presented their paper on the isolation of peptide fractions and a low-M.W. component which were responsible for foaming of white sugars. The proportion of the foam causation was questioned by Mr. VAN DER POEL while Professor PREY suggested that lactic acid might be determined as a guide to the pectin contents since they were often associated.

The final paper of the session, presented by J. GENOTELLE, described experiments on the measurement of viscosity in sugar boiling by means of an ultrasonic instrument. After overcoming practical difficulties, it was found suitable for industrial control, and was subject to less influence from the presence of crystals.

After lunch the Swedish Sugar Corporation had arranged a visit to their technical research laboratories at Arlöv where visitors were shown the various laboratories where work was in progress on analytical techniques, molasses exhaustion, sugar degradation and colour formation, milling of sugar, ion exchange, automatic in-line analytical instruments, development of by-products, including fermentation for yeast and citric acid production, etc. and many other studies.

The following morning saw a renewed working session under the chairmanship of Dr. K. VUKOV, when the first paper, by F. HEITZ, dealt with the use of the Calvet microcalorimeter for the study of sugar crystallization; there was much interested comment on the question of specific areas, heats of solution, etc. but the author mentioned that the work described is in a preliminary stage and that not enough data have been collected other than to confirm the order of magnitude of VANHOOK's figures.

Dr. S. HILL then presented his second paper on continuous crystallization and the application of a computer to solving design difficulties; he again emphasized that design of a practical classifier is still in its initial stages. The effects of omission of topping and only partial topping on the non-sugars content and sugar and molasses yields were described by Dr. J. HENRY, who concluded that although well-topped beets were preferable, scalped beets would also be acceptable to Belgian sugar factories. Professor F. SCHNEIDER and Mr. P. DEVILLERS gave accounts of trials conducted on similar lines in Germany and France, respectively.

Professor MANTOVANI then took the chair while Dr. VUKOV presented two papers, the first on the importance of the reducing matter content as a measure of juice quality before and during processing, and the second on the incompleteness of precipitation of calcium carbonate in second carbonatation. Mr. J. STAMBUL referred to the importance of the effect of micro-organisms in governing reducing matter content of juice in diffusion, while a number of speakers described their own experiences in regard to supersaturation of calcium carbonate in juices.

Dr. G. ASSALINI presented his paper describing the "Aconex" continuous ion exchange unit at an Italian sugar factory. Mr. DEVILLERS referred to the possibility of using ammonia for regeneration of the anion exchanger; however, the sugar company's preference was for caustic soda.

R. F. MADSEN described the development and use of bag filters by the Danish Sugar Corporation for first carbonatation juice. Questioned as to the F_k and sludge solids content, he replied that these were governed by conditions in the factory although the solids content was restricted because the rotary vacuum filters would not accept too thick a sludge.

Development of micro-organisms of various sorts at low temperatures was described by Dr. H. P. HOFFMANN-WALBECK who showed that deterioration on thawing of frozen beet was due mainly to mesophilic and psychrophilic bacteria.

In the afternoon, under the chairmanship of J. F. T. OLDFIELD, Dr. D. GROSS presented a paper on the fractionation and characterization of sugar colour using modern techniques such as high-voltage paper electrophoresis, use of new ion exchange materials, gel filtration and membrane dialysis. Application of gel filtration to thick juice, molasses and a deionized dialysate had been used by Dr. E. REINEFELD to isolate colouring matter fractions which indicated the presence of high M.W. compounds even in the early stages of sugar production.

Professor R. WEIDENHAGEN then took the chair while Professor F. SCHNEIDER described work on the adsorption of colouring matter on and into the core of the exchanger resin particles. The nature of the fixing of irreversibly adsorbed colour was discussed by a number of speakers; Professor SCHNEIDER considered that a physical adsorption process was involved but Dr. GROSS referred to his experience of chemisorption of low M.W. phenolic compounds.

Mr. A. LEMAITRE gave an account of investigations on the effect of a number of conditions—pH, presence of oxygen, action of salts—on the corrosion of mild steel evaporator tubes. Measurements of corrosion were in terms of the iron dissolved; Professor MANTOVANI referred to the seriousness of pitting corrosion where a serious deep hole can occur with only a slight loss of iron by weight. Dr. A. EMMERICH mentioned that supplementary oxygen in the solution was relatively inactive if the original oxygen content was sufficient to cause corrosion. He also referred to the importance of copper which might be the origin of cavities in a steel tube. The final paper, by Dr. T. YAMANE *et al.*, was read in his absence by Professor MANTOVANI, and referred to the separation of higher and lower M.W. colouring matter fractions from affined sugars and refinery liquors and their relative proportions at various stages during the process.

Dinner during the evening of the 8th June was by invitation of the Swedish Sugar Corporation and Mr. DIEDEN again spoke to members, commenting on the excellence of the Congress. Dr. CARRUTHERS, in reply, thanked Mr. DIEDEN and the Corporation on their hospitality and kindness and paid special tribute to the efforts of Mr. O. WIKLUND who had been responsible for much of the organization in Sweden.

On the next day two separate excursions by coach were arranged, for members with different interests; the first was to the beet sugar factory at Hasslarp where harvesting and drying of grass was shown, followed by a visit to the beet breeding station at Hilleshög.

The second excursion was to the beet sugar factory at Ortofta, followed by a visit to the Arlöv sugar refinery. Ortofta is a white sugar factory of 5150 tons/day capacity and possesses some very old horizontal pans dating from the 19th century which are a remarkable contrast to the modern Landsverk pans and other plant in the rest of the factory. An interesting feature of the factory is its system for flume and waste water treatment in lagoons and spray ponds where aeration and chlorination combine to reduce the BOD_5 to about 40 before the water is discharged to the river.

Arlöv refinery is located some 5 km north of Malmö and produces cube sugar and a variety of other products. About 50,000 tons of raw sugar from Swedish sugar factories is processed, together with about 100,000 tons of imported raws, most of the supplies to the refinery arriving in road tankers. Beet and cane raws are received separately and processed differently up to bone char filtration. A feature of the refinery is the four lines for production of sugar cubes by the continuous SSA system in which the moist sugar is delivered to a succession of frames (made of cast aluminium coated with a hard alloy and then with polytetrafluoroethylene). These are subjected to rapid horizontal vibration to settle the sugar and then to light vertical vibration to free the frames which are then returned to the beginning of the line. The formed cubes on their steel band conveyor are dried by a high-frequency dielectric heater in which their temperature is raised from 45° to 100°C and the moisture content reduced from 2% to 0·5%. Automatic equipment then fills the dried cubes into packets which are then made up into larger packages and sent to store.

In addition to the four lines at Arlöv, two lines are being installed this year at Eskisehir in Turkey and one each at Čakowice in Czechoslovakia and Crockett refinery in U.S.A. In 1966 a line was installed at Porkala in Finland and in 1965 at Siegendorf in Austria.

Sugar cane agriculture

Stability of soil aggregates treated with distillery slops or blackstrap molasses. R. PÉREZ E. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 174–185.—The many types of cementing agents that may be responsible for bonding and stabilizing soil particles into aggregates are referred to. Investigations carried out in an attempt to ascertain how long soil aggregates persist in soils when stabilized by the use of either blackstrap molasses or rum distillery slops are described. With a fourth of an acre-inch application of both materials a favourable lasting effect was observed. This persisted even after the growth of four consecutive crops.

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Planter's aid. ANON. *Sugar Bull.*, 1966, **45**, 3.—A description is given of this tractor-drawn cart at the open, rear end of which three men sit planting cane. The seed cane is moved by hydraulic jack from the front to the rear as needed, operation of the jack being by the tractor driver.

* * *

Comparison of granular and spray formulations of insecticides for control of the sugar cane borer. S. D. HENSLEY and E. J. CONCIENNE. *Sugar Bull.*, 1966, **45**, 26–30.—Since 1958 effective control of the borer *Diatraea saccharalis* has been obtained with organic insecticides, notably "Endrin" and "Thiodan", but owing to high levels of resistance developed by the borer during the last four years other insecticides are being used such as "Guthion" and "Sevin". Large area aircraft-treated plots were used in making comparisons between granular and spray application. By-and-large, spray application was as effective as granular application. Sprays should result in savings to the grower as water is used as the insecticide carrier instead of commercial clays. Transport costs should also be less. Spray formulations are also less detrimental to ants or other beneficial ground-inhabiting insects.

* * *

Social benefits at El Potrero. ANON. *Bol. Azuc. Mex.*, 1966, (204), 12–13.—The Potrero sugar cane estate is one of the oldest and best known in Mexico. When factory sugar was first produced in Mexico, in the first decade of this century, it was actually known as "azúcar Potrero" or Potrero sugar. An account is given of the numerous social benefits or amenities the company provides for its field and factory workers, including modern housing and a special kindergarten school.

Cultural conditions for sugar cane at Potrero. ANON. *Bol. Azuc. Mex.*, 1966, (204), 14–17.—The nature of the soils and rainfall conditions prevailing on the Potrero estate are described and the benefit from irrigation emphasized. New irrigation facilities and the construction of a large canal are explained.

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Environment and sugar cane areas in Mexico. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1966, (204), 18–25. The hazards of soil erosion in Mexico are discussed and the conditions necessary for successful cane cultivation, notably rainfall and soil moisture.

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Innovations in cane handling. G. R. TIMMONS. *Sugar Bull.*, 1966, **45**, 35.—Four innovations in cane handling are described: (1) two 6-ton, chain net, Cameco wagons pulled in tandem during field loading, (2) a concrete-surfaced ramp transfer loading station, (3) a newly installed unloading device able to raise the cane out of the chain-net wagons or trailers without tipping the wagon or trailer, (4) a new bridge crane with a grab load capacity of 12 tons.

* * *

Cultivation on contour for sloping land. ANON. *Producers' Rev.*, 1966, **56**, (9), 13–15.—Some of the cane land in New South Wales is sloping and cannot be worked successfully by flat land cultivation methods. The importance of contour cultivation and planting of cane is stressed. Apart from soil erosion a more uniform distribution of water across the field is obtained. The advantages of a leguminous cover crop on fallow land are pointed out. Raindrops and their potentially harmful action on the soil are also discussed.

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Wire armoured tractor tyres. ANON. *Producers' Rev.*, 1966, **56**, (9), 23.—Tractor tyres with a steel wire armour mesh under the tread to protect the casing against penetration by stakes and roots are now being made in Australia. They are regarded as ideal for working in newly cleared bush country where tree roots or fire-hardened stakes can damage an unprotected tyre beyond repair.

* * *

A curious insecticide problem. ANON. *Producers' Rev.*, 1966, **56**, (9), 27.—Attention is drawn to the fact that the soldier fly pest of cane is not as readily controlled by certain insecticides in some parts of Queensland as it is in others. It is thought that, over the period of twenty years, the insect may have developed some degree of resistance. At this stage, however, this belief is purely speculative.

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Fertilization of sugar cane in Réunion. F. FRITZ. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1965, 17–25.—Experimental work was continued in connexion with deficiency in phosphorus, potassium and sulphur. Some results obtained in the previous season were confirmed. Nitrogen application at the rate of 100 kg/ha was usually sufficient for maximum yield. In soils of marked potassium deficiency 300 kg/ha K_2O was needed to correct the deficiency.

* * *

Sugar cane diseases in Réunion. M. HOARAU. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1965, 26–60.—Special attention has been paid to gummosis owing to the damage that may be caused by the disease under climatic conditions favourable to it. The degree of susceptibility of different varieties is discussed at some length. Other diseases discussed which have been subject to observation or experiment are ratoon stunting disease, chlorotic streak, leaf scald, Fiji disease and a rust (*Puccinia kuehnii*).

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Introduction of *Diatraeophaga striatalis* to Réunion. J. ETIENNE. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1965, 64–78.—An account is given of the experimental introduction of this parasite to Réunion in the hope that it might give some degree of permanent control of the stalk borer or spotted borer, *Proceras sacchariphagus*. The methods adopted in breeding the insect under laboratory conditions is described in some detail, and illustrated with photographs. Large-scale production of the parasite under controlled conditions is beset with difficulties.

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On the methodology of sugar cane selection. C. N. BABU, S. SINGH and R. S. KANWAR. *Indian Sugar*, 1966, **16,** 389–391.—The long period that normally elapses from the raising of seedlings to the release of a variety is deplored. The advantages of the pit method of planting with selection work are discussed, especially in testing for red rot resistance, this disease being very serious in northern India.

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A study of fluctuations in cane supply to the sugar industry of the Punjab. S. S. GREWAL and A. S. KAHLON. *Indian Sugar*, 1966, **16,** 405–419.—An enquiry is reported which was designed to study the degree of fluctuation of cane supplies to Punjab factories and the causes of this fluctuation.

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Improving sugar cane varieties in Puerto Rico. E. BONETA-GARCIA. *Sugar y Azúcar*, 1966, **61,** (11), 44–46.—Details of breeding and selection work in Puerto Rico are discussed and the great increase in the scope of the work in recent years pointed out. From approximately 10,000 seedlings produced in 1952 the number has constantly increased until in 1966 around 1,000,000 were germinated. Bunch planting is practised. Resistance to mosaic disease is one of the main objectives in the breeding programme. It is considered that new varieties capable of replacing most of the current commercial varieties will soon be available.

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Mechanical harvesting of recumbent cane in Florida. J. E. CLAYTON and H. D. WHITTEMORE. *Sugar y Azúcar*, 1966, **61,** (11), 50–53.—The difficulties of working mechanical harvesters on the soft, peaty, or muck soils of Florida cane areas are pointed out. The various types of mechanical harvester that have been tried and modifications made to them are discussed. Manufacturers, producers and mills are working together to try to find a successful and economical method of harvesting Florida sugar cane.

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Relation of pith in sugar cane to yields of cane and sugar. L. G. DAVIDSON. *Sugar y Azúcar*, 1966, **61,** (11), 54–55.—Two studies on pith were conducted in Louisiana during the 1965 harvest season. These involved determination of the percentage of pith in various stalk segments and the effect of pith on density of millable stalks and moisture and sucrose percentage in pith and normal storage tissue. It was concluded that the economic importance of small amounts of pith in sugar cane may be easily overestimated. Average pith content was only 2·7% by weight and 6·8% by volume of millable stalk.

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Early application of nitrogen as a means to mitigate its adverse effect on the juice quality of sugar cane. G. N. MISRA. *Indian Sugar*, 1966, **16,** 469–472. Results are given of field trials involving the application of nitrogen fertilizer at different stages of growth of the ratoon crop, carried on over three seasons. Early application, i.e. at first irrigation, soon after dismantling of ridges, gave markedly superior results to later application. Similar results by earlier workers in India are referred to.

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Nitrification in relation to pH—its importance in fertilizer nitrogen utilization by cane in some sugar belt soils. R. A. WOOD. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 241–246.—In nitrogen mineralization studies on several Natal sugar belt soils delays in nitrification were noted where pH was 5·2 or below, especially on acid sandy soils. Lime application at rates of 2, 4 and 8 tons per acre led to rapid nitrification, the environment having become more favourable for nitrifying bacteria. The results have a bearing on the choice of N fertilizers for cane in acid sandy soils.

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Abnormal nitrogen requirements of sugar cane on the montmorillonitic black clay soil of the Kafue flats of Zambia. D. S. HUGHAN and D. R. C. BOOTH. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 247–

252. The soils of the Kafue Flood Plain, some of the heaviest tropical black clays of the world and subject to severe cracking in dry weather, are described. Their nitrogen requirements are heavy but with dressings of 300 lb N per acre and 76 lb P_2O_5 (K nil) cane yields of over 90 tons per acre in 12 months are possible. Flood and furrow irrigation is practical in the dry season.

* * *

The influence of trash on nitrogen mineralization—immobilization relationships in sugar belt soils. R. A. Wood. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 253-262.—As some Natal sugar belt soils are heavily trashed it was decided to investigate the rate of nitrogen turnover as this trash may lock up considerable quantities of N. Addition of sulphate of ammonia (200 lb N/acre) with trash (10 tons/acre) stimulated decomposition and provided N surplus in all soils.

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Some characteristics of the soils of the sugar cane growing areas around Malelane—Komatipoort, Eastern Transvaal. R. R. Maud and E. A. von der Meden. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 263-272.—This investigation was undertaken because the soils of this region, a new cane growing area in South Africa, are little known and more basic information about them is needed. Climate and geology are discussed and a soil map provided. The soils reflect closely the geology of the area and vary much in chemical and physical properties. The better soils may be expected to yield excellent crops of cane and the poorer ones, with correct agronomic practice, should also yield good crops.

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Note on salinity limits for sugar cane in Natal. E. A. von der Meden. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 273-275.—This study was carried out in an area (Nkwaleni valley in Zululand) showing numerous outbreaks of brakish conditions reflected in cane growth or behaviour. Estimations were made for conductivity, pH and N, the limits under which cane will thrive or grow being similar to those recorded for cane in other countries. Waterlogging is frequently to be linked with salinity and better drainage often effects a remedy.

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Availability of soil water to sugar cane in Natal. J. N. S. Hill. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 276-282.—A series of irrigation frequency studies on different soil types are here recorded. The author concludes that under Natal conditions the potential response to irrigation is far greater on heavy soils than on sand. Reasons for holding this belief are given.

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The use of perforated pipes for irrigation experiments. P. J. M. de Robillard and M. J. Stewart. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 283-285.—Owing to windy conditions during the summer months on the Natal coast the use of overhead irrigation in irrigation trials is unsatisfactory. The substituting of light, portable, perforated, 2-inch metal piping with a 30-40 inch high spray ("Perf-O-Rain") proved eminently satisfactory. Details of layout and use are given.

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Some factors influencing sucrose % cane at Hippo Valley Estates. C. A. Johnson. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 299-303.—Sugar cane was first planted at Hippo Valley in 1959 and the first crushing season started in 1962. On account of unsatisfactory sucrose % cane at first, due to pressure for cane for the mill, routine maturity testing was started. An account of this is given. A correlation was found to exist between diurnal temperature and sucrose % cane.

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The results of herbicide screening trials in sugar cane during 1965. J. M. Gosnell and G. D. Thompson. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 304-311.—Results with a wide range of herbicides are given. In two experiments where pre-emergent herbicides were compared the best results were obtained with 7175, 2,3,6-TBA+ MCPA, DCPA + 2,4-D, "Atrazine" and "Norea". In two trials to compare post-emergent herbicides, "Bromacil" was outstanding. Mixtures of "Diuron" and "Bromacil" gave the best results.

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Weed control on a newly developed estate at Mazabuka, Zambia. D. S. Hughan and D. R. C. Booth. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 312-314.—The rapid planting up of this new sugar cane estate (Tate and Lyle Group) and the weed problems to be faced are described. Extensive use of chemical weedkillers on two separate fronts—virgin land and old arable land—is under way. For pre-emergence control on the lighter red soils, "Prometryne" at 4 lb per acre and "Prometrone" at 4 lb per acre are suitable. Pre-emergence control on heavy montmorillonitic clays requires "Atrazine" at 6 lb per acre. For post-emergence control on all soil types, "Paraquat" at 2 pints per acre should be used. Control on the estate will consist of a combination of chemical and mechanical methods combined with hand-weeding.

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Problems of weed control on an estate. E. C. Gilfillan. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 315-316.—Experience with increasing use of herbicides in cane fields owned by the progressive Tongaat Sugar Company on the Natal coast is outlined. Weed control problems are discussed from a practical estate point of view, with reference to three main groups of weeds—broad-leaved (or dicotyledonous weeds), *Cyperaceae* or sedges and *Gramineae* or grasses. The use and limitations of 2,4-D, 2,4,5-T and "Paraquat" are described and a new technique for grass control is advanced which involves a split treatment of "Dalapon" and "Paraquat".

Sugar beet agriculture

Insect control on sugar beets by seed or soil treatments. H. E. Dorst. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 649–653.—Field experiments are reported in which the value of incorporating insecticides in the watering material of pelleted sugar beet seed was assessed for the control of sugar beet root maggot (*Tetanops myopaeformis*), the garden symphylan (*Scutigerella immaculata*) and the beet leafhopper (*Circulifer tenellus*). Low dosages of "V-C 13", "Di-Syston", and "Phorate" gave promising results with all three pests. "Aldrin" gave promising results against root maggot and symphylan. Indications were that phytotoxicity may be a limiting factor in this type of treatment.

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Effectiveness of selection for tetraploid plants in C_0 generation on the basis of the number of chloroplasts in stomata. H. Savitsky. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **13**, 655–661.—Seeds of certain sugar beet strains were subjected to colchicine treatment, sown in a greenhouse and resulting plants studied. The writer concludes that selection of tetraploid plants in the treated mixoploid C_0 generation based on the leaf characteristics, number of chloroplasts, number of chromosomes, size of stomata, etc. is an unreliable method. Selection for tetraploids in C_0 generation should be based on selection of diploid gametes (pollen grains) which will produce a tetraploid progeny.

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A method for positive selection of 4N sugar beet plants in the vegetative C_0 generation. G. H. Rank and L. E. Evans. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **13**, 687–697.—The effect of colchicine treatment on chromosome duplication at various stages of growth was studied. This was related to pollen mother cell analysis and progeny classification. Colchicine had a variable effect on the type of chimera and chromosome number produced in different plants.

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On the nature of hatching of *Heterodera schachtii*. III. Principles of hatching activity. D. R. Viglierchio and P. K. Yu. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **13**, 698–715.—The sugar beet nematode was reared on sugar beets in sand culture in a greenhouse and the collected cysts used in hatching tests with various stimulators or substances believed to stimulate hatching. These included sugars and related compounds, organic acids, vitamins and related compounds, amino acids, nucleosides and derivatives, fatty acids, alkaloids, dyes and miscellaneous biologically active compounds. It was found that many biologically active compounds at the appropriate concentration and under the proper conditions were as capable of stimulating larval emergence as the crude leachate preparations. Sucrose could be a good hatch stimulant yet dextrose and fructose were not.

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Genetic monogerm sugar beet seed. J. Grüneberg. *Zucker*, 1966, **19**, 486–494.—The history of development of present-day commercial monogerm seed is outlined. It is pointed out that varieties developed in the U.S.A. and U.S.S.R. gave inferior yields and showed a tendency to bolt when cultivated in middle and western Europe. Varieties more recently bred in Europe, such as "Gemo" and "Monobeta", have given a better performance.

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Some effects of inoculation with yellowing viruses on the susceptibility of sugar beet to fungal pathogens. I. Susceptibility to *Peronospora farinosa*. G. E. Russell. *Trans. British Mycological Soc.*, 1966, **49**, 611–619. Downy mildew of beet is usually only of limited economic importance in Britain but may be serious where crops are grown for seed production. Wide differences in susceptibility were found and virus tolerant sugar beet varieties observed. It was found that inoculation with yellowing virus could greatly affect the susceptibility of some varieties or genotypes to downy mildew. This increases the difficulty of selecting for resistance to downy mildew.

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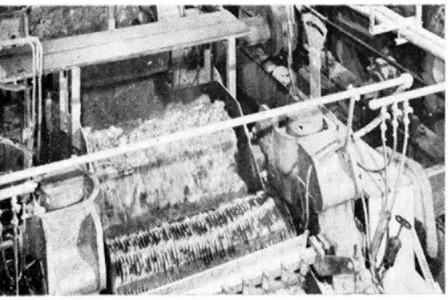
Some effects of inoculation with yellowing viruses on the susceptibility of sugar beet to fungal pathogens. II. Susceptibility to *Erysiphe* species. G. E. Russell. *Trans. British Mycological Soc.*, 1966, **49**, 621–628. In field and glasshouse experiments large differences in susceptibility to powdery mildew (*Erysiphe polygoni*) were observed between individual virus-tolerant sugar beet lines and varieties. This disease is occasionally present in sugar beet in eastern England, especially in August and September in warm, dry summers. The severity of powdery mildew infection of virus tolerant varieties of sugar beet was increased by infection with beet yellows virus or beet mild yellowing virus. The effect or nature of the infection is regarded as obscure.



Cane sugar manufacture

Vacuum pan control. Progress report No. 1. D. H. JONES and D. E. WARNE. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 181–191.—An investigation has been started at Gledhow sugar factory where an *A*-massecuite seed pan is to be provided with equipment for measurement for as many as possible of the variables which affect boiling. At present, temperature is measured to within 0·1°C just beneath and just above the calandria and just below the recommended strike level. Conductivity of the massecuite is measured using electrode pairs situated in the bottom of the pan and 18 inches above the calandria in the same vertical plane. Vacuum control is achieved by an absolute pressure recorder/controller governing water flow to the pan condenser. Preliminary experiments towards the end of the 1965 season indicated that circulation did not follow the generally-accepted pattern, and more elaborate temperature measurements are to be made to investigate this. With absolute pressure automatically controlled, the pan boiler improved his work by giving more attention to the boiling. Measurements of the conductivity gave an indication of the circulation and the influence of added syrup could be observed from the conductivity graphs.

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Vacuum pan boiling and automation. J. J. QUINTERO. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 188–193. See *I.S.J.*, 1967, **69**, 145.

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Automatic evaporator control and resulting operating economies. G. G. MOYER. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 194–207.—The objectives of efficient evaporator control are discussed and methods of regulating juice level, steam feed, pressure in the last effect and syrup Brix are described. The syrup Brix control system described incorporates a density transmitter and a recording controller, and full details are given of a Honeywell flow-through density transmitter operating on the same principle as the Rotameter Mfg. Co. Ltd. instrument[1]. Also considered are the use of a central control panel and possibilities of manual control. Improvements obtained by using a Honeywell system for evaporator control are listed, and additional benefits that could be obtained by using a computer in connexion with the system are also mentioned.

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Recent technical advances in the sugar industry of Peru. J. C. P. CHEN. *Sugarland*, 1966, **3**, (7), 24, 26, 28–31.—A brief account is given of the Peruvian sugar industry, and of recently applied developments in cane washing, cane diffusion, mill sanitation, juice clarification with magnesium oxide and using polyelectrolytes for aiding sedimentation, mud filtration, solving of evaporator scaling problems, the use of surface-active agents in pan boiling, centrifuging of *B*-molasses for sludge removal, installation of continuous centrifugals for low-grades and affination, of ceramic polish filters for refinery liquors, of a new 350 tons/day refined sugar dryer/cooler, expansion of factory capacity, bulk sugar handling and utilization of bagasse and molasses.

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Approximation formulae for evaporation plant calculations. H. J. SPOELSTRA. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 41–48.—A series of equations are quoted (but not derived) relating quantities involved in two evaporation schemes: a quadruple-effect evaporation scheme and a quintuple-effect scheme, both with full condensate flashing. The terms are not defined but are to be inferred from flow diagrams for the schemes.

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A note on the problem of production of white sugar without sulphur. D. P. KULKARNI. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 49–52.—A variation of the defeco-melt crystallization process of GUPTA *et al.*[2] was tested at Yeshwant Sahakari Sakhar Karkhana Ltd. Instead of remelting the *A*-sugar and using this melt to boil an *R*-strike on a seed of washed *B*-sugar, the *A*-strike was washed and used as seed for a *R*-strike boiled on remelted *B*- and double-cured *C*-sugar. The colour was I.S.S. 29 and had a brown tinge, so that it would not be a suitable replacement for sulphitation sugar of I.S.S. 30, which standard would have to be abolished if the D.M.C. process were generally adopted as the result of non-supply of sulphur. This is borne out by the author's experience that white sugar boiled from sulphitation syrups continues to have a brown tinge when it is boiled on seed or melt from raw sugar massecuites.

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Entrainment and the entrained liquor. A. SINGH. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 53–55.—Examination of entrained liquor from a trap showed that the purity ranged from 9·94 to 45·11 and was far removed from that of the mother

[1] *I.S.J.*, 1955, **57**, 52; 1958, **60**, 182.
[2] *ibid.*, 1966, **68**, 340.

liquor in the evaporator, although there was no indication of fermentation. It is suggested that a steam-distillation of impurities has occurred.

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Recovery of sulphur dioxide from the stack gases of a sulphiter. B. B. Paul and A. K. Mitra. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 57–61.—A plate-type absorption tower has been used successfully for recovery of unused SO_2 from the exhaust of the sulphiter by absorption in juice which is then sent to the sulphiter. Information is given regarding calculation of its dimensions and performance, and it is shown that when the syrup sulphiter exhaust was also connected to the tower, a saving of 0·005–0·0105% sulphur on cane was achieved.

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Some measures for reducing the consumption (of sulphur) during the manufacture of white sugar. H. Singh. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 63–65.—Average consumption of sulphur in a carbonatation factory in India is 0·02% on cane, but the author has reduced it in his factory to 0·009% by means of a number of modifications to the plant and operation. These include the use of a continuous sulphur melter to ensure constant feed to the sulphur furnace, the recovery of SO_2 by means of a gas absorption tower mounted on the syrup sulphiter, and regulation of the air compressor to deliver air at 125–150 c.f.m. per lb of sulphur burnt, ensuring a 5 ft head of syrup above the withdrawal point for sulphited syrup, the pH of which was maintained at 5·0–5·5.

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Theoretical possible recovery of raw sugar in a white sugar factory when switched over to raw sugar manufacturing. B. B. Paul. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 67–71.—Production of raw sugar instead of white sugar permits a higher recovery because of the contribution of the pol in the molasses film on the raw sugar crystals, to the lower production of final molasses, and to the smaller losses in press-cake. These are calculated and give a total possible extra recovery of 1·093% on cane.

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Mill setting calculations. T. T. Oommen and K. G. Hathi. *Proc. 34th Conv. Sugar Tech, Assoc. India*, 1966, 89–96.—Two methods have been used by Tungbhadra Sugar Works (Pvt.) Ltd. for calculation of mill settings for their tandem, and both are described. The first is an arithmetical method based on assumed figures for residual juice, fibre % cane, bagasse % cane and bagasse density, while the second uses charts produced by Farrel Corporation, Ansonia, Conn., U.S.A.

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Splitting the "multiple effect" evaporator. S. K. Ghosh. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 137–143.—The effect on steam economy of using a first vessel of a multiple-effect evaporator as a pre-evaporator or vapour cell is examined theoretically, and it is concluded that steam consumption will be the same or better if the evaporation rate in the vapour cell is equal to or higher than the evaporation rate in the multiple-effect evaporator before the splitting. With an average value of 24 lb/sq.ft./hr, the rate for multiple-effect evaporators becomes 12 lb/sq.ft./hr for a double-effect, 8 lb/sq.ft./hr for a triple-effect, etc., so that the economy will depend on the rate of drawing-off vapour possible in the vapour cell and the number of effects in the evaporator.

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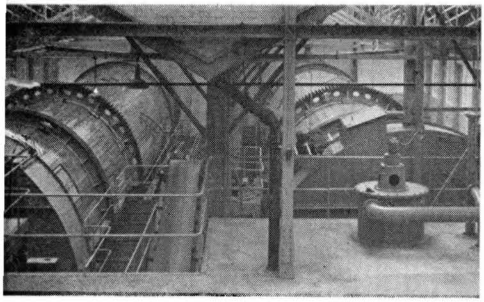
Refining of sugar cane juice by (the) ion exchange process in India. I. Studies on resin characteristics and different techniques. II. Pilot plant trials. III. Study on the economic proposal. S. Mukherjee, S. K. Ghosh, P. C. Nigam and S. K. Srivastava. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 145–161, 163–177, 179–192.—(I) Preliminary studies indicated that of the resins examined, "Duolite C-25" strong cation exchanger and "Duolite A-7" weak anion exchanger, both being opaque resins, were the best combination, the "A-7" resin combining colour and anion removal. Use of a reverse-bed technique is not suitable for cane juice processing and a mixed-bed system gave better results than a direct-bed system.

(II) Pilot plant trials using the two resins in a proportion of 1:2 are described and the results tabulated. Ash removal reached 95% and sucrose inversion was insignificant. Juice dilution was only 3–5% and regenerant consumption was reduced to 1·1 kg/kg of ash removed for the acid and 1·1 equivalents/equivalent of ash removed for the anion regenerant. Resin capacity obtained corresponded to 30–40 gal/cu.ft. of strong resin. Resin requirements were rated at 1·25 cu.ft. of strong cation exchange resin and 3·475 cu.ft. of weak anion exchange resin per ton of cane per day. Ammonia was more suitable for anion exchanger regeneration than soda-ash because 85–90% recovery could be achieved by distillation and its effluent was more easily disposed of. The mixed-bed technique gave better deionization and less inversion than the direct-bed system. Recovery of sugar might be expected to be 10–11% better than with conventional processing, as a result of the rise in purity from clear juice to de-ionized juice, and of better molasses exhaustion. Sugar produced was of higher quality and kept better. The molasses produced contained total sugars exceeding 60% and only 3–4% ash, so that it was edible. Scaling of the evaporator was negligible.

(III) Examination of the capital and working costs of the process, and the value of the benefits to be achieved indicate that the process is economically feasible. Foreign exchange requirements for resin are the principal limiting item, but with resin manufacture in India this consideration should lose its importance, especially as sugar production is an earner of foreign currency for the Indian economy.



Beet sugar manufacture

Optimum conditions in boiling, crystallization and spinning of beet sugar massecuites. YU. D. KOT. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 96–106.—Laboratory tests showed that both 1st and 2nd (final) massecuites should be boiled at below 80°C (76–78°C), although the temperature of a 1st massecuite boiled from a high Brix syrup (above 65°Bx) is preferably raised to 85°C immediately after nucleation, and directly the pan has been loosened the temperature should be reduced to 76–78°C. Water drinks (or green syrup diluted to 50–60°Bx) are recommended for loosening 2nd (final) massecuite. Where a 2nd massecuite has been boiled at high vacuum (equivalent to about 65°C) to give a maximum crystal content (45–50%), drinks of syrup diluted to 50°Bx or water should be added before the massecuite is dropped. Large doses of water should be added to batch crystallizers. In the case of continuous crystallizers, water should be added continuously to a 1-metre section of the crystallizer and the massecuite should have a temperature of 60–65°C. 2nd massecuite should be cooled to 30–35°C and subsequently reheated before spinning (the temperature depending on purity and supersaturation). The temperature in the interlining space in centrifugals used for 2nd massecuite should be as high as that of the massecuite being spun, so that it is recommended that the top and bottom covers be closed during spinning to prevent air intake.

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Examination of new types of vacuum pans. YU. D. KOT, N. I. BURYAKOV and A. L. SOKOLOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 117–128.—Details are given of tests in which Soviet VAAZ and VAMTs calandria pans were compared. The VAMTs, a modification of a previously tested design, has a calandria above which are four heating elements (one above the other) made up of oblate tubing. While the boiling time, massecuite and molasses Brix and purities, and crystal content were almost the same in the two pans, crystal uniformity and composition in the VAMTs were better, with a greater proportion of 0·75–1·0 mm crystals. The high degree of uniformity is attributed to the small initial quantity of syrup feed (20%) and to the sectional arrangement of the heating surface. Certain modifications considered necessary are detailed.

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Conditions of crystal growth in a massecuite. A. L. SOKOLOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 128–134.—In tests to determine the factors affecting crystallization rate, it was found that the thickness of the molasses film surrounding the sugar crystals in a massecuite differs according to crystal size, being much smaller around small crystals (0·1–0·2 mm) than around large crystals (1·0–1·5 mm). Thus the molasses film thickness per unit crystal surface, and consequently the amount of sucrose in solution, will depend on both crystal size and on massecuite crystal content. Tables are given showing the number of crystals per g of sugar, the crystal mass, the surface area of single crystals and the surface area of 1 kg of crystals for crystal sizes in the range 0·1–1·5 mm and showing the molasses film thickness corresponding to a given crystal sugar and molasses content in the massecuite. On the basis of GENIE's findings[1] that for a maximum crystallization rate in a high purity massecuite the molasses film thickness per unit crystal surface should be 0·1–0·2 mm, a table is given showing the crystal sugar and molasses content in a massecuite necessary to give a 0·1 mm molasses film at a given crystal length.

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Method of calculating (the parameters of) a multi-sectioned continuous vacuum pan. M. L. VAISMAN, V. N. GOROKH and V. D. POPOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 159–178. Equations are developed which permit calculation of the heating surface and effective section volume of a multi-sectioned vacuum pan of given throughput handling massecuite of given purity. The method used, based on the work of GOLOVIN & POPOV, is applied to the design of a pilot-scale pan handling 5 metric tons of 1st massecuite per hour. Full details are given of this sample calculation, showing the calculated materials balance, heat transfer coffiecients and required heating surface, feed conditions, crystallization parameters, and boiling time corresponding to a number of given factors.

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Experimental investigations of sugar dryers. D. S. SHEVTSOV and B. F. MILYUTENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 205–268. Full details are given of tests carried out on various types of Soviet-designed white sugar dryers. These included twin- and single-drum, vertical multi-stage and fluidized bed types. The smallest amount of crystal damage (6·3%) occurred in the fluidized bed dryer; in the vertical dryer 10·1% of the crystals were crushed, while in the drum dryers the quantity rose to 18–23% at a moisture content of 0·02–0·04%

[1] *I.S.J.*, 1962, **64**, 233.

On the other hand, the power consumption (by fans, drives, etc.) per kg of water evaporated was lowest in the drum types (0·7 kW/kg) and greatest in the fluidized bed dryer (2·5 kW/kg), while the vertical type consumed 1·1 kW/kg. The fuel consumption for drying was about the same in all dryers. Recommendations concerning modifications to drum dryers are listed.

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Aerodynamics of a shaft lime kiln fired on oil or natural gas. L. D. SHEVTSOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 178–192. Guidance is given on conversion of existing shaft lime kilns to oil or gas firing, based on experiments with a model kiln and with reference to the experience at certain Soviet sugar factories.

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Utilization of "degraded" vapours (Brüdendampf). W. VON PROSKOWETZ. *Zucker*, 1966, **19**, 568–578. While international nomenclature defines "Brüdendampf" (vapour formed when a solution is evaporated or a material dried) as "degraded" vapour, it is pointed out that this will apply only in certain special cases, and definitely not when the vapour is in its primary form. Examples are quoted, from the sugar and heavy chemicals industries, showing various applications of "Brüdendampf". These include its use as a heating medium for raw juice in its existing form or compressed for use in the pan station (as at Aarberg in Switzerland) or in the evaporator station (as in a number of factories in France and Belgium). At Aarberg the use of "Brüdendampf" permits power to be sold to the public network. Brief mention is made of a scheme developed at Slavkov sugar factory in Czechoslovakia 35 years ago, in which a concentrated solution of a highly hygroscopic substance ($CaCl_2$) was fed into the condensing vessel and heated to about 125°C by the "Brüdendampf" and subsequently used for heating elsewhere in the factory. One of the major defects was the considerable corrosion of vessels and pipelines.

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Investigation of the performance of a J-type diffuser. P. M. SILIN, A. F. KIZENKO and V. N. DRUZHLYAKOV. *Sakhar. Prom.*, 1966, **40**, (11), 29–32.—The very low value of diffusion constant A found previously for J-type diffusers ($3{\cdot}9 \times 10^{-6}$) was incorrectly calculated on the assumption that all the time spent by the cossettes in the diffuser was "effective" time, whereas a considerable part of the time was spent in pre-scalding. The new value found for a J-IV diffuser from two determinations ($4{\cdot}5 \times 10^{-6}$) approximates to that found earlier for other continuous diffusers[1]. Losses were 0·33% on weight of beet without press water return and 0·22% on weight of beet with press water return, which values are in agreement with Hungarian sugar factory experience.

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Storage of mechanically-harvested beet at "Kommunar" sugar factory. A. E. POPOV and M. C. PECHENKINA. *Sakhar. Prom.*, 1966, **40**, (11), 42–46.—Mechanically-harvested beet were stored in artificially ventilated piles after some cleaning by equipment provided on a BUM-U4M beet piler. This handling was found to increase beet damage, which was already 100% greater than that of the manually-harvested controls. The percentage of wilting and rotting among the mechanically-harvested beet was much greater than in the controls as was the trash content. While the percentage weight losses were the same in both groups of beet, the daily sugar losses were 0·037% in the case of the mechanically-harvested beet and 0·016% in the controls, giving a drop in sugar content from 17·0% to 12·6% after 116–155 days in the case of the mechanically-harvested beet but only from 17·1% to 15·4% in the case of the controls after 98–118 days.

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Forced ventilation of sugar beet piles at factories of the Central Black Earth and Kuban' Regions. V. G. PODVIGIN and A. M. ELAGIN. *Sakhar. Prom.*, 1966, **40**, (11), 46–50.—Experience with forced ventilation systems at various Soviet sugar factories is discussed. Tests on beet piles ventilated periodically by air fed along conduits and up through shafts (6 or 8 per conduit) of varying bores are described. In these the beet were stored to a height of 6 metres in piles 66 m long × 15 m wide. The sugar content fell from 14·96% to 14·5% and from 15·14% to 14·39% after 72 and 70 days, respectively, compared with a corresponding drop from 14·68% to 13·73% and from 15·05% to 13·72% after 71 and 59 days, respectively, in unventilated control piles. While the temperature in the ventilated piles did not exceed 5·5°C during storage, in the control piles it reached 10°C and above.

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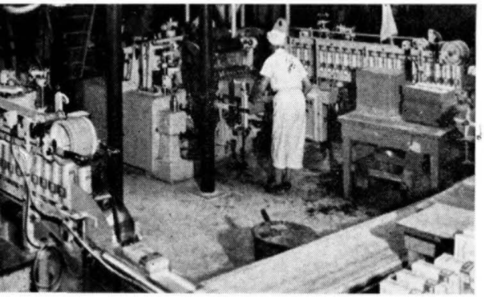
Theoretical fundamentals of the prerequisites for development of the sugar industry. S. ZAGRODZKI. *Gaz. Cukr.*, 1966, **74**, 233–239.—The various aspects considered in this discussion are: the expected increases in sugar consumption in Poland (with reference to the present levels of consumption in Poland and certain other European countries); the increased beet yield and hence beet acreage that will be required to meet the extra demands; the effect of campaign length on sugar factory capacities, as well as on the level and costs of sugar production at particular periods during a campaign; and the optimum date for the start of a campaign as dependent on its length. While the total factory capacity over the campaign should be adjusted to the quantity of beet produced in that time, the author considers it preferable to have large factories with a daily slice of 5000 tons of beet, and/or "mother" factories with several juice stations having a total daily capacity of 15,000 tons of beet. On the other hand, it is thought better to refer the performance of a sugar factory to the quantity and quality of the sugar produced rather than to the daily beet slice.

[1] *I.S.J.*, 1967, **69**, 146.



Sugar refining

Studies on a slime-producing bacterium from a sugar refinery. J. D. Sanders and W. E. Norris. *Texas J. Sci.*, 1965, **17,** (1), 113–121; through *S.I.A.*, 1966, **28,** Abs. 463.—Morphological, biochemical and physiological studies showed that the bacterium, isolated at the Imperial Sugar Company's refinery at Sugarland, Texas, was not the one usually encountered, *Leuconostoc mesenteroides*, but a hitherto unlisted species of *Pseudomonas*. Incubation with raw or refined sugar, glucose or fructose, in distilled water or in a yeast extract-peptone medium as a broth or as an agar, showed that growth and slime production were most rapid under aerobic conditions in media containing 5% sucrose at 37°C.

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Front end loaders solve a sticky handling problem. Anon. *Mod. Materials Handling*, 1966, **21,** 64–65; through *S.I.A.*, 1966, **28,** Abs. 750.—The system for charging and discharging of the Imperial Sugar Company's bulk raw sugar silo at Galveston, Texas, is briefly described. On discharging, about a third of the sugar falls by gravity into hoppers in the floor. The rest is fed into the hoppers by two specially adapted tractor shovels, which are also briefly described with photographs.

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Char house modifications at St. Lawrence Sugar Refineries Limited. Refinery Staff, St. Lawrence Sugar Refineries Ltd. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 19–24.—The spent char from each of the 40 char cisterns is discharged as a slurry through a central plug valve in the dished bottom made of a "Neva-Clog" screen, and is flushed down a 100-ft long sloping pipe into one of four dewatering cisterns (there is one pipe and one cistern per row of 10 char cisterns). The dewatering filter is provided with a hydraulically-operated sliding bottom carrying a "Neva-Clog" screen. The filter is filled with water before the slurry is introduced to permit the conveying water to overflow to the drains and prevent clogging of the char bed with fine dust. The char is dewatered by compressed air and is carried by belts to a bucket elevator feeding the revivification kiln, whence it is taken to the top of the char house by a pivoted bucket elevator and discharged onto an oscillating screen for "scalping". From there it passes to a distribution hopper feeding four variable-speed conveyor belts, each of which discharges the char onto an oscillating conveyor over a row of filters. Each cistern is fed with a controlled char-liquor mixture, the liquor being fed from a stack of offset cones on top of the filter which is connected to an appropriate outlet on the oscillating conveyor. The cone stack is totally enclosed and has a liquor inlet, flow meter and liquor control valves, the whole assembly being movable by one operator from one filter to another by an overhead monorail. The water from the dewatering cisterns passes over a vibrating screen on its way to the sewer for char reclamation. Of the total loss of 0·6% char at the refinery, 0·4% is reclaimed as dust.

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Adsorbent work in sugar refining. F. M. Chapman. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 25–33.—The mechanical properties of bone char of upper and lower limits of M.A. (mean aperture) (0·7–0·35 mm) and the operational aspects of a refinery decolorizing station are considered in order to explain why it is impossible to optimize the volume of the station. Comparison of a bone char plant (also suitable for granular carbon) handling 1 million lb of liquor per day, in which the liquor columns are in series of four, with one of identical throughput in which the columns are in parallel, shows how the new system with the liquor flow in series has a smaller pressure drop (34 compared with 37 p.s.i. in the parallel flow system), a char "burn" half that of the old system, less non-effective time, and better sweetening-off. Arguments are presented for the author's view that continuous decolorization is not to be recommended.

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Refined sugar conditioning and storage. A. M. Howes. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 214–219.—Conditioning of refined sugar is described and the factors known to affect it are briefly discussed. An account is given of a case of dampening of packeted refined sugar in storage, attributed to extreme weather conditions, and conclusions drawn from experience are presented as practical steps to take for optimum conditioning and prevention of deterioration.

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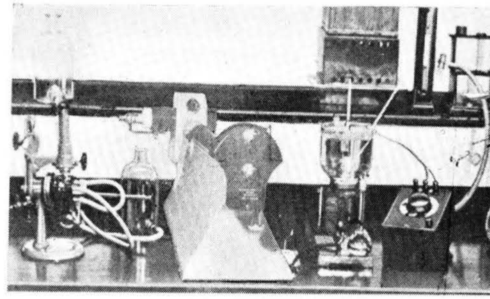
Kinetic evaluation of continuous and batch methods of refining. II. Relationship between the statistically defined average retention time of a component in an apparatus, the amount of the component in the apparatus and the amount of the component passing through the apparatus during continuous processing. J. Buriánek. *Listy Cukr.*, 1966, **82,** 243–252.—The average retention time is defined by two almost identical equations as (i) that period spent in the apparatus by molecules entering it simultaneously, and (ii) that period spent in the apparatus by molecules discharged simultaneously. The relationship ignores the mixing method used in the apparatus. It is assumed that the time spent in the apparatus is the same for each molecule, so that once equilibrium is attained distribution curves for particular components in particular sections are reproducible. The theoretical calculations have been verified by laboratory experiments.

Laboratory methods & Chemical reports



Re-crystallization of sugar crystals with supersaturation fluctuations. YU. D. KOT and A. L. SOKOLOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 106–117.—Tests were carried out on production of enlarged sugar crystals by continued crystallization under conditions of fluctuating supersaturation brought about by water drinks or temperature adjustment. The sugar crystal fines were dissolved and the remaining crystals mingled with syrups prepared from white sugar, raw sugar and yellow sugar, respectively. The massecuites formed were heated during 1 hr to 60°C, cooled with stirring to 30°C, then reheated to 60°C and again cooled to 30°C, and so on. The crystal composition was determined after every 10 heatings. Under the temperature conditions, the degree of heterogeneity of the crystals first increased, then gradually decreased. In all cases the temperature fluctuations caused a substantial increase in the length of the crystals. Addition of water drinks to a massecuite cooled from 75°C to 70–65°C (and subsequently cooled during 16 hr to 50–40°C) improved the crystal size and uniformity of the massecuite, particularly when added at 6% on weight of massecuite in one dose. The proportion of crystals measuring 0·8–1·0 mm rose from 20·32% to 75·50%. An artificial massecuite prepared at 50°C, then heated for 15–60 min to 70–80°C and cooled during 12 hr to 50°C also gave better crystal size and uniformity. In the case of the first massecuite, the improvement was attributed to molasses exhaustion as well as dissolving of small crystals, while in the second massecuite it was due solely to dissolving of some crystals and enlarging of the others. The time taken to cure massecuites after heating and re-crystallization was considerably shortened, e.g. from 22 to 14 min.

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Calcium determination in sugar factory products by flame photometry. V. A. TSIRUL'. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 139–149. The literature on calcium determination by flame photometry is reviewed and details are given of methods used by the author in the preparation of standard solutions for the construction of a calibration curve: mixing of two juices with different calcium contents; adding $CaCl_2$ and other interfering impurities (e.g. Na and sucrose) to a 1:1 diluted juice; and stepwise gassing of 1st carbonatation juice. The most suitable for standards containing more Ca than the test sample was found to be neutralizing of carbonatation juice by gassing, followed by CaO determination with EDTA and division of the juice into a number of fractions, one of which is the standard, $CaCl_2$ being added to the other fractions as required. For standards with less Ca than the test sample, a very small amount of oxalic acid is added to the cold juice; calcium oxalate is partially precipitated and the remaining oxalic acid removed by adding a small quantity of $CaCO_3$, excess of which is filtered off with the oxalic precipitate, leaving a filtrate which is the standard. Comparison between an EDTA titration method and flame photometry used to determine the Ca content of 2nd carbonatation juice showed that while the overall relative error for the flame photometric method fell between —0·17 and +7·85% where the standards were prepared from juices from three different factories, this range was narrowed to —0·17 to +3·24% where the standards were prepared from the juice at one particular factory.

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Mechanism of the Maillard reaction. I. JEŽO. *Listy Cukr.*, 1966, **82**, 259–262.—The literature on the Maillard reaction is reviewed (with 26 references) and the mechanism explained, with the aid of graphic diagrams, under two main groups: (i) reaction of D-glucopyranose and D-fructofuranose, occurring as a result of thermal hydrolysis of sucrose, with ammonia present, to give combination compounds which are then rearranged (Amadori or Heyns rearrangement) to form D-glucosamine or D-fructosamine. Recombination of these (dehydration and isomerization of the double bonds) gives a mixture of thermolabile polyhydroxyalkyl derivatives of pyrazine and imidazole. Examples are given of these and of side groups split off under the effect of heat. (ii) Reaction of secondary amines with sucrose at higher temperatures results in double displacement [of the type of combination compound formed by method (i)] and the resultant compound cannot be subjected to intermolecular condensation, while its thermal degradation leads to formation of ternary amines.

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Differences in chemical and physico-chemical properties of vacuum pan and open pan sugars as produced in India. S. K. D. AGARWAL. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 60–74.—The major differences between vacuum pan and khandsari crystals are discussed. These include a much higher CaO content (and hence conductivity), turbidity and colloid content and lower filtrability of the open pan crystals, while the pol, reducing sugar content, SO_2 content, colour and viscosity of both types are about the same. The differences in the appearance of the crystals, and particularly the softness of the khandsari crystals, are also discussed[1].

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Thermal stability of beet juice. V. A. KOLESNIKOV. *Sakhar. Prom.*, 1966, **40**, (11), 25–28.—Sulphitation juice of pH 7·5–7·7 and 2nd carbonatation juice of pH 8·7–9·0 were heated, separately, in a metal cylinder on a glycerine bath under pressure in the temperature range 100–135°C for 1 hr. Over the range 100–120°C increase in colour was linearly dependent on temperature, whereas at 125–135°C the relationship was curvilinear. In all cases the increase in the colour content of the unsulphited juice was greater than that of the sulphited juice, particularly at 120–135°C, where it was approx. 100% greater. There was only very slight fall in pH at 100–120°C for both juices, but thereafter the fall was greater and particularly sharp above 130°C. In all cases the pH fall was more rapid for the unsulphited juice. At 100–120°C there was practically no increase in the colloid content, but as with the pH drop, there was a sharper increase at 120–130°C and a considerable rise above 130°C. In further tests the juices were heated during 12 min at 126, 119, 110 and 99°C (a total of 48 min) to simulate the conditions in a quadruple-effect evaporator. The total increase in colour content was 60% for the unsulphited juice and 33% for the sulphitation juice. The smaller colour increase for the sulphitation juice was ascribed to inhibition of invert decomposition and of melanoidin formation at the lower pH. In evaporation tests, in which the juice was concentrated from 13 to 65°Bx, the pH of the unsulphited juice fell from 8·84 to 7·50, while that of the sulphited juice fell from 7·68 to 7·30. The colour rose from 22·3°St in the case of the carbonatation juice to 37·3°St, while that of the sulphitation juice rose from 16·6°St to 22·5°St.

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Systematic quality control of Peruvian raw sugar. P. HONIG and J. C. P. CHEN. *Sugar J.* (La.), 1966, **29**, (5), 18–24.—See *I.S.J.*, 1965, **67**, 122.

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Evaluation of sugar quality in relation to the measurement of whiteness. G. FIORENZI. *Quaderni di Merceologia*, 1964, **3**, 101–121; through *S.I.A.*, 1966, **28**, Abs. 800.—The reflectance of three samples of refined sugar of 0·007–0·030% ash content was measured with a Beckman DU spectrophotometer over the range 380–770 mμ at 10 mμ intervals. The results were expressed as % of the reflectance of a freshly-deposited layer of MgO, and were integrated over the whole range by the C.I.E. method to give trichromatic components *Y* and *Z*. The two latter values were converted into whiteness values either by the Judd's Whiteness formula as given by HUNTER[2] or by the simplified formula of DE VLETTER & FRIELE[3]. The two whiteness values were nearly linearly related, the former value *B* being 100 when the latter value *W* was approx. —3·0, with $\Delta B = -2{\cdot}83 \Delta W$. However, the *W* values magnified the errors in the measurement of colour saturation, so that the reproducibility (% error) of the *W* values was much lower (more variable) than that of the *B* values in the two purer samples of sugar, and slightly better or less variable in the least pure sugar. The specifications of the Comitato Interministeriale Prezzi (C.I.P., Italy) for refined and white sugars are tabulated, and a new grade ("extra fine granulated refined sugar") is mentioned, having an ash content of $\not>$0·004%. The measurement of whiteness is reviewed with 33 references to the literature.

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Improvement in raw sugar quality. R. P. JENNINGS. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 29–63.—Analysis of South African raws supplied to the Hulett sugar refinery at Rossburgh indicate that quality has improved over the period 1963/64 to 1965/66 in respect of filtrability, grain size and fines content, and impurities within the crystal.

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The quality of imported raw sugars. R. P. JENNINGS and R. VAN KEPPEL. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 196–198.—Raw sugar was imported into South Africa in 1965/66 from Mauritius, Brazil, San Domingo and Thailand. Previously raw sugar imports had been from Cuba in 1961 and from Taiwan, Indonesia and San Domingo in 1964/65. Comparative analyses are tabulated for these sugars and for contemporary Natal sugars, and differences are discussed.

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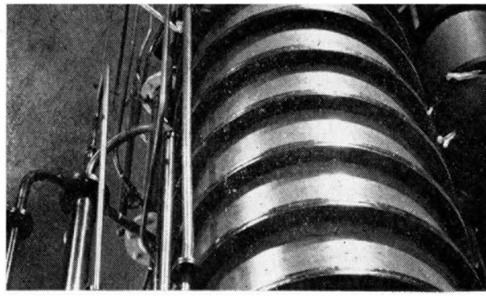
Some effects of borax on the polarization of sugar solutions. D. ADAM and R. P. JENNINGS. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 206–213. Observations of the effects of borax on the polarization of solutions of pure sugars proved inconsistent with the findings of LÓPEZ HERNÁNDEZ[4]. The use of borax in greater concentrations than those recommended by LÓPEZ for determining sucrose in impure sugar solutions has proved promising, and, following a study of the mechanism of the reaction between borax and the reducing sugars, a method is proposed for rapid determination of sucrose in invert syrups. In this, 6·5 g of the test syrup is weighed into a 100-ml flask, 50 ml of 4% borax is added, and the flask contents mixed by swirling. After settling aside for 60 min, the solution is made up to 100 ml, mixed and polarized using a 200-ml tube in a standard saccharimeter. If clarification is necessary, it should be done with a minimum of dry lead acetate after making up to volume. The pol reading, multiplied by 4, gives the % sucrose in the sample.

[1] *See I.S.J.*, 1966, **68**, 231–235.
[2] *J. Opt. Soc. Amer.*, 1960, **50**, 44–48.
[3] *I.S.J.*, 1964, **66**, 270.
[4] *ibid.*, 1963, **65**, 46–48, 72–73, 107–109.

By-products



A project study on bagasse pulp and paper. J. C. Espinosa, G. T. Pison and A. R. Apacible. *Sugarland*, 1966, **3**, (5), 8–14.—See *I.S.J.*, 1967, **69**, 91.

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A new field open to the cane agricultural industry: by-products industry. *Brasil Açuc.*, 1966, **68**, (1), 14–19. An interview is reported with M. Henri Wendling, Director of the Société pour la Valorisation des Matières Végétales, of Paris, in which he refers to the opportunities for by-products utilization in Brazil, and in particular, to sucrochemicals, bagasse paper products and furfural production.

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Extraction of pectic substances from (sugar) beet. Factors influencing the quality of the product. M. Catalan. *Anales Estac. Exper. Aula Dei* (Zaragoza), 1964, **7**, 133–150; through *S.I.A.*, 1966, **28**, Abs. 588. Dried pulp was washed twice with either water or 1% NaCl, and was then treated with 4% tartaric acid or 2% HCl at 95°C to extract pectin which was then precipitated with 2 volumes of 96% ethanol. The pectin quality, proportional to the uronic acid content, was greater at lower temperatures; at 95°C, tartaric acid was superior to HCl. An extraction period of 4–5 hr is recommended. Washing with NaCl led to a significant reduction in the protein content of the pectin as compared with water washing, and to a slight increase in uronic acid content. The use of acid ethanol, double precipitation or pepsin hydrolysis to improve quality were also investigated.

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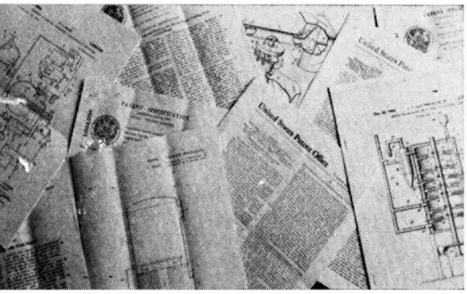
The separation and composition of predefecation mud and possibility of using it in livestock raising. A. K. Kartashov, R. G. Zhizhina and N. A. Maksimova. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 64–83.—Tests showed that predefecation at low pH (approx. 7) with addition of not less than 0·55% lime gave a mud having excellent filtrability (F_k less than 55). The volume of mud after 25 min was 11–14%. The mud was easily filtered by vacuum filters. Details of the composition of predefecation mud as found by the present and other authors are tabulated. These show the presence of albumins, phosphorus, calcium carbonate and a number of trace elements. While predefecation mud is not suitable as a main feed because of its calcium carbonate and magnesium content, it can be used as a supplementary ration where the normal ration is poor in nitrogen or calcium.

Efficient use of beet pulp. L. E. Fleishman. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 149–159.—While beet pulp treated with HCl suffered lower daily losses of dry solids during 4 months' storage under cover than did pulp treated with final molasses and with ammoniacal water, respectively, the weight increase of cattle fed on it was very small. The greatest daily weight increase (132·2% on the control) was given by the pulp treated with ammoniacal water. This pulp contained 5·42% total N and 5·89% amino acids compared with 1·21% and 4·13%, respectively, in untreated stored pulp (all expressed on 100°Bx). On the basis of 3 years' tests, it is recommended to treat fresh pulp used directly as fodder with urea, fresh pulp stored under cover with ammoniacal water, and dry pulp with urea, final molasses and fodder yeast. A number of recommendations are given for reducing pulp losses, retaining its nutritive properties and for enriching it with protein and N compounds.

* * *

Preliminary investigations of the bacteria in (beet) pulp from a DDS continuous diffuser. K. Mossakowska. *Gaz. Cukr.*, 1966, **74**, 246–248.—Tests in Czechoslovakia showed that in pulp (from BMA and DDS diffusers) inoculated with cultures prepared from *Lactobacillus plantarum*, *L. casai*, *L. delbrückii* and *Streptococcus lactis* there was a sharp increase in the lactic bacteria during the first 14 days of fermentation, while the development of putrefying bacteria was inhibited. After 28 days the ratio between the lactic bacteria in the inoculated and in the control samples was reduced, but was still considerable, while after 60 days the counts of lactic and putrefying bacteria were identical. From the tests it was concluded that it was the adaptation of the bacteria to a given environment, and particularly their activity, which was decisive during fermentation, and not the bacterial count. Investigations in Polish sugar factories using DDS diffusers, particularly at Goslawice, showed a considerable preponderance of *Bacillus stearothermophilus* in raw juice and press water. At Goslawice, the ratio of thermophiles to mesophiles in pulp varied from 27·3 to 1433·3:1 before disinfection with 0·004% formalin on beet, and ranged from 12·5 to 92·6:1 after disinfection. In press water the ratios ranged from 3·6 to 2250·0:1 before disinfection and from 4·4 to 136·0:1 after disinfection. No marked difference was found in the mesophilic and thermophilic counts in pulp taken direct from the press and from a point some 400 metres from the factory where the beet growers collect the pulp.



Patents

UNITED STATES

Beet thinner. F. SCHURMANN, of Vienna, Austria. **3,232,353.** 14th May 1963; 1st February 1966.

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Beet thinner implement control device. A. M. A. FERTÉ, of Terny-par-Margival (Aisne), France, *assr.* G. C. GUGENHAN. **3,233,681.** 27th December 1963; 8th February 1966.

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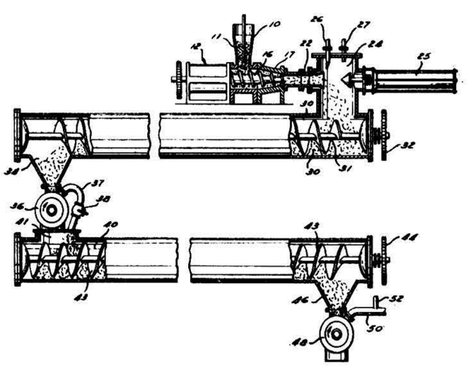
Continuous digestion of bagasse. E. J. VILLAVICENCIO, M. SIERRA R. and S. ESCOBAR, *assrs.* CÍA. INDUSTRIAL DE AYOTLA S.A., of Mexico City, Mexico. **3,238,088.** 4th December 1962; 1st March 1966.

Bagasse or depithed bagasse is delivered to an inlet 10 and fed by screw 11 to a pressure feeder 12. The pressure feeder has a screw 16 extending into a tapered conical section 17 joined by a plug section 22 to one side of a receiving chamber 24 provided with a blow-back control 25, a steam inlet 26 and a chemical inlet 27. The bagasse passes into one end of the long cylindrical impregnating chamber 30 through which it is slowly and uniformly conveyed by screw 31, sufficient agitation being provided to allow thorough exposure of the bagasse to the steam and chemicals. The outlet 34 of the chamber 30 leads to a disc refiner or defibrator 36 which abrades the bagasse to separate the fibre bundles.



The treated bagasse is transferred through outlet pipe 37 and valve 38 to the inlet 41 of digestion chamber 40, similar to the chamber 30, through which the bagasse is conveyed by screw 43 to the outlet 46 where it is transferred to a second refiner 48. The finished pulp is discharged through pipe 50, water being added through pipe 52 to reduce its temperature and to prevent flashing as pressure is released. The steam supplied through inlet 26 is at 150 p.s.i.g., equivalent to 366°F, and a pressure drop through refiner 36 reduces the pressure in chamber 40 to 135 p.s.i.g., equivalent to 358°F. These pressures are sufficient to allow the residence time for the bagasse to be only 30 minutes during which time the chemicals —required to the extent of only 60% of the usual quantities—convert the bagasse to the type of pulp required.

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Beet harvester. W. H. CONANT, of Minneapolis, Minn., U.S.A., and L. L. HUGHES, of Anoka, Minn., U.S.A. **3,240,276.** 1st February 1963; 15th March 1966.

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Cane or beet diffuser. J. E. DIAZ COMPAIN, of New York 25, N.Y., U.S.A. **3,244,560.** 23rd April 1963; 5th April 1966.—See *I.S.J.*, 1966, **68,** 116.

* * *

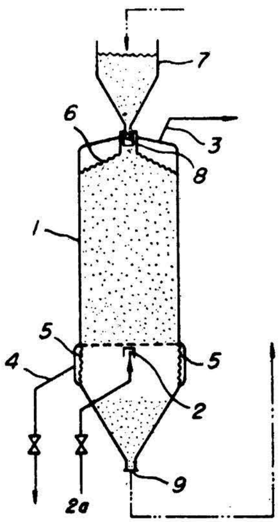
Adsorption or ion exchange treatment column. K. MIHARA and T. YAMASHIKI, *assrs.* ASAHI KASEI KOGYO K.K., of Osaka, Japan. **3,244,561.** 14th December 1962; 5th April 1966.

The column 1 is provided with a feed distributor 2, in the form of a vertical closed pipe with radial slots to give uniform distribution of the feed provided through pipe 2a. The conical base of the column has a discharge port 9 while a further upper discharge port 3 is provided for the treated liquid. An annular outlet provided with a screen 5 supplies a third discharge port 4. Above the column is a hopper 7 containing granular material such as bone char, active carbon or ion exchange resins, which are transferred to the column through valve 8.

When the feed liquor is admitted through distributor 2 the granular material is separated into two portions, the upper one providing counter-current treatment of the liquor as it passes upwards towards port 3, the granular material being held by screen 6. The second portion is discharged with the flow of liquor through port 9 for separation and regeneration. When the treatment cycle is ended, the valve in pipe 2a is closed and that in pipe 4 opened; discharge of

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).

liquid from around the distributor 2 removes the upward pressure on the column of granular material and, when valve 8 is opened, fresh material from



hopper 7 enters the column while spent material falls under gravity into the lower part of the colunm. The column may be used in series with similar columns for sequential treatment of liquor with, e.g. cation- and anion-exchange resins, etc.

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Clarifier. J. A. LEVENDUSKY and H. H. AVERY, *assr.* UNION TANK CAR CO., of Chicago, Ill., U.S.A. **3,245,543.** 7th November 1960; 12th April 1966.

Juice enters the clarifier 10 by way of conduit 30 which delivers it to the distribution cup 32. The shape of this cup induces slight turbulence and flocculation occurs at the entry. Heavy material sinks as shown by arrows 37 onto the tray 48 and is directed by the scrapers 56, mounted on radial arms 54 extending from the slowly revolving shaft 46, into the sump 51. Pickets 55 attached to arms 54 agitate the mud in the sump, aiding the release of trapped pockets of clear juice, while similar pickets 58 agitate the collecting mud, to aid the release of gases. The latter, together with gas released on first admission of the hot juices into the clarifier, produce a foam which with the entrapped impurities is skimmed by blades 44 and directed into trough 47.

The partially purified juice follows the direction of arrows 35 and enters free-fall zone 36. Clear juice is withdrawn through pipes 42, while muds settling on stationary conical trays 60a, 60b, and 60c are directed outwardly by scrapers 68a, 68b, 68c, mounted on arms 66a, 66b, 66c extending from shaft 46, so that they fall into zone 36. The muds collect on the conical bottom 18 of the clarifier and are directed by scrapers 78 on arms 76 into the sump 74 where they are thickened by pickets 84, attached to scraper 82, before leaving the unit through pipe 85.

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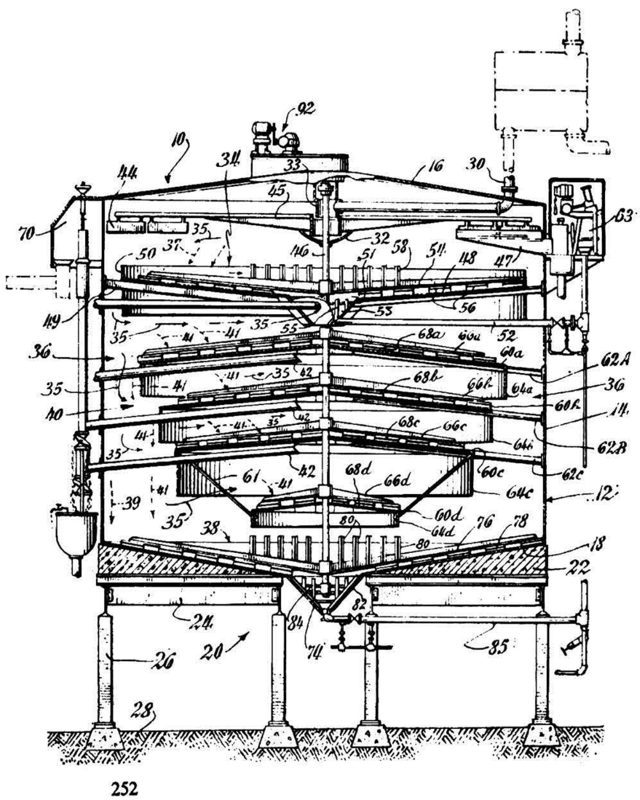
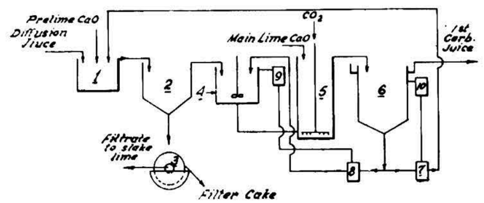
Carbonatation. R. H. VAN NOTE, *assr.* DORR-OLIVER INC., of Stamford, Conn., U.S.A. **3,245,834.** 26th November 1962; 12th April 1966.

The continuous scheme indicated in the flow diagram is devised to produce maximum economy and efficiency and juice quality, utilizing the improved decantation, thickening and filtering qualities of $CaCO_3$ solids formed at a solids concentration of 50–70 g/litre. Diffusion juice is introduced into the prelimer 1 which is preferably of the Brieghel-Müller type[1], together with lime (0·3–0·5% CaO on beet) and carbonatation sludge from the thickener 6, the latter for the purpose of "stabilization" of the juice[2]. The sludge comprises "clean" $CaCO_3$ particles which do not include the impurities rendered insoluble by liming (as in the usual Brieghel-Müller "stabiliza-



[1] U.S. Patent 2,610,929; *I.S.J.*, 1953, **55**, 193.
[2] U.S. Patent 2,697,049; *I.S.J.* 1955, **57**, 263.

tion"), since these are separated in thickener 2 from which clear overflow is sent to the further stages in which the sludge is produced.



The sludge from thickener 2 is sent to filter 3 which yields a filter cake and a filtrate which is used for slaking of lime. The clear prelimed juice from thickener 2 is sent to tank 4 where main lime is added (1·5–2·25% on beet) and sufficient recycled "clean" $CaCO_3$ from thickener 6 to ensure that when the lime is gassed to produce $CaCO_3$ the quantity of the latter will be in the range 50–70 g/litre. The mixture is sent from tank 4 to the carbonatation tank 5 and gassed before passing to thickener 6. The mix-tank density controller 9 regulates the capacity of pump 8 to maintain constant a predetermined ratio of juice to $CaCO_3$ within tank 4, and the sludge quantity control 10 regulates the return pump 7 to ensure that the amount of sludge withdrawn from thickener 6 is the same as the amount added, i.e. that the sludge quantity within the thickener remains constant.

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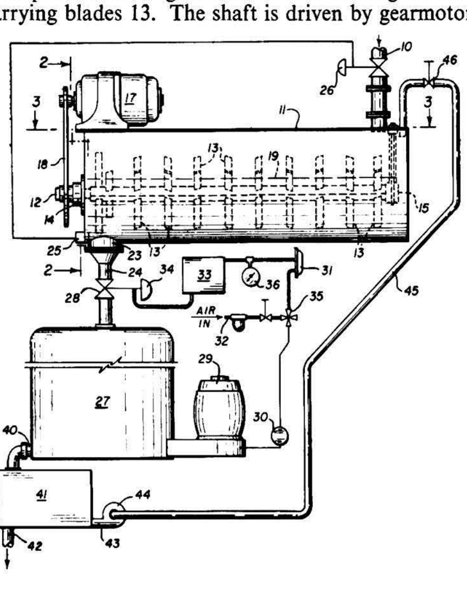
Massecuite or magma mixer. C. R. Steele and F. B. Price, *assrs.* American Factors Associates Ltd., of Honolulu, Hawaii, U.S.A. **3,247,021.** 5th July 1963; 19th April 1966.

Within the mixer tank 11 is a shaft 12 supported in a suspended bearing 15 and a wall bearing 14 and carrying blades 13. The shaft is driven by gearmotor



17 through belts 18. The device 25 senses the level of massecuite of magma in the mixer and controls the rate of addition through pipe 10 by means of valve 26, so as to maintain a constant level 19 which is such that the blades are substantially exposed as the shaft 12 rotates. This causes aeration of the massecuite as well as thorough mixing on its way from the entry end of the mixer to the discharge end where it passes through a sump 23 into pipe 24 and so into the continuous centrifugal 27 under the control of valve 28 which is regulated in accordance with the load on the motor 29 driving the centrifugal.

Some of the molasses separated by the centrifugal may be returned by pump 44 along pipe 45 and via valve 46 into the mixer to reduce the stiffness of the massecuite. This action, together with the aeration, reduces the viscosity of the massecuite, making it easier to separate the crystal content.

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Cane juice extraction. G. F. B. Appel, *assr.* Honolulu Iron Works Company, of Honolulu, Hawaii, U.S.A. **3,248,262.** 17th August 1962; 26th April 1966. See U.K. Patent 1,045,190[1].

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Sugar purification process. W. A. Welch, *assr.* Carus Chemical Co. Inc., of La Salle, Ill., U.S.A. **3,248,264.** 26th November 1963; 26th April 1966. Raw sugar melt or raw cane juice is clarified with lime and phosphoric acid in the presence of 0·05–0·17% of potassium permanganate on sugar weight; the latter reacts with impurities in the liquor, giving insoluble oxidation products which are removed with the calcium phosphate precipitate (by aeration and skimming). The permanganate is converted to insoluble MnO_2 which improves the cohesion of the phosphate precipitate while the sucrose is not affected.

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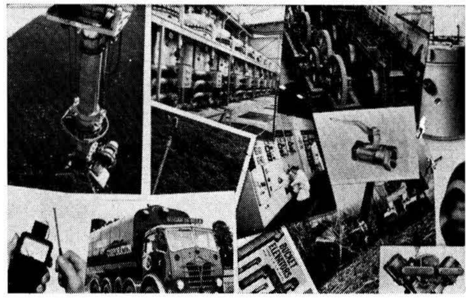
Preparation of purified sucrose esters. L. Nobile and T. La Noce, *assrs.* Ledoga S.p.A., of Milan, Italy. **3,249,600.** 15th August 1962; 3rd May 1966.—See U.K. Patent 1,018,533.[2].

* * *

Ion exchange purification of liquids. J. A. Levendusky, *assr.* Union Tank Car Co., of Chicago, Ill., U.S.A. **3,250,702.** 8th March 1963; 10th May 1966.—The liquid (sugar solution) is passed through a bed comprising a mixture of anion and cation exchange resin particles in a size range 60–400 mesh (most by weight being in the range 100–400 mesh). The cation exchange resin particles are in the H form or NH_4 form and comprise 5–95% (20–80%) of the total. The anion exchange resin is in the OH form. The volume of the mixed bed can be greater than that of separate beds and the pressure drop overall is lower. The mixed bed of resins may be used in the form of a precoat applied to a filter through which the liquid is passed.

[1] *I.S.J.*, 1967, **69**, 124.
[2] *I.S.J.*, 1966, **68**, 252.

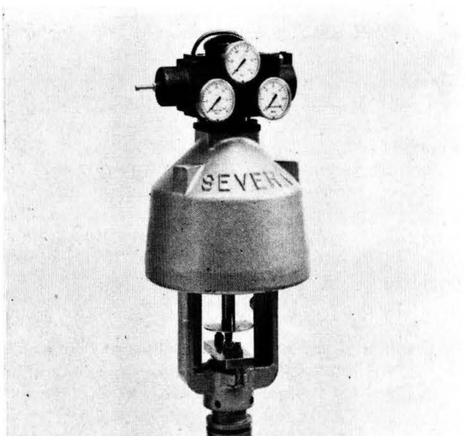
Trade notices



> **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.**

Standard control valves. The Severn Instrument Co. Ltd., Middle Spillmans, Stroud, Glos., England.

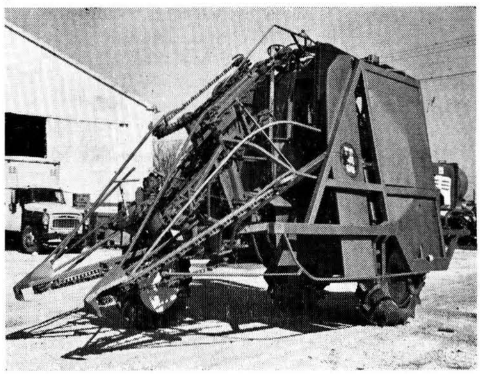
The Severn Instrument Co. Ltd., who manufacture special control valves, have now produced a range of standard control valves. The actuator is of the piston type with integral positioner which has external zero and stroke adjustments. Cooling fins, soft



seats and side-mounted handwheels can be fitted if required. Valve bodies are available screwed or flanged to all normal standards and in most materials, including carbon steel, stainless steel, bronze, "Hastelloy", monel and aluminium bronze.

The Thomson "Golden Harvester". Thomson Machinery Company Inc., P.O. Box 71, Thibodaux, La., 70301 U.S.A.

The "Golden Harvester", named to commemorate Thomson's 50th year in business, is suitable for erect cane and is designed for two-man operation; it is driven by a single engine instead of two as used with previous models, and with a lower centre of gravity is at least 50% more stable. The high clearance of earlier harvesters has been retained, however, and capacity is 25% greater, averaging well over two acres per hour.



Two optional features permit one-man operation; these are the new "Cane-Saver" cutting head and the "Auto-Gate" 3-row hydraulic piler. The former employs a new concept in hydraulics, which is being patented internationally; it automatically senses the correct height to cut precisely at ground level, giving almost a ton more cane per acre with a higher sucrose content, and eliminating the need for stubble shaving in many instances. The "Cane-Saver" uses a cutting blade which turns at nearly twice the speed of conventional blades, preventing shattering of stalks and tearing of roots in the cane bed.

PUBLICATIONS RECEIVED

STEEL FLOORING AND RAILING. Bettles Ltd., Fordhouses, Wolverhampton, England.

Information is available in brochure form on "Ambi-Deck" steel flooring and stair and step-latter treads, and on "Ambi-Rail" steel handrails. "Ambi-Deck" flooring is available in 20 ft × 3 ft mats (or can be made to customers' requirements) and is manufactured by continuous pressure welding to give a high load:weight factor and hence maximum strength. Complete fusion of the joints minimizes corrosion. The stairtreads are available with three types of nosing.

U.S. Sugar Supply Quota 1967

Area	Quota increases 6th June	23rd June	30th June	Total quota
	(short tons, raw value)			
Domestic beet	95,333	47,667	47,667	3,215,667
Mainland cane	34,667	17,333	17,333	1,169,333
Hawaii	—	—	—	1,252,543
Puerto Rico	—	—	—	725,000
Virgin Islands	—	—	—	0
Total Domestic	130,000	65,000	65,000	6,362,543
Philippines	—	—	—	1,126,020
Argentina	1,549	774	775	62,782
Australia	2,520	1,260	1,260	190,539
Bolivia	149	76	74	6,075
Brazil	12,591	6,296	6,296	510,359
British Honduras	155	77	77	13,318
British West Indies	2,120	1,060	1,060	182,820
Colombia	1,333	666	666	54,006
Costa Rica	1,482	742	740	60,087
Dominican Republic	12,595	6,298	6,298	615,367
Ecuador	1,832	915	916	74,257
Fiji	553	277	276	41,813
French West Indies	667	333	334	57,509
Guatemala	1,250	624	625	50,636
Haiti	700	349	350	28,353
Honduras	149	76	74	6,058
India	1,008	504	504	76,216
Ireland	—	—	—	5,351
Malagasy	119	60	59	8,997
Mauritius	231	116	115	17,466
Mexico	12,876	6,437	6,438	521,837
Nicaragua	1,482	742	740	60,087
Panama	932	467	467	37,804
Peru	10,043	5,022	5,022	407,073
Salvador	916	458	459	37,134
South Africa	742	370	372	56,103
Swaziland	91	45	46	6,881
Taiwan	1,050	525	525	79,391
Thailand	231	116	115	17,466
Venezuela	634	315	317	25,652
TOTAL	200,000	100,000	100,000	10,800,000

Brevities

Swaziland sugar industry[1].—New legislation has been promulgated under the Sugar Law, 1967. Under the provisions of the Sugar Industry Agreement contained in this law, the affairs of the industry are to be managed by the Swaziland Sugar Association, and the agreed formula for the division of proceeds between millers and growers is currently in operation. All the industry's export sugar is now being moved in bulk from mill to railhead and thence in specially constructed wagons to the bulk sugar terminal at Lourenço Marques, in Portuguese East Africa, where it is stored pending loading direct into the ship's hold. Although exceptionally wet weather has been experienced in recent months, both sugar mills commenced crushing cane for the 1967/68 season after the off-season overhaul.

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French sugar production target[2].—The sugar production target for the 1967/68 beet campaign has been fixed at 1,853,000 metric tons, white value, compared with a target of 1,500,000 set for the 1966/67 camapign.

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Réunion sugar production 1966/67[3].—Sugar production in 1966/67 totalled 224,429 metric tons, compared with 247,800 tons in 1965/66. Exports during the calendar years 1966 and 1965 were 221,648 tons and 203,198 tons, respectively.

New sugar factories for Portuguese East Africa[4].—Government sanction has been requested for the establishment of a sugar factory in the Dondo (Maniça and Sofala) area of Mozambique. The proposed annual capacity is to be 150,000 tons of cane. Authority has been granted for the installation of a new cane factory at Marromeu in Lourenço Marques.

* * *

Jordanian beet sugar factory possibility[5].—An Austrian consultancy has obtained positive results in a study to determine whether a beet sugar factory would be an economical proposition in Jordan. A factory with an initial slicing capacity of 1000 tons of beet/day, later increasing to 1500 tons of beet/day, is suggested. This would give 15,000 tons of white sugar in the first year, and 30,000 tons after three years, which would be sufficient to meet the country's sugar requirements.

* * *

U.A.R. sugar industry expansion[6].—The United Arab Republic plans to increase the area under cane by utilizing the water supply from the Assuan reservoir. Expansion of the sugar industry has already started. A factory under construction at Kous is expected to start operations in 1968, with an annual output of 150,000 tons of sugar, while another factory, of 100,000 tons of sugar annual output, is to be built at Sishna. The Edfu factory is to be extended. Once these schemes have been completed, an annual sugar production in the U.A.R. of 850,000 tons is envisaged.

* * *

Nigerian sugar production[7].—Sugar production in Nigeria in 1966/67 totalled 20,930 long tons, refined value, compared with 12,074 tons in 1965/66. The increase was partly due to higher sugar yields per acre, which increased from 2·6 tons in 1965/66 to 3·5 tons in 1966/67.

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Guatemala sugar production 1966/67[8].—Sugar production in Guatemala in 1966/67 is estimated at 173,000 metric tons, compared with 167,674 tons in 1965/66.

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Cuban-Swiss sugar deal[9].—An agreement has been signed whereby Switzerland, who is claiming 18 million francs (£1½ million) in compensation for three Cuban food firms nationalized 8 years ago (these had been mainly controlled by Swiss interests), will buy 40,000 metric tons of sugar per year from Cuba over an 8-year period. The sugar will be paid for at world market prices.

* * *

Mexico sugar crop[10].—The leader of the Sugar Workers Union has forecast a record sugar production of 2,300,000 tons of sugar. At a domestic consumption of 1½ million tons and allowing 250,000 tons for reserves, this will mean 550,000 tons of sugar available for export.

* * *

Chile beet sugar factory[11].—It is reported that a new sugar factory with a daily slicing capacity of 3000 tons of beet (expandable to 4500 tons/day) has started operations in Chile. This is expected to make Chile 57% self-sufficient in sugar, the consumption standing at 277,000 tons per annum.

1 *Overseas Review* (Barclays D.C.O.), May 1967, 21.
2 F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (13), 5.
3 C. Czarnikow Ltd., *Sugar Review*, 1967, (815), 98.
4 *Overseas Review* (Barclays D.C.O.), May 1967, 24, 25.
5 *Zeitsch. Zuckerind.*, 1967, **92**, 275.
6 F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (15), 16.
7 C. Czarnikow Ltd., *Sugar Review*, 1967 (817), 107.
8 F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (14), 14.
9 *The Times*, 31st May 1967.
10 *ibid.*, 19th June 1967.
11 *ibid.*

Brevities

Brazil bulk terminal plans[1].—The President of the Instituto do Açúcar e do Alcool has authorized the Pernambuco Regional Delegation to make preliminary studies for the construction of bulk sugar and molasses terminals at the port of Recife.

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Trinidad Sugar Control Board.—At the inaugural meeting of the Trinidad Sugar Industry Control Board held recently, Sir HAROLD ROBINSON was unanimously elected Chairman. The other members are: Mr. FRANK BARSOTTI (Deputy Chairman), Mr. E. J. HAMILTON, Dr. MEDFORD ALEXANDER, Mr. F. H. B. BLACKBURN, Mr. C. W. HOWARD, Mr. C. B. CARTWRIGHT, Mr. S. N. GIRWAR, Senator R. ALI and Mr. P. TANKOO. The proposal for the introduction of the Board was suggested by the Mackenzie Commission of Inquiry in 1960 as "the best machinery to establish harmonious relations between the sugar companies and the cane farmers and to assist in solving the problems of the industry". The functions of the board include checking the computation of the price formula, approving the granting, transfer and cancellations of contracts between manufacturers and cane farmers, the allocation of tonnages for each crop year to cane farmers and estate owners, and advising on the exercise of the powers in relation to the fixing of quotas under the Sugar Quotas Ordinance.

* * *

West Germany sugar and beet prices[2].—The Federal Parliament has approved the decree regulating prices of sugar and sugar beet for the year 1967/68. Both are to remain unchanged from 1966/67, the beet price being DM 7.25 per 100 kg of beets at a sugar content of 15·5%. The decree extends only to the 30th June 1968, however, since the E.E.C. sugar market regulations and common prices become effective on the 1st July.

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Ghana sugar industry study[3].—As a result of the recent visit to Ghana of a British trade delegation, two sugar production experts from Tate & Lyle Ltd. have arrived in Ghana to investigate the general structure of the sugar projects at Asutsuare in the Eastern Region and Komenda in the Central Region. Their assignment includes the study of field organization, types of cultivation in relation to soil suitability of sugar cane varieties, irrigation requirements, harvesting methods and factory techniques.

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Sugar refining in Portugal[4].—Sugar refined in Portugal in the calendar year 1966 totalled 173,827 metric tons, a small increase on the 1965 total of 161,874 tons.

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Israel sugar imports[5].—Sugar imports into Israel in 1966 were almost the same as the previous year, at 70,290 metric tons, refined value, compared with 70,655 tons in 1965. Turkey again supplied the largest share, at 25,639 tons as against 25,634 tons in 1965, while imports from Poland and Hungary, at 18,497 and 8448 tons respectively, were less than the 1965 imports of 21,535 and 10,324 tons. The U.S.S.R. was a new supplier in 1966, however, with 13,706 tons which made up for most of the imports in 1965 from Belgium (8472 tons), France (633 tons), Rumania (625 tons) and the U.K. (1675 tons). Other countries supplied the balance of 4000 tons in 1966 and 1757 tons in 1965.

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Sugar ester production in Japan[6].—The Dai-Nippon Sugar Manufacturing Co. Ltd. had succeeded recently in the industrialization of sugar ester production on the commercial scale. It has completed a new factory having a monthly production capacity of 100 tons of ester. The product, synthesized from sugar and fatty acid, is given the registered name "Nitto Ester" and is an edible, odourless, tasteless and non-irritating surface-active agent. There is a vast range of potential applications, including the food, pharmaceutical, cosmetic, detergent and other fields.

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Mexican sugar consumption[7].—Sugar consumption in Mexico during 1966 reached 1,430,277 Spanish tons, an increase of 5·2% over that of the previous year which was itself higher than the 1964 figure by 3·8%.

[1] *Brasil Acuc.*, 1967, **69**, (5), 8.
[2] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (16), 6.
[3] *Standard Bank Review*, June 1967, 15.
[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (16), 13.
[5] *Lamborn*, 1967, **45**, 96.
[6] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (16), 18.
[7] *Bol. Azuc. Mex.*, 1967, (213), 3.

International Symposium on Sugar Esters

The programme for the International Symposium on Sugar Esters to be held in San Francisco during 9th–11th August has been announced by WILLARD MARCY, vice president of Research Corporation and chairman of the symposium. Topics to be covered are development of sugar esters, applications in foods, cosmetics, agriculture, and detergents and use of sugar ester detergents for water pollution control. Participants will represent American, Japanese and French industrial concerns, and U.S. universities, government agencies and professional organizations.

The meetings will be at the Jack Tar Hotel, San Francisco. Business sessions are scheduled for 10th and 11th August; a reception for participants and guests will be held on 9th August and an informal dinner on 10th August.

The programme includes papers on the history of sugar esters, by H. B. HASS (Consultant, M. W. Kellogg Co.), the Nebraska-Snell process, by M. KAMMERLOHR (Assistant Attorney General, State of Nebraska), production of esters, by a representative of Dai Nippon Seito Kaisha, Ltd., sugar supplies (speaker to be announced), applications of esters in foods, by N. ISHLER (Consultant, Colonial Sugars Company) and by a representative of Dai Nippon Seito Kaisha, Ltd., applications of sucroglycerides in foods, by a representative of Melle-Bezons, S.A., applications of esters in cosmetics, by H. ROBINETTE, Jr. (Consultant, Colonial Sugars Company), esters in agriculture and detergents, by D. M. DOTY (Technical Director, Fats & Protein Research Foundation Inc.), sucroglycerides in animal feeding, by a representative of Melle-Bezons, S.A., esters in agricultural sprays, by F. W. SLIFE, H. WATKINS and D. CANTLIFFE (of the University of Illinois and Purdue University), esters as detergents, by A. SCHWARTZ (Harris Research Laboratories), fat supplies, by P. J. MALONE (Mitchell, Hutchins & Co. Inc.), esters as detergents, by C. J. O' BOYLE (Director of Research, Colonial Sugars Company), Government pollution control measures, by I. M. TERZICH (Sanitary Engineer, U.S. Department of the Interior), and water pollution control problems, by C. WAYMAN (Colorado School of Mines).