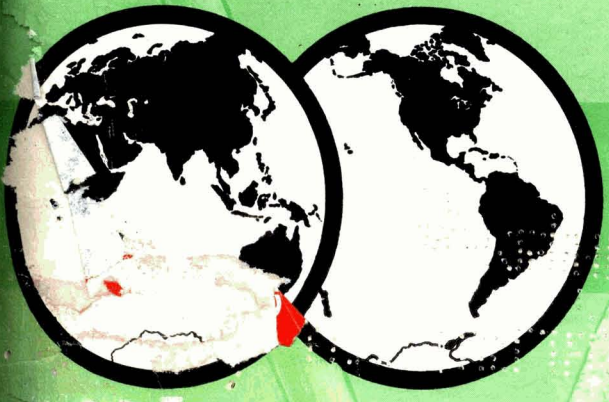
THE International Sugar Journal



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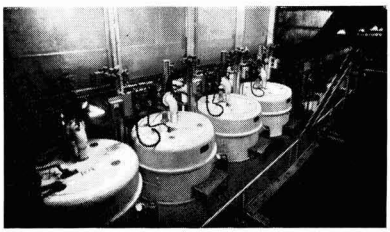

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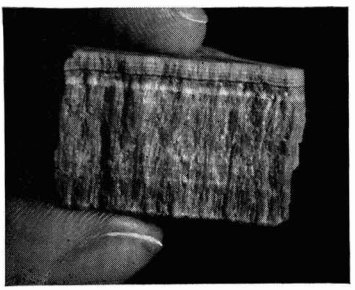

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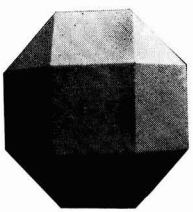

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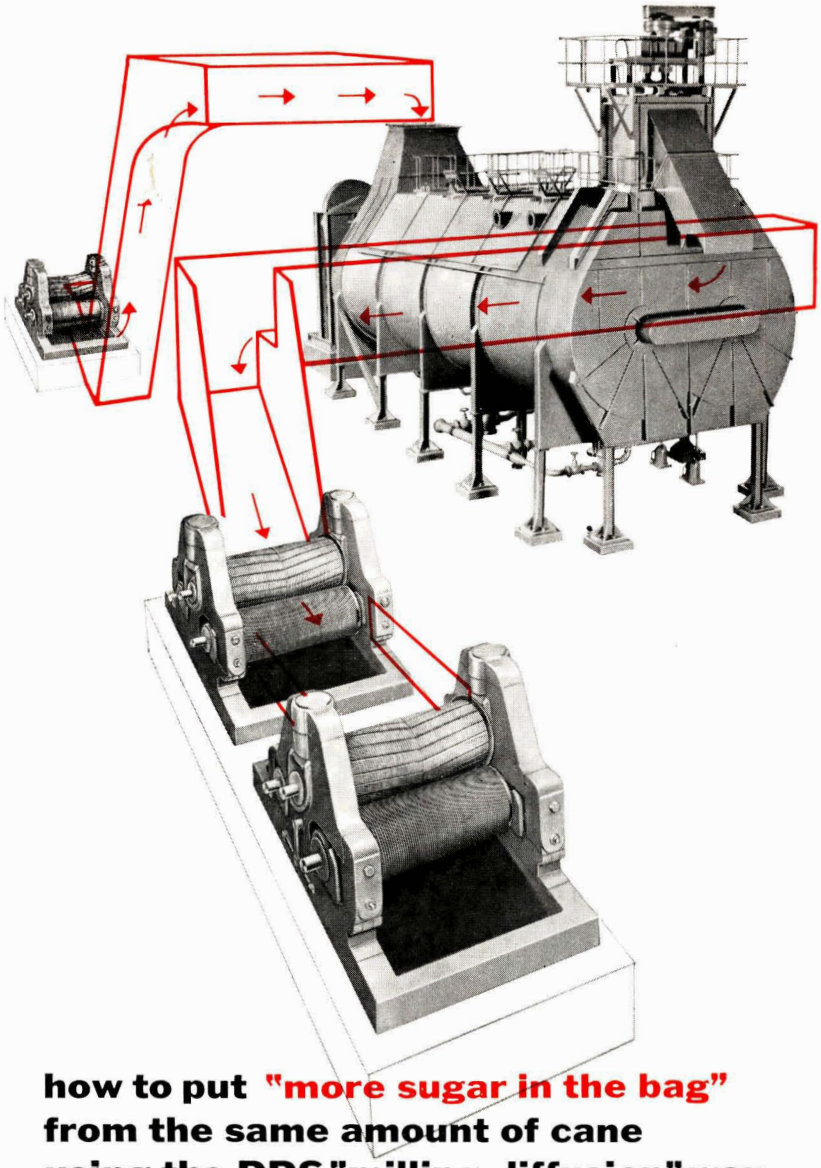

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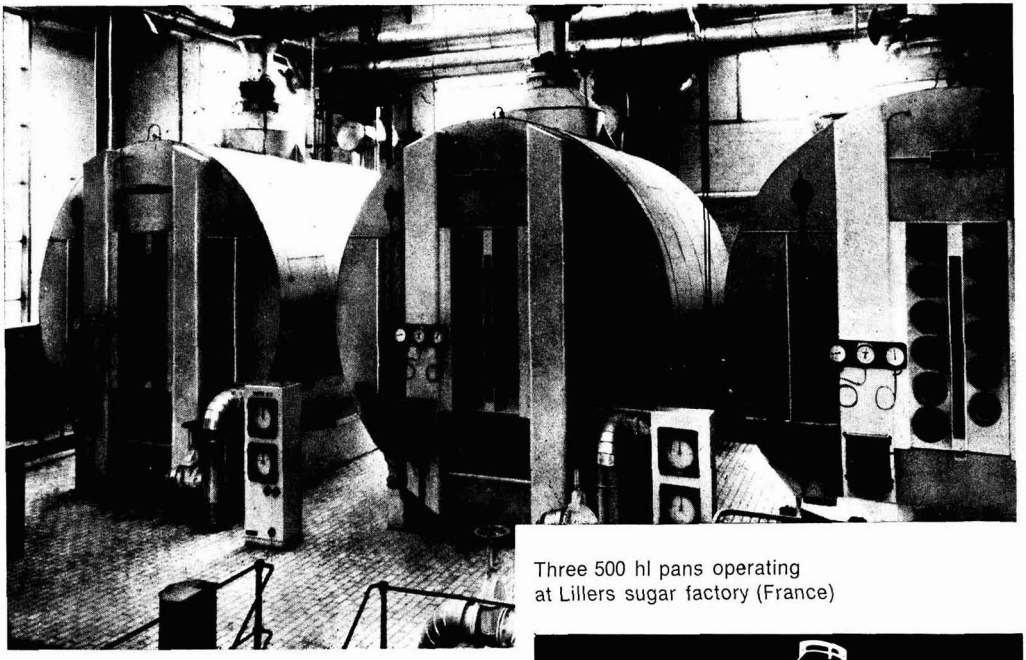
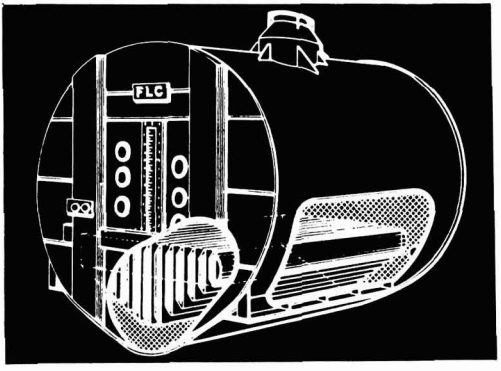


Three 500 hl pans operating
at Lillers sugar factory (France)



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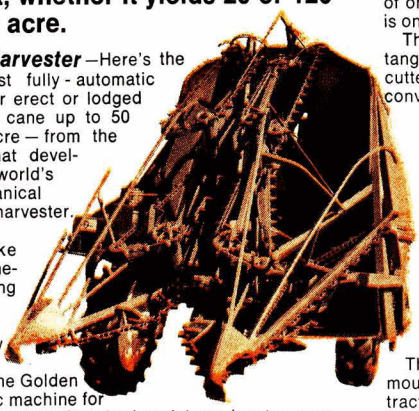

Golden Harvester —Here's the world's most fully-automatic harvester for erect or lodged soldier-type cane up to 50 tons per acre — from the company that developed the world's first mechanical sugar cane harvester.

Optional features like the new "Cane-Savor" cutting head and the "Auto-Gate" 3-row hydraulic piler make the Golden an automatic machine for one-man operation. Standard model requires two men.

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Développement et description du procédé de flottation avec un décanteur à plusieurs compartiments. A. P. SARANIN. *p.* 99–103

L'auteur décrit des essais sur le procédé de clarification nommé flottation aussi que le décanteur à plusieurs compartiments qu'il a créé. Il discute des résultats obtenus à l'aide du décanteur à la raffinerie de Millaquin au Queensland, qui montrent que le procédé de phosphatation/flottation a amélioré l'efficacité de la clarification de refonte en comparaison avec les résultats obtenus à l'aide de filtration sous pression. Par suite, la qualité de la raffinade a été améliorée.

* * *

La couleur de jus pendant la concentration dans l'évaporateur. H. ZAORSKA et S. ZAGRODZKI. *p.* 104–108

Les auteurs donnent les détails d'essais dans une sucrerie, pendant lesquels on a trouvé que le niveau du jus de betteraves dans les effets de l'évaporateur a une influence décisive sur l'accroissement de la couleur. Le maintien de corrects niveaux bas de jus dans tous les corps de l'évaporateur mène à une augmentation de couleur seulement de 50–60%, pendant que des niveaux de jus excessivement hauts dans les effets individuels peuvent mener à un accroissement triple de couleur.

* * *

La circulation forcée dans des appareils à cuire. 3-ème partie. S. HILL, W. M. NICOL et P. D. FIFE. *p.* 109–112

Des essais sur des masses cuites de basse pureté dans des appareils à cuire à faisceau et à surfaces de chauffe rubanées ont montré que dans le cas de masses cuites de haute viscosité, particulièrement dans des appareils à faisceau dans lesquels se produit une haute résistance à la circulation, les différences entre les efficacités des agitateurs à helices de types divers étaient très petites. Cependant, le type le plus effectif était l'agitateur à helice à écoulement axuel ayant quatre branches à 60° montées sur un moyeu dont le diamètre est un tiers du diamètre total; sa position optimale était au fond du tube central. On recommande ce type pour tous appareils pour des masses cuites de haute et moyenne pureté.

Entwicklung und Beschreibung des Flotationsverfahren in Mehrkammerdekanteuren. A. P. SARANIN. *S.* 99–103

Der Verfasser beschreibt Versuche mit dem Flotationsverfahren von Dekantierung und gibt die Besonderheiten des von ihm projektierten Mehrkammerdekanteurs. Ergebnisse, die durch Anwendung des Dekanteurs in der Raffinerie Millaquin in Queensland erhalten wurden, werden diskutiert, wobei es gezeigt wird, dass das Phosphatieren-Flotationsverfahren höhrer Klärungsleistungsfähigkeiten für Einschmelzsirup gegeben hat, im Vergleich mit den Ergebnissen, die mittels der Druckfiltration erhalten wurden. Dadurch hat man die Raffinadequalität erhöht.

* * *

Saftfarbe während der Konzentration in Verdampfapparaten. H. ZAORSKA und S. ZAGRODZKI. *S.* 104–108

Die Verfasser berichten über Fabrikversuche, in den man fand, dass der Rübensaftstand in den Körpern eines Verdampfapparats entscheidend auf eine Farberhöhung wirkt. Die Erhaltung von richtigen, niederen Saftständen in allen Körpern eine Farbzunahme nur von 50–60% verursacht, während übermässig hohe Saftstände in den einzelnen Körpern eine dreifache Farberhöhung verursachen können. Die Ergebnisse werden in Tabellen und Diagrammen dargestellt.

* * *

Zwangsumlauf in Kochapparaten. Teil. 3. S. HILL, W. M. NICOL und P. D. FIFE. *S.* 109–112

Versuche mit Nachproduktfüllmassen in einem Heizkammerapparat wie auch in einem mit Bandheizflächen versehenen Apparat haben gezeigt, dass bei hohen Füllmasseviskositäten, besonders in Heizkammerapparaten, die hohen Widerstand dem Umlauf leisten, die Unterschiede zwischen den Leistungsfähigkeiten der verschiedenen untersuchten Schraubenrührwerktypen sehr gering waren. Dennoch hat das Achsenfliessen-Schraubenrührwerk mit vier 60°-Flügeln auf einer Nabe, deren Durchmesser ein Drittel des Gesamtdurchmessers ist, die höchste Leistungsfähigkeit; seine beste Lage war unten im Umlaufrohr. Diese Art Schraubenrührwerk wird für alle Kochapparate für Füllmassen von hoher und mittlerer Reinheit empfohlen.

Desarrollo y descripción del proceso de flotación en el clarificador tipo "multicell". A. P. SARANIN. *Pág.* 99–103

Ensayos del proceso de clarificación por flotación se describen, así como detalles del clarificador tipo "multi-cell" diseñado por el autor. Resultas obtenido con el clarificador en la refinería de Millaquin, en Queensland, se discuten, y demuestran que el proceso de fosfatación/flotación ha mejorado la eficiencia de clarificación del licor de refundo en comparación con las resultas obtenido por uso de filtración. Como resulta, la calidad del azúcar refinado se ha elevado.

* * *

Color de jugo mientras concentración en evaporadores. H. ZAORSKA y S. ZAGRODZKI. *Pág.* 104–108

Se presentan detalles de ensayos en un azucarera, en que se halla que el nivel de jugo de remolacha en los cuerpos del evaporador tiene un efecto decisivo sobre crecimiento de color. Sostenimiento de correctos niveles bajos de jugo en todos cuerpos causa un crecimiento de color de sólo 50–60%, mientras niveles de jugo excesivamente altos en los cuerpos individuales pueden causar un crecimiento triplo de color. Las resultas se presentan en forma tabular y gráfica.

* * *

Circulación por fuerza en tachos. Parte III. S. HILL, W. M. NICOL y P. D. FIFE. *Pág.* 109–112.

Ensayos con masas cocidas en tachos con elementos de caldeo en la forma de una calandria y de cintas demuestran que, a viscosidades altas de la masa cocida, especialmente en los tachos a calandria que ofren altas resistencias a circulación, estan muy pequeñas las diferencias entre las eficiencias de los tipos de impulsor examinados. Sin embargo, el tipo el más eficiente es el impulsor axial con cuatro aletas montado a 60° sobre un buco que ocupa un tercio del diametro; su situación optima es del conducto descendente. Este tipo se recomienda en todos tachos para masas de alta y media-pureza.

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXXI APRIL 1969 No. 844

Notes & Comments

World sugar balance.

Last month we published estimates made by F. O. Licht K.G. at the end of January covering the world statistical balance. Licht has published new balance figures for the exporting countries of the world although this is not a complete revision since fresh figures for the importing countries are not included. It is highly significant, however, that the Cuban production estimate has been reduced from 6,000,000 tons earlier to 5,000,000 tons which would reduce that country's export availability by a corresponding amount, and similarly the final stock figure at August 1969 would also be reduced by one million tons from 17,406,000 tons.

Of course, other factors will probably have resulted in changes in estimates for other countries but this single major fall is likely to be preponderant, and Licht's current final stocks estimate will probably not be very far from 16,406,000 tons which represents only 23·4% of his 1969 consumption estimate of 70,030,000 tons.

* * *

World sugar price.

The reaching of the new International Sugar Agreement six months ago gave a tremendous fillip to the mood of the world sugar market but it was pointed out at the time that the statistical position was improving steadily and, even had there been no agreement, it was likely that values would improve over the depressed levels which had obtained during the previous four years apart from the brief rise during the 1967 Middle East war.

With the entry into force of the Agreement and establishment of quotas at 90% of the basic entitlements, confidence has returned, and the real strength of the sugar industry's position is now being recognized. Actual and future sugar prices have risen steadily on the London market and the Daily Price at the time of writing is £37 per ton, the highest nce August 1964 when prices were sliding from the 105 peak of the previous December. The ISA ice is 3·62 cents per lb, well over the floor level of s.

ice has mar[illegible]self i[illegible]hey[illegible]vs; [illegible] in 1956, wh[illegible]

in previous years, this importer must turn to other sources to meet her needs, and an obvious one has been Cuba. But Cuba's first offer at a recent tender was based on the London Terminal Market price, but with premiums for three and four months call higher than previously known at 32s and 42s per ton. The offer was refused by the Japanese because they felt that if they agreed to these terms other exporting nations were certain to seek similar price increases.

A second offer with premiums of 29s and 36s 6d per ton was accepted, and the quantity involved is believed to be 350–400,000 tons. South Africa has offered to sell Japan another 132,500 tons on the same basis while Japanese negotiators are understood to be considering an offer from Australia on terms involving premiums of 31s 6d and 39s.

In the case of white sugar, E. D. & F. Man[1] comment: "The outlook for Whites for the near future continues static, but demand is expected to accelerate towards the middle of the year when stocks in various importing countries will have substantially receded. We expect the value of Whites to improve considerably in relation to raw sugar levels, as we do not foresee any firsthand selling pressure developing. By that time second-hand sugar which is lying in European ports should have disappeared and will contribute to stabilize the white sugar values. The fear that the non-members sellers, i.e. the EEC, China and East Germany, will disrupt the market can now be discounted."

* * *

UK sugar surcharge reductions.

In view of the continuing rise in the world price of raw sugar on the London Market, the UK Minister of Agriculture, Fisheries and Food made Orders under the Sugar Act 1965 reducing the surcharge from 2¾d per lb (25s 8d per cwt) to 2½d per lb (23s 4d per cwt) from the 19th February and again to 2¼d per lb (21s 0d per cwt) from the 7th March 1969.

* * *

International Sugar quota redistribution.

With the rapid rise of the ISA price to 3·62 cents/lb since the entry into force of the Agreement, the pros-

[1] *Remarks on the Sugar Situation*, 28th February 1969.

pect must be faced that the International Sugar Council might have to redistribute quotas in the next few weeks. C. Czarnikow Ltd.[1] has pointed out that: "the Council has authority to redistribute quota shortfalls when the ISA prevailing price reaches 3·50 c per lb. By definition the prevailing price can only be said to have reached 3·50 c per lb when the average for a period of 17 consecutive market days has reached that level and when the first and not less then twelve days within the period have also reached at least that level. Consequently, even with a continued rise in values, the earliest date on which the Council would be empowered to redistribute quota shortfalls would be sixteen days after the ISA price first reached 3.50c per lb (13th March).

"Quite apart from the timing of possible reallocations, it is worthwhile to consider how large the tonnage is which could be redistributed. According to our statistics the total quantity available for shipment to the world market from member countries this year will fall short of current quotas and entitlements by around 800,000 tons. But it is unlikely that shortfalls amounting to anything like this tonnage will be declared at this stage. Many producers are still in the early stages of their campaigns while others will commence new crops during the last few months of the year; it is understandable, therefore, that they should adopt a hopeful attitude for the time being and refrain from making an official declaration until they have to do so under the terms of the Agreement.

"The regulation regarding notification of shortfalls is that each exporting member must notify the Council on at least two occasions each year whether it will be able to use its quota in effect and, if any, the part which it expects not to use. The first notification must be as soon as possible, but not later than 15th May and the second as soon as possible after that date but not later than 30th September. We anticipate that only those exporters which are quite certain they will fall short of their quotas in effect will be prepared to indicate their willingness to surrender part of their entitlements by the 15th May; consequently other exporting territories, which we expect will eventually have to declare shortfalls, may actually be in the position of receiving quota increases if any when the question of shortfalls comes to be considered. Accordingly, despite the substantial indicated shortfall position which we believe exists for the year as a whole, we do not believe that important additional tonnages will become available from this direction in the next few months."

* * *

European sugar production, 1968/69.

The International Association for Sugar Statistics has recently issued its estimates for beet sliced and sugar production in member countries of Western Europe. These have been published by F. O. Licht K.G.[2], together with revised estimates by Licht of figures for Greece, Ireland, Italy and Yugoslavia, which are not members of the Association. The IASS figures were reported by member countries in response to an enquiry in the last week of January and, as the campaign was generally completed then, the figures will certainly be final ones for the most part and consequently later adjustments are likely to be only small. The figures are reproduced elsewhere in this issue but show, in total, that beet sliced in the IASS member countries amounted to 63,332,631 metric tons, compared with 58,038,201 tons in the 1967/68 campaign, an increase of 9·12%.

Sugar production was consequently raised from 8,630,249 tons to 9,103,683 metric tons, raw value, but this increase was only 5·37%, reflecting a lower yield. Sugar production in the non-member countries is estimated by Licht to be 19·60% lower in 1968/69, at 1,968,000 tons as against 2,447,708 tons in 1967/68, bringing the total European production figure to 11,071,683 tons compared with 11,077,957 tons in 1967/68.

The principal differences between the IASS figures and Licht's estimates in November 1968[3] are increases of 100,000 tons for Turkey, 28,000 tons for Sweden, 20,000 tons for Belgium and 18,000 tons for France.

* * *

British Sugar Corporation Ltd. 1967/68 report.

The report of the Corporation for the year ended 30th September 1968 gives statistical data on beet and sugar production in the 1967/68 campaign which have already been reported in this Journal. It also gives a more detailed account of the background to that campaign and continuing development. For instance, we read of the application of systemic insecticide to 75% of the 1967 crop to prevent a heavy virus yellows infection, once a cause of heavy loss. Reduction of singling has followed the use of monogerm seed, used for 14% of the 1967 crop, and the control of weeds by herbicides. Nearly all the crop was harvested mechanically and 61% of beet delivered was put through cleaner-loaders to reduce dirt tare.

The slicing capacity of the Corporation's factories again increased to a record 58,269 tons/day, and substantial capital investment has continued. Reconstruction of the Wissington factory will raise throughput from 3000 to 7200 tons/day, while obsolete boiler and power plant at Bury St. Edmunds and Cantley has been replaced at a cost of more than £1,250,000. Automatic sampling installed at two factories is expected to be completed throughout the Corporation by the start of the 1969 campaign. Modern pulp presses have been installed at a number of factories and a new plant at Peterborough now packs pulp in 80-lb paper sacks.

Bulk road tankers for delivery of both dry and liquid sugars have been increased, and bulk storage facilities increased by a 10,000-ton silo at Bardney.

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[1] *Sugar Review*, 1969, (908), 41.
[2] *International Sugar Rpt.*, 1969, **101**, (4), 1–2.

Development and description of the multicell clarifier flotation process

by A. P. SARANIN

Introduction

SEPARATION of suspended fine particles and floccules from liquids and solutions by flotation processes is practised in many industries. The separation is achieved by floating off the particles with the aid of air bubbles, induced either by blowing of compressed air or by precipitation of dissolved air. In the sugar industry flotation clarifiers are in use in conjunction with phosphoric acid-lime defecation, whereby tricalcium phosphate floc occludes the impurities, links with the air and floats to the surface as a scum. The commonly-used clarifiers for this purpose are the Williamson, Jacobs and "Colloidair", essentially rectangular or U-shaped tanks and troughs with provisions for feed entry at one end and discharge of the clarified "tailings" at the bottom of the opposite end.

This paper outlines the experimental studies which led to the development of an improved type of clarification process—the multicell clarifier flotation process. It describes the process now in operation at the Millaquin Refinery in Queensland.

The process represents a significant departure from conventional procedures and design of the clarifier in the following features:—

(1) floc seeding technique,

(2) dual temperature concept,

(3) melt liquor entry into the appropriate "feed layer", and

(4) cylindrical construction of the clarifier with two or more superimposed cells.

These features provide for better clarification efficiency, greater operational control, many-fold increase in throughput per unit of floor area and much lower cost of construction.

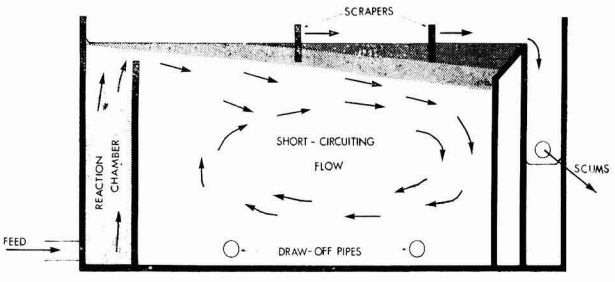

Fig. 1. Conventional clarifier flow pattern

Investigation of the flotation process

Problems associated with the flotation process first became evident in 1956, when the Millaquin Refinery installed a conventional flotation unit which, after considerable effort, failed to attain satisfactory performance and was abandoned. A series of investigations were carried out over the next three years on a laboratory scale and covered the physico-chemical phenomena related to aeration, floc formation, flotation rates and design criteria. This led to the concepts of floc seeding, dual temperature and multicell features. A part of the conventional clarifier was salvaged, new tanks and equipment were added in order to incorporate these concepts and the multicell process, in an improvised form, was put into operation in September 1959. The findings from these investigations were recorded in a thesis in1962[1]. A summary of this thesis was published in 1966[2].

The process with improvised multicell equipment operated fairly well right from the start, but additional improvements were progressively made and this brought about technological and economic advances in performance. As the equipment consisted of a conglomeration of salvaged parts and other items which had been gradually devised and added, wear took place at a rapid rate and this led to its being discarded in November 1967, and a new multicell clarifier[3], incorporating a cylindrical design, was installed. The design of this clarifier was developed by experiments over the years, first on a bench scale and subsequently on a pilot plant scale. The developmental experiments are described below.

Experiments with bench-scale cylindrical clarifier

The rectangular vessel design of conventional clarifiers has a number of disadvantages such as high floor area per unit of throughput, short-circuiting in flow patterns and inevitable mixing of feed with scums. These points were established by investigation of flow patterns in the rectangular clarifier cell. Fig. 1 shows the patterns of flow of the melter in such a flotation cell. It was noted that passage of the aerated and flocculated melt liquor over the weir separating the reaction and flotation chambers unavoidably results in mixing and redispersing of the floated-up scums. With increased flow rate, the redispersion and carry-over of the scums set the limiting capacity to the flotation cell. Dye and alkali "shot" tests have indicated short-circuiting in the pattern of flow along the paths shown in the sketch (Fig. 1). Operating characteristics and limiting rates for the rectangular cell clarifier are given in Table I.

[1] SARANIN: "A Flocculation-Flotation Process for Clarification of Sugar Refinery Melt using Phosphoric Acid and Lime." Thesis, University of Queensland, June 1962.

[2] *I.S.J.*, 1966, **68**, 37-39.

[3] UK Pat. No. 1,107,096; *I.S.J.*, 1969, **71**, 28.

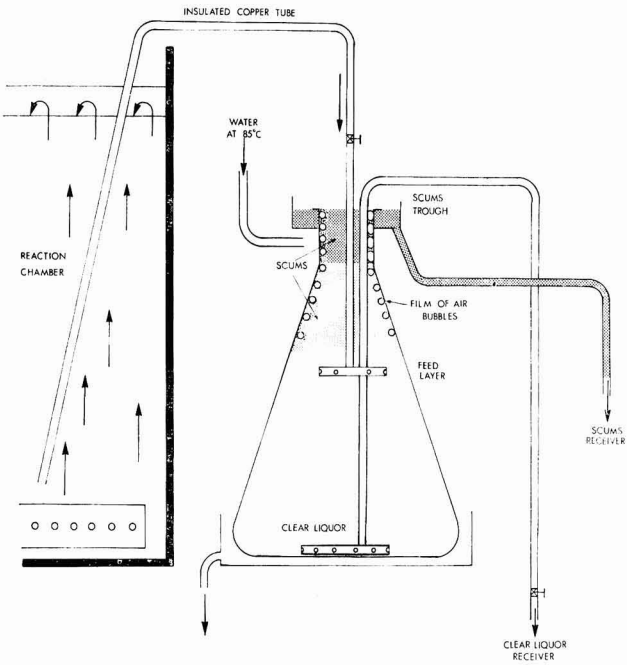

Fig. 2. Bench-scale cylindrical flotation clarifier

It had been felt that the shortcomings of the conventional clarifiers could be overcome by the use of cylindrical vessels and by a more rational arrangement of flow streams, with particular attention given to feed and draw-off streams for scums and "tailings". The design of such equipment required investigation to provide design criteria with respect to (i) scums "mobility", (ii) location of the "feed layer" and (iii) limiting rates for scums and tailings. To obtain these criteria a bench-scale "cylindrical" clarifier consisting of a 6·2 litre Erlenmeyer flask, fitted with scum overflow trough and adjustable level feed and draw-off rings, was set up as shown in Fig. 2. This was installed to run in parallel with a conventional flotation cell, with a feed of aerated and flocculated melt liquor drawn from a common reaction chamber. The variables investigated in these experiments were:

1. Rates of flow per unit of area and volume.

2. Efficiency of clarification in the respective cells.

3. The optimum feed level in the experimental cell.

4. Mobility of scums through a narrow channel and varying degree of slope of the scum channel.

The experiments revealed the following interesting and encouraging information with regard to the above variables:

1. Rates of flow were found to be significantly higher in the cylindrical cell as compared with the conventional type cell, as shown in Table I in terms of limiting rates.

2. The same applies to efficiency of clarification.

3. The feed level position relative to the depth of the cell has a significant effect on the throughput, and the optimum position depends on the proportion of air in the feed, the feed rate and the required thickness of the scums. By judicious choice of the feed level it was found possible to absorb the kinetic energy of the feed without disturbing the scums and, at the same time, provide an effective isolation of the scums from the clarified melt liquor.

4. The scums showed an excellent rising "mobility" along sloping and narrow channels, even when the Erlenmeyer flask was tilted to provide a 45°

Table I. Comparative technical data on the conventional cell, the bench-scale cylindrical and the pilot-scale multicell clarifiers

Technical data	*Conventional cell*	*Bench-scale cylindrical clarifier*	*Pilot Multicell Clarifier*	
			Two cells in parallel run	*Two cells in series run*
App. Limiting Feed Rate*, cu.ft./sq.ft. of flotation area/hr	9·6	13·6	12·7	16·6 (per floor area)
App. Limiting Feed Rate, cu.ft./cu.ft./hr	2·1	6·7	6·4	4·2
Theoretical Detention Time, $t = \frac{A \times h}{g}$, min.	28	9	9·5	14
Detention Efficiency, %†	39	55	57	71
Tailings Velocity at Limiting Rate, $V = \frac{A}{g}$, ft/min	9·5	13·5	12·5	16·5
Scums volume % feed, V/V	5·5 – 6·0	4·5 – 5·5	5·0	5·0
Turbidities (Adsorbance × 100, 800 nm)	10·0 See Fig. 4.	8·5	See Fig. 4.	

* Feed rate beyond which clarification ceases to be complete and carry-over of floc occurs
† Actual detention time % theoretical
A = Projected area of the cell at feed level, sq.ft.
h = Height of the cell, ft
g = Total feed, cu.ft./min
t = Time, min

slope. It was observed that the larger sized air bubbles rose first to the ceiling surface and provided at all times a "lubricating film" at the intersurface for free movement of the scums. It was thus established that the movement of consolidated scums along converging and narrow channels is not the problem it was thought to be in the past.

Following these encouraging results a pilot plant was set up.

Experiments with pilot multicell clarifier

The pilot clarifier consisted of two superimposed cells with overall dimensions of 1 ft 6 in. diameter by 3 ft high. Fig. 3 shows the arrangement of the cells, of the feed and draw-off rings and of the scum channels.

In these tests the performance of the pilot plant was again compared with that of a rectangular flotation cell of conventional design. The two flotation units were fed from a common reaction chamber with aerated and flocculated sugar melt liquor of 63°Bx at 185°F.

Having two cells in the pilot unit it was possible to run them (1) in parallel and (2) in series. In the latter case the feed was introduced into the bottom cell and the clear tailings from this were heated to 205°F and fed to the top cell for secondary flotation and de-aeration. Run in parallel, the flotation area of the clarifier was double the floor area; run in series, the flotation area was equal to the floor area.

The variables which were measured were the feed rates, scum volume % feed and turbidities of the clarified melt liquors.

The rates and scum volumes are given in Table I, whereas turbidity trends at different feed rates are plotted in Fig. 4.

The main points in comparative performance were as follows:

At the same feed rates, expressed in cu.ft./sq.ft. of flotation area/hr, the pilot clarifier produced liquor of significantly better quality in terms of turbidity measured at 800 nm with a "Spectronic-20" instrument, than did the conventional unit, as is evident from Fig. 4. At the same level of clarification, expressed in terms of turbidity, the pilot clarifier of a comparable height had at least 30% greater capacity than the conventional cell.

When the two cells were run in series the pilot clarifier capacity in terms of floor area was of the order of 1·7 times that of the conventional cell.

Generally, the findings from the pilot plant experiments showed the advantages to be derived from the new design and also provided the necessary design criteria for the construction of a full-scale clarifier unit.

Description of multicell flotation clarifier

The first commercial size multicell flotation clarifier was installed at the Millaquin Refinery in November 1967. The current melting rate is 180 tons of raws per day with projected capacity of 220 tons/day. It had been designed with a view to the integration of all the features of the multicell process into one unified system to optimize (i) clarification effect, (ii) costs of labour and materials and (iii) level of chemical inversion.

Fig. 5 gives the design of the clarifier. The overall dimensions of the cylindrical portion are 7 ft diameter × 9 ft high. It has three cells and a reaction chamber under the bottom cell. Each cell has an independent arrangement for feed and draw-off pipes for clarified melt liquor and scums, as well as scum paddles. The feed and withdrawal pipes are arranged to operate the top and middle cells in parallel and the bottom cell in series with these. The clarifier is constructed of mild steel plate

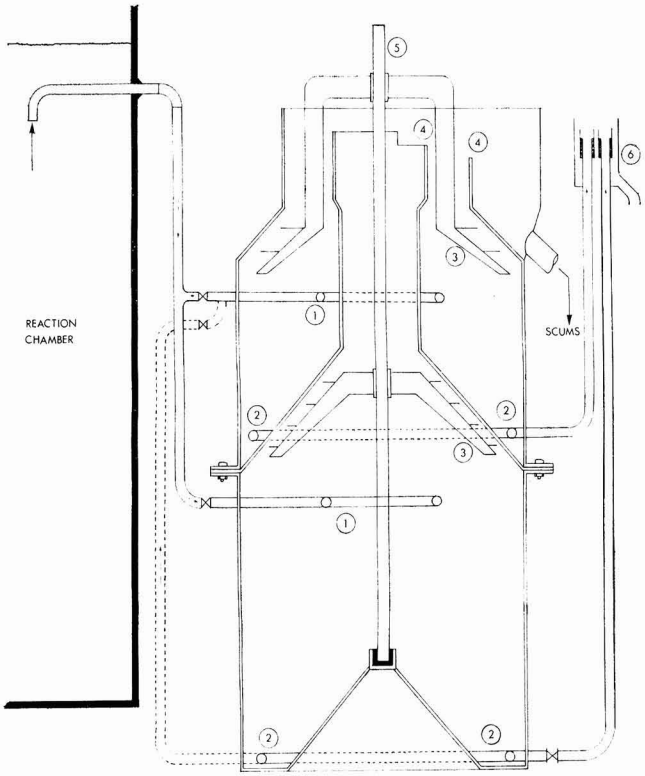

Fig. 3. Pilot-scale multicell flotation cl[illegible] feed ring; 2—draw-off rings; 3—[illegible]er arms; [illegible]erflow weirs; 5—[illegible]ntral shaft carr[illegible] scraper[illegible]

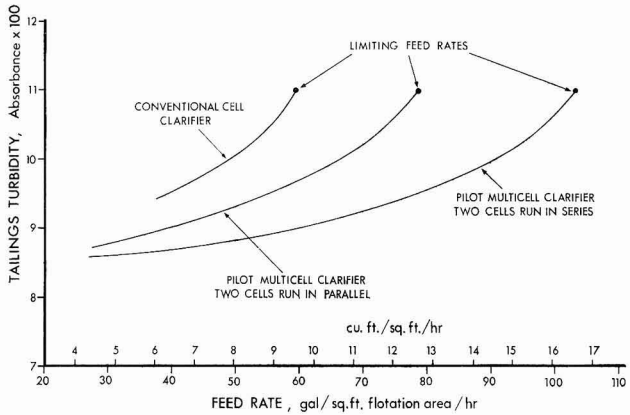

Fig. 4. Trends in turbidities of tailings with increase in feed rates and also limiting feed rates for the conventional cell and the pilot multicell clarifiers

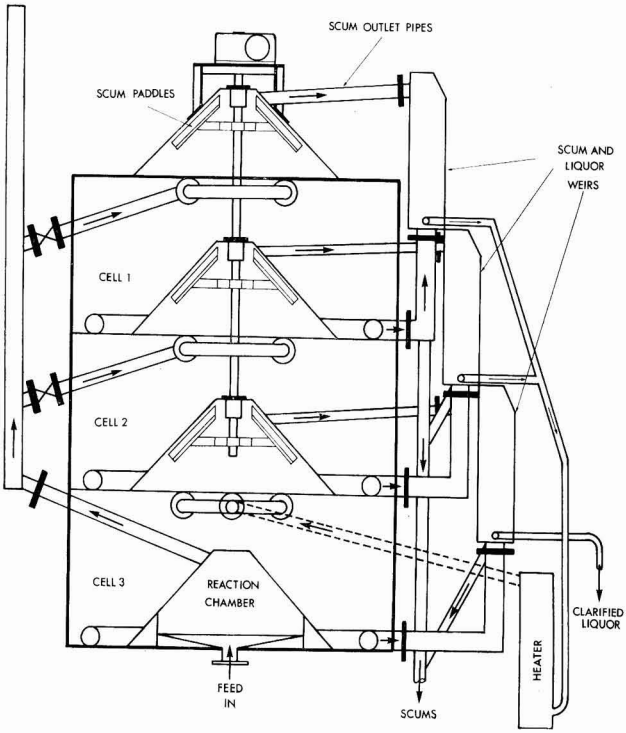

Fig. 5.

The auxiliary equipment to the clarifier is as follows: rotary screen, centrifugal process pump, in-line blender, pressure retention tank, tubular heater and instruments for control of temperature, pH, pressure and rate of air intake.

Multicell flotation clarifier process

Fig. 6 shows a diagrammatic arrangement of the process in its final form as it is now operating at the Millaquin Refinery.

The melt liquor, at 63°Bx and 185°F, after passing through the screen, enters the process pump. Phosphoric acid is added at the suction side of the pump and process air also is added at this point. The liquor is delivered to the pressure retention tank at 75 p.s.i.g. Lime saccharate and floc are introduced between the pressure tank and the in-line blender. The aerated and flocculated liquid then enters the reaction chamber from which it is fed to the top and middle flotation cells.

The clarified liquor drawn off from these two cells passes through the external tubular heater, where it is preheated to 203°F, and enters the bottom cell. The clarified and de-aerated liquor drawn off from the bottom cell is sent to the char house without further treatment.

The scums drawn off from the two flotation cells and the de-aeration cell are collected in a common de-aerating tank and its sugar content recovered by pressure filtration. The filtrate from this is combined with the clarified melt liquor.

The multicell flotation clarifier process, as developed over a period of nine years of operation to its present final form, has brought about the desired technological and economic advantages. The main objective of the project was improvement of the sugar produced and this has been achieved. Prior to 1959 the clarification of melt liquor was effected by pressure filtration which gave poor clarification, high consumption of char and refined sugar of unacceptable quality. The phosphatation/flotation process described here has improved the clarification efficiency, thus leading to reduction in char consumption, and at the same time brought the refined sugar to a desirable quality level. Comparative performance of the two processes is as shown below.

In addition to this quality improvement, significant economic advantages have accrued. These are: reductions

	Pressure filtration	*Multicell clarifier*
Colloids removal % colloids in melt liquor	16	40
Colour removal % colour in melt liquor	12	45
Combined colour removal by clarification and char % colour in melt liquor	71	97
White sugar colour (at 60°Bx)	5·0–6·0	0–1·1
Comparative char consumption	100	60
Char reduction %	-	40

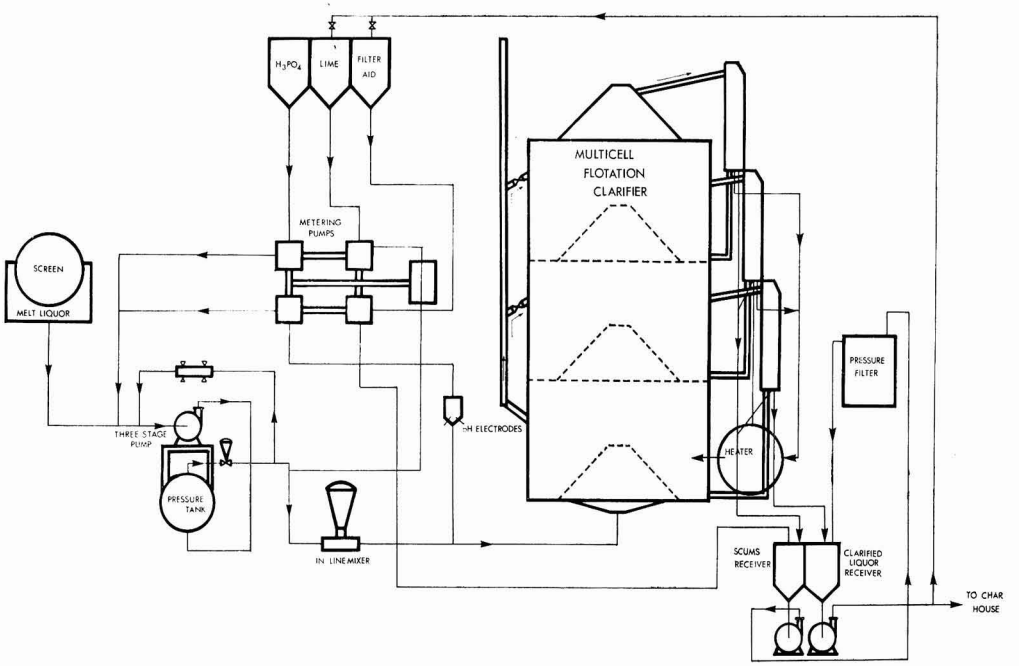

Fig. 6. Diagramatic arrangement of multicell flotation clarifier process

in labour, in new char and in char revivification costs and savings in maintenance owing to retirement of a char kiln, cisterns and of an evaporator station. A considerable reduction in kieselguhr consumption has also resulted.

Constructional and operating advantages of the new clarifier design are considerable. These include:

1. Economy of construction of a cylindrical vessel compared with that of a rectangular tank.

2. Saving in floor area owing to superimposing of cells.

3. Ability to arrange feed into an appropriate density layer, thus isolating the scum from the clarified liquor.

4. Incorporation of a de-aeration cell in the clarifier permits clarified liquor to be delivered directly to char cisterns without further treatment.

The new design overcomes the main shortcomings of the phosphatation/flotation process in that it effects a considerable reduction in the floor area required. The relative capacities of the conventional and of the new clarifiers, as assessed from published literature and experience, are shown below.

	Capacities, cu.ft./hr		
Type of clarifier	*Per sq.ft. floor area*	*Per cu.ft. clarifier volume*	*Per unit*
Williamson	1·6	1·1	112
Jacobs	1·6	1·6	160
"Colloidair" (M.50)	7·2	1·4	240
Multicell (7 ft dia. × 9 ft) (Three Cells)	16	2·1	590

Estimated capacities of other sizes of multicell clarifiers are as follows:—

Dimensions	*No. of Cells*	*Capacity cu.ft./hr*
4 ft dia. × 8 ft	3	200
6 ft dia. × 8 ft	3	450
8 ft dia. × 9 ft	3	800
10 ft dia. × 9 ft	3	1280
10 ft dia. × 12 ft	4	1750
12 ft dia. × 13 ft	4	2400
14 ft dia. × 15 ft	4	3200

Acknowledgments

Thanks are expressed to the Board of Directors of the Millaquin Sugar Company Limited, for permission to publish this paper and to Mr. E. W. DUUS, Mr. S. A. WOODALL and Mr. C. J. ALLEN for their continued encouragement and assistance during the course of the project, also to the Chemical and Engineering Staff of the Millaquin Refinery for the co-operation and assistance which has been extended to me.

Juice colour during concentration in evaporators

by H. ZAORSKA and S. ZAGRODZKI (Dept. of Sugar and Food Technology, Lodz Technical University, Poland)

Paper presented to the 19th Technical Conference, British Sugar Corporation Ltd., 1968

IT has long been known that purified juice darkens during evaporation. In some sugar factories the increase in colour does not exceed 50% while in others it is more than doubled[1]. This depends upon the thin juice quality and its correct purification, i.e. the removal of all harmful non-sugars from the juice. Colour increase in sugar solutions is caused largely by the presence of reducing non-sugars[2] and mainly by invert sugar which forms condensation products with amino-acids[3,4,5]. These products, when heated, polymerize and form colour substances with high extinction coefficients[6]. Juice discoloration is also related to the hydrogen ion concentration in the thick juice; too low a pH can cause inversion of the sucrose while, on the other hand, too high an alkalinity is the cause of the rapid decomposition of traces of glucose[7] and fructose. Fructose is particularly sensitive to higher temperatures[8] in alkaline solutions. The increase in juice colour owing to the presence of melanoidin and Maillard compounds[9] is also dependent upon the temperature and alkalinity of the solution. Maintaining the juice temperature above 110°C results in the decomposition of the sucrose and in the formation of coloured caramel-like compounds[10].

The problem is simplified by assuming that all reactions which produce an increase in juice colour are related to temperature, to the duration of the process and to juice concentration in the individual evaporator effects. It is therefore desirable to prevent the formation of colour in juices undergoing evaporation[11].

The majority of tests in connexion with the problems discussed have been carried out with synthetic solutions[12–16]. Since very few measurements had been made during the campaign in the factory itself, it seemed appropriate to investigate some causes of colour increase under normal processing conditions. These investigations were concerned with the influence of temperatures and juice retention times in the various evaporator effects and with the juice levels in the tubes of the individual bodies. The latter factor had not been considered in previous investigations. In order to exclude the possibility of inferior quality juices being used, the factory investigations were carried out at the beginning of the campaign.

EXPERIMENTAL

The investigations were carried out during the first fortnight in October in a factory extracting raw juice by DDS diffusion, followed by conventional juice purification, i.e. cold progressive preliming, hot main liming and 1st and 2nd carbonatation without sulphitation. The juice was concentrated in a Robert-type quadruple evaporator.

The average results obtained from the juice analyses during the investigations were as follows:—

	Brix	*Pol*	*Purity*	*pH*
Raw Juice	14·8	13·3	89·85	6·2
Purified Thin Juice	12·9	12·05	93·4	9·1

As the investigations were of only one day's duration, it was not necessary to take into account any variations in the quality of the raw material. The individual readings were taken at 30-minute intervals. Juice levels and temperatures were measured in each evaporator effect immediately above the heating surface. Samples were taken continuously from the outlet of each body over 30-minute periods. The juice samples were passed through special coolers and could thus be collected at a temperature of 25°C in closed receivers. The refractometric dry substance was determined and, after filtration, the specific extinction was measured with monochromatic light at a wavelength of 560 nm, using the "Spekol" spectrocolorimeter of VEB Carl Zeiss Jena. The juice colour was expressed as specific extinction related to Brix.

The flow rate of juice entering the evaporators varied between 76 cu.m./hour and 110 cu.m./hour and this influenced the results to some extent. The thin juice concentration varied between 12·0° and 13·5°Brix. Evaporator juice levels were kept normal over a long period. During the final experimental period the juice levels were deliberately maintained at higher levels.

Table I shows the analytical data obtained in chronological order.

These figures clearly indicate that the juice colour was related to the levels in the individual bodies. Unfortunately the juice levels fluctuated slightly during the investigations and the temperatures were not absolutely constant.

Table II shows the relationships between the juice level in each body and the juice colour. For this, the calculated average colour from all 20 readings was compared with the colour obtained when the juices were at their lowest and highest levels. The last column in Table II shows the total colour increase (%) for the entire evaporator station. When

[1] SMOLENSKI: *Gaz. Cukr.*, 1931, **39**, 121.
[2] CARRUTHERS *et al.: Proc. 13th Meeting C.I.T.S.*, 1963, 210.
[3] PREY *et al.: ibid.*, 88.
[4] *idem., Zeitsch. Zuckerind.*, 1966, **91**, 457.
[5] PREY: *Zucker*, 1967, **20**, 272.
[6] PIECK: *Proc. 13th Meeting C.I.T.S.*, 1963, 40.
[7] DUBOURG and LEMAITRE: *ibid.*, 109.
[8] CARRUTHERS *et al.: Paper presented to 15th Tech. Conf. British Sugar Corp. Ltd.*, 1962; *I.S.J.*, 1962, **64**, 343.
[9] DUBOURG and DEVILLERS: *Ind. Alim. Agric.*, 1962, **79**, 625.
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[11] SZAREJKO *et al.: Roczn. Tech. Chem. Zywn.*, 1957, **2**, 101.
[12] ZAGRODZKI and LISKA: Unpublished work.
[13] KOLESNIKOV: *Sakhar. Prom.*, 1966, **40**, (11), 25.
[14] VAISMAN *et al.: ibid.*, 1968, **42**, (1), 15.
[15] *idem ibid.*, 1967, **41**, (4), 28.
[16] TOBILEVICH *et al.: ibid.*, (3), 12.

Table I. Summary of data

Time	Thin Juice			Juice from 1st effect				Juice from 2nd effect			
	Brix	Specific extinction (560 nm)	Juice flow rate, cu.m./hr	Juice temp., °C	Juice level, cm	Brix	Specific extinction (560 nm)	Juice temp., °C	Juice level, cm	Brix	Specific extinction (560 nm)
0800	—	—	—	128·2	120	—	—	117·8	125	—	—
0830	12·5	0·227	—	129·0	115	19·1	0·250	118·5	125	32·9	0·293
0900	12·5	0·182	106	127·5	120	19·1	0·226	117·2	100	34·5	0·254
0930	12·5	0·167	—	127·0	125	18·4	0·225	116·5	110	32·55	0·298
1000	12·5	0·227	107	126·2	125	18·9	0·214	116·1	125	33·0	0·266
1030	12·7	0·171	—	129·5	125	19·1	0·230	119·1	125	32·8	0·260
1100	12·55	0·181	107	128·0	120	19·0	0·241	117·4	125	39·7	0·227
1130	12·65	0·187	—	129·5	120	19·7	0·236	119·4	125	34·35	0·283
1200	12·9	0·169	108	128·2	120	18·4	0·245	118·1	125	32·2	0·278
1230	12·9	0·169	—	129·2	140	18·2	0·228	119·0	145	29·7	0·260
1300	13·35	0·168	110	126·0	120	19·15	0·220	115·0	120	28·35	0·261
1330	13·0	0·167	—	125·5	130	18·7	0·226	114·2	130	27·7	0·253
1400	13·0	0·167	110	125·0	120	18·9	0·214	116·0	120	28·0	0·250
1430	13·05	0·159	—	128·8	140	20·1	0·230	118·2	145	37·2	0·265
1500	13·05	0·141	110	127·5	140	20·05	0·234	116·4	145	36·7	0·294
1630	—	—	—	128·2	135	—	—	117·8	150	—	—
1700	12·8	0·148	77	129·5	125	18·7	0·266	119·2	180	32·0	0·406
1730	12·5	0·152	—	129·2	120	18·0	0·276	119·1	165	30·2	0·429
1800	12·5	0·158	76	130·5	115	18·5	0·234	120·2	170	29·0	0·398
1830	12·3	0·170	—	129·0	200	20·1	0·263	118·0	180	32·8	0·363
1900	12·3	0·172	76	128·2	200	20·1	0·262	117·6	200	32·8	0·364
1930	12·0	0·174	—	130·5	190	19·4	0·254	120·4	180	36·5	0·347

Time	Juice from 3rd effect				Juice from 4th effect		
	Juice temp., °C	Juice level, cm	Brix	Specific extinction (560 nm)	Juice temp., °C	Juice level, cm	Brix
0800	109·6	130	—	—	98·5	90	—
0830	110·5	120	43·65	0·325	99·0	85	57·8
0900	109·5	120	46·8	0·292	97·7	85	60·2
0930	108·5	120	46·2	0·319	97·5	85	59·2
1000	107·7	120	44·1	0·265	97·1	90	56·8
1030	109·7	120	44·45	0·268	98·5	85	57·0
1100	110·0	120	44·7	0·270	98·6	95	64·0
1130	112·5	120	44·0	0·287	100·5	95	62·0
1200	109·7	120	44·6	0·288	100·7	80	59·8
1230	111·5	150	40·9	0·298	100·5	100	55·6
1300	106·0	120	37·5	0·271	94·0	100	50·9
1330	105·5	135	36·6	0·258	94·0	140	50·0
1400	106·0	120	41·8	0·263	94·0	85	57·0
1430	108·0	145	50·3	0·284	97·2	130	67·4
1500	108·5	160	51·7	0·310	96·5	130	68·6
1630	109·6	170	—	—	97·5	140	—
1700	111·0	180	49·8	0·440	97·5	160	62·7
1730	109·5	200	41·8	0·456	97·5	180	56·1
1800	112·0	190	37·4	0·478	96·5	180	50·7
1830	111·0	200	38·4	0·453	97·0	180	51·4
1900	110·5	200	38·4	0·452	97·5	180	51·4
1930	112·0	200	41·1	0·447	99·2	180	52·3

evaporator juice levels were at their lowest, the juice supply rate to the station was fastest (110 cu.m./hour). When, on the other hand, juice levels were highest the supply rate was comparatively slow (76 cu.m./hour). The average increase in the specific extinction during evaporation was from 0·172 for thin juice to 0·352 for thick juice, i.e. from 100% to 204%. At the lowest juice levels the increase was from 0·167 to 0·268, i.e. from 100% to 160%. At the highest levels the increase was from 0·172 to 0·514, i.e. from 100% to 299%.

Fig. 1 shows the increase in colour during evaporation. The individual curves correspond to the different [illegible] in the evaporators. Looking at Curve a (overall averages) and more especially at Curve b (lowest levels), it is seen that the main increase in colour takes place in the first evaporator bodies. However, a considerable increase in colour is also observed at high juice levels (Curve c) and the rate of this increase is almost constant.

Here it must again be pointed out that the influence of the juice levels in the individual bodies and the supply rate to the evaporators is cumulative. Taking juice retention time at lowest levels and fastest supply as 100%, retention time at highest levels and slowest supply was calculated to be 185%.

The increase in colour at high juice levels is not only due to the longer retention time in the evaporators

Table II. Comparison: Colour increase during juice concentration in evaporator

	Thin Juice	*Juice from 1st Effect*		*Juice from 2nd Effect*		*Juice from 3rd Effect*		*Juice from 4th Effect*		*Total Colour Increase* %
Averages of 20 analyses										
Specific extinction (560 nm)	0·172	0·238		0·304		0·342		0·352		104
Colour increase in each effect, %			38		28		12		3	—
With lowest juice levels and shortest retention time in evaporators at 1400 hr										
Specific extinction (560 nm)	0·167	0·214		0·250		0·263		0·268		60
Colour increase in each effect, %			28		17		5		2	—
With highest juice levels and 85% longer juice retention time at 1900 hr										
Specific extinction (560 nm)	0·172	0·262		0·364		0·452		0·514		199
Colour increase in each effect, %			53		35		24		14	—

but also to the increased boiling temperature in the lower portion of the tubes where the hydrostatic pressure is higher and is responsible for an additional average increase of about 1°C.

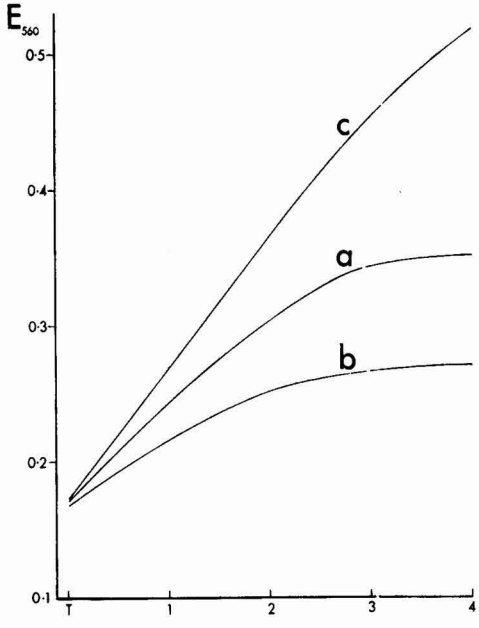

Fig. 1: Increase in juice colour (E_{560}= specific extinction at 560 nm) during concentration in individual effects. Key: T = Thin juice, 1 = juice from 1st effect, 2 = juice from 2nd effect, 3 = juice from 3rd effect, 4 = juice from 4th effect. (a) Averaged results of 20 analyses, (b) at lowest juice levels in bodies, (c) at highest juice levels in bodies.

In Table III are summarized mean temperatures taken at lower and upper tube positions and mean boiling temperatures for each body. Apart from longer retention time and higher boiling temperatures affecting the colour increase at high juice levels, poor juice circulation is also a contributory factor, particularly in the end bodies. Owing to the higher juice level the circulation velocity through the tubes is reduced, resulting in overheating of the thin juice layer in immediate contact with the tube surfaces. This was the reason for the more marked colour increase from 5% to 24% in the 3rd body and from 2% to 14% in the 4th body. The colour increase in the individual effects of the evaporator station, expressed as a percentage, is shown in Table II.

Further investigations on the influence of higher juice levels in evaporators on the colour increase were made by light extinction measurements using wavelengths ranging from 420 nm to 720 nm.

Juice samples were taken from individual bodies in two separate experimental series: i.e. at highest and lowest juice levels. The test results are summarized in Tables IV and V. These show that the greatest colour increase observed with monochromatic light was in the wavelength range of 470 nm to 600 nm. The results have also been plotted on a semi-log scale in Figs. 2 and 3.

Discussion of Results

The results given indicate the high degree of dependance of the thick juice colour on the maintenance of correct juice levels in the evaporators.

It is common knowledge that excessively high temperatures in the 1st and 2nd effects influence the colour of the juice unfavourably. For this reason the heating surface of the first effect is frequently increased in order to reduce the boiling temperature. This increase in heating surface in the evaporators does, however, mean a longer retention time with an accompanying increase in the total juice colour.

With higher juice levels the juice temperature in the lower portion of the tubes is slightly higher owing to the additional hydrostatic pressure, resulting in an increase in colour. At the same time, the useful temperature drop is the governing factor affecting the rate of heat transfer at the evaporator heating surface; this will be decreased by an amount equal to the higher juice levels. The heat transfer coefficient K is dependent on this.

After consideration of all the relevant factors it is not difficult to prove that the correct maintenance of

Table III. Theoretical calculation of effect of juice level in each body on additional B.P.E. owing to change in hydrostatic pressure

	Effect No. I	II	III	IV
Mean juice temperature at heating surface in each body, °C.....	128·2	117·8	109·6	97·6
Correct juice level in each body, cm.....	65	100	145	155
B.P.E. of juice in lower portion of calandria, attributable to hydrostatic pressure, °C	0·9	1·9	3·4	5·6
Mean additional B.P.E. attributable to hydrostatic pressure, °C	0·2	1·5	2·5	3·9
Mean juice temperature in each body, °C	128·4	119·3	112·1	101·5
Lowest juice level in each body, cm.	120	120	120	85
B.P.E. of juice in lower portion of calandria, attributable to hydrostatic pressure, °C	1·6	2·3	2·8	3·2
Mean additional B.P.E. attributable to hydrostatic pressure, °C	0·4	1·7	2·1	2·5
Actual mean juice temperature in each body, °C	128·6	119·5	111·7	100·1
Highest juice level in each body, cm	200	200	200	180
B.P.E. of juice in lower portion of calandria attributable to hydrostatic pressure, °C	2·6	3·9	4·7	6·5
Mean additional B.P.E. attributable to hydrostatic pressure, °C	0·8	2·7	3·3	4·4
Actual mean juice temperature in each body, °C	129·0	120·5	112·9	102·0
Difference between B.P.E. for lowest and highest juice levels in each body, °C	0·4	1·0	1·2	1·9

Table IV. Variations of specific extinction with low juice levels in evaporators, at 1300 hours

Light wavelength, nm	*Thin juice* 13·35°*Bx*	*Juice from 1st body Level 120 cm Temp. 126°C* 19·15°*Bx*	*Juice from 2nd body Level 120 cm Temp. 115°C* 28·35°*Bx*	*Juice from 3rd body Level 120 cm Temp. 106°C* 37·5°*Bx*	*Juice from 4th body Level 120 cm Temp. 94°C* 50·9°*Bx*	*Total colour increase* %
			Specific Extinction			
420	1·490	1·840	2·090	2·190	2·240	50
470	0·596	0·800	0·953	1·008	1·028	72
520	0·294	0·392	0·464	0·485	0·496	69
560	0·168	0·220	0·261	0·271	0·277	65
620	0·095	0·122	0·141	0·147	0·150	58
670	0·055	0·069	0·0794	0·0825	0·0842	53
720	0·039	0·045	0·0510	0·0527	0·0533	36

Table V. Variations of specfic extinction with high juice levels in evaporators, at 1830 hours

Light wavelength, nm	*Thin Juice* 12·3°*Bx*	*Juice from 1st body Level 200 cm Temp. 129°C* 20·1°*Bx*	*Juice from 2nd body Level 180 cm Temp. 118°C* 32·8°*Bx*	*Juice from 3rd body Level 200 cm Temp. 111°C* 38·4°*Bx*	*Juice from 4th body Level 180 cm Temp. 97°C* 51·4°*Bx*	*Total colour increase* %
			Specific Extinction			
420	1·590	2·200	2·720	3·130	3·370	113
470	0·610	0·950	1·330	1·690	1·850	203
520	0·304	0·479	0·679	0·875	0·984	223
560	0·170	0·263	0·363	0·453	0·511	201
620	0·094	0·140	0·186	0·221	0·242	158
670	0·054	0·074	0·094	0·108	0·118	118
720	0·038	0·047	0·055	0·061	0·065	71

low juice levels in the evaporators has a great influence on the efficient functioning of the evaporator station. Owing to this fact it is even possible to obtain satisfactory results with a smaller heating surface.

As a result of the general endeavour to produce the highest quality white sugar, the sugar factory strives to keep the thick juice colour at a minimum as the colour of the white sugar will largely depend upon

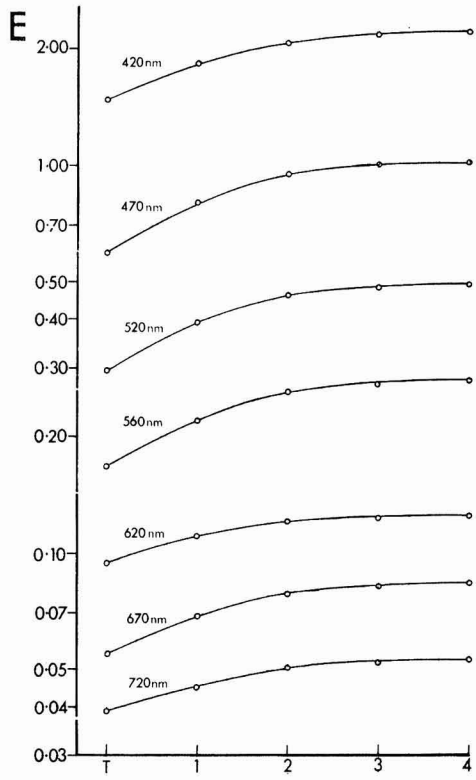

Fig. 2. Changes of specific extinction (E) at low juice levels in evaporators (1300 hours). Key: T = Thin juice, 1 = Juice leaving the 1st effect, 2 = Juice leaving the 2nd effect, 3 = Juice leaving the 3rd effect, 4 = Juice leaving the 4th effect.

this[17-21]. By maintaining low levels at the evaporator station it is possible to produce light thick juices—of only about half the colour—and consequently considerably whiter sugar.

The results of the test have shown that the final colour of the thick juice is determined to a much greater degree by the low juice levels in the 1st and 2nd effects than by those in the later effects. For practical purposes, however, it must be assumed that the juice levels have to be kept low in all bodies.

The viscosity of the juice increases with progressive concentration through the various effects. The negative influence of this phenomenon is intensified by the gradually reducing temperature in the subsequent effects. It is therefore necessary to maintain higher juice levels in the final effects in order to ensure coverage of the entire heating surface.

As a rough practical rule it may be assumed that the level required for the complete coverage of the heating surfaces may be expressed as a percentage of of the tube length equal to the **Brix** value of the juice leaving the particular body, i.e. 19% for the first body, 33% for the second body, 45% for the third body and 60% for the fourth.

Conclusions

(1) The juice level in the evaporator bodies has a decisive influence on the colour increase of the juice.

(2) The maintenance of correct low juice levels in all effects of the evaporator station causes a colour increase within the limits of 50% to 60%.

(3) Excessively high juice levels in the individual bodies may cause a three-fold colour increase.

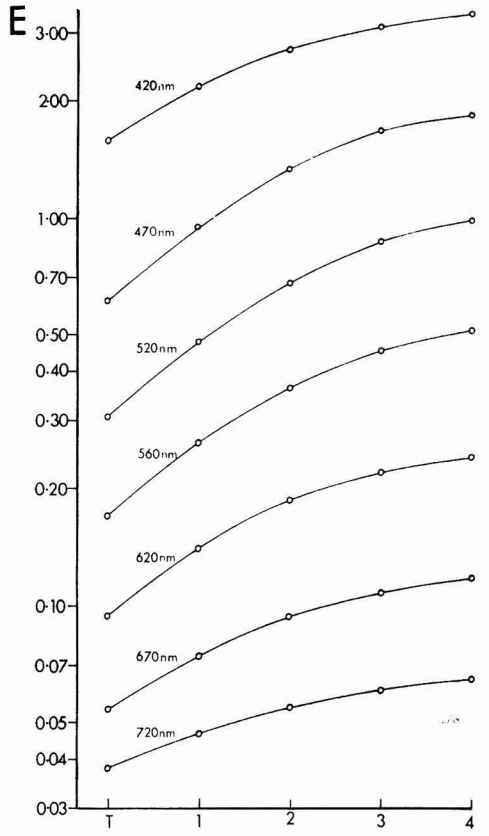

Fig. 3. Changes of specific extinction (E) at high juice levels in evaporators (1830 hrs). Key: T = Thin juice, 1 = Juice leaving 1st effect, 2 = Juice leaving 2nd effect, 3 = Juice leaving 3rd effect, 4 = Juice leaving 4th effect.

[17] Zagrodzki: *Gaz. Cukr.*, 1964, **72**, 87.
[18] *idem ibid.*, 1966, **73**, 1.
[19] Smolenski: *ibid.*, 1934, **42**, 57.
[20] Zaorska: *I.S.J.*, 1964, **66**, 260, 285.
[21] Uscati: *Ind. Alimentara*, 1966, **17**, 464; through *S.I.A.*, 1967, **29**, Abs. 587.

Forced circulation in sugar pans

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PART III

(10) *Observations on a model of a low-head vacuum pan*

A low-head, ribbon-element, pan is shown in Fig. 17. This pan has a downtake diameter of 82 inches so the model was built to a scale of 1/13·6 to suit the available 6-inch diameter impellers.

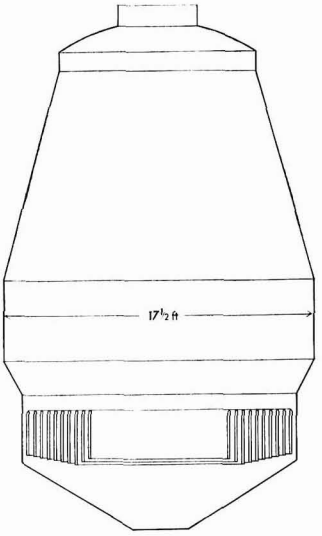

Fig. 17. Low-head ribbon pan

Variation of the number of blades of the axial-flow impeller and its position in the downtake gave results which are in accordance with the previous findings. A four-blade impeller in the intermediate position is the most efficient (Figs. 18 and 19).

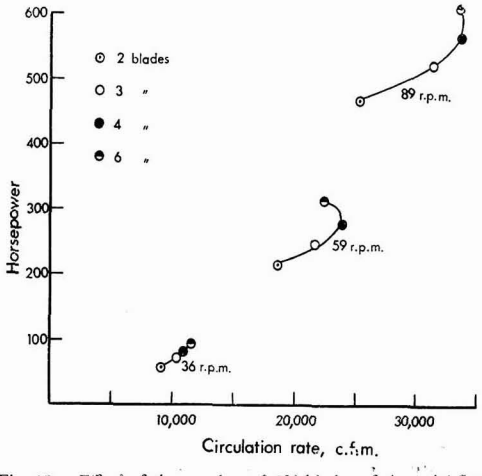

Fig. 18. Effect of the number of blades of the axial-flow impeller in the low-head pan

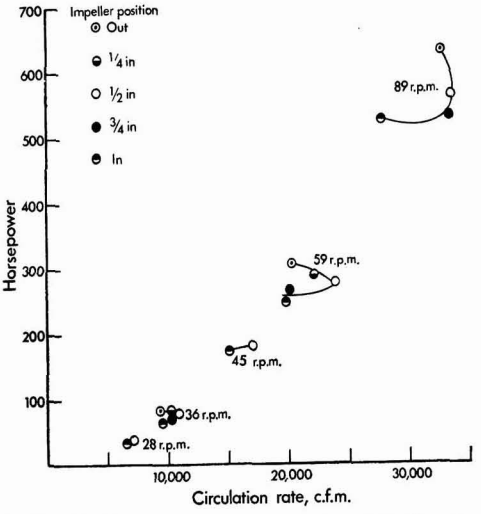

Fig. 19. Effect of position of the 4-bladed axial-flow impeller in the downtake of the low-head ribbon pan

Photographs of the circulation pattern at strike level show that in the region of increased diameter there is a zone of almost complete stagnation (Fig. 20a). This zone can be reduced by mounting an annular deflector plate above the outer ring and substantially eliminated by the addition of a second plate (Figs. 20b, 20c and 20d).

Experiments with Low Purity Massecuites

For the extension of this investigation to the low purity region, a ribbon-element recovery pan, the SR1 pan, and a calandria pan used for raw sugar production, the C pan, were taken as representative of their particular types (Figs. 21a and 21b).

The relevant effective viscosities were determined as described above and they are included in Table III.

(1) *The ribbon pan (SR1 pan)*

The scale of the model was 1/10. Fig. 22 shows the flow pattern at 170 poises. Flow is preponderantly through the outer ring spaces and the volume of substantially stagnant massecuite is fairly small.

Optimization studies on the impellers led to conclusions similar to those reached for lower viscosities.

1. The trimmed and "cleaned-up" mixed-flow impeller and the 4-blade, small-hub, axial-flow impeller have approximately equal performance. They are significantly better than the original axial-flow impeller and the truncated and trimmed mixed-flow impeller.
2. The best position for the modified axial-flow impeller is the intermediate position.

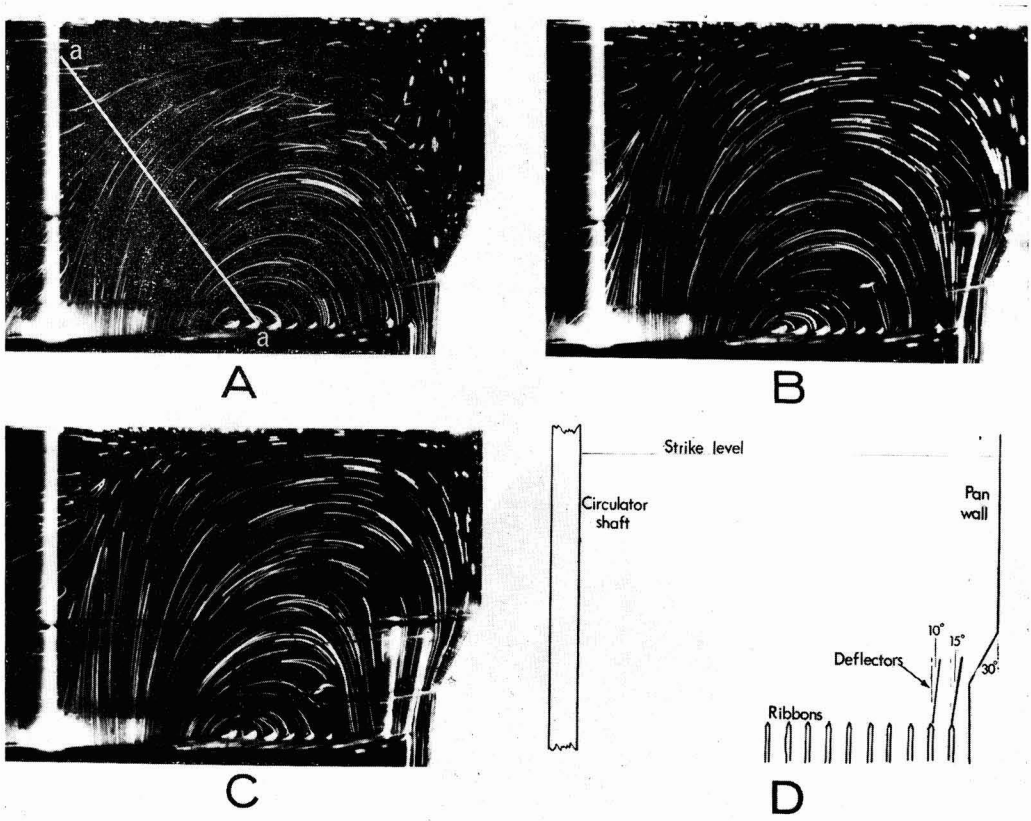

Fig. 20. (*a*) No deflector, (*b*) one deflector over outer ring, (*c*) two deflectors, (*d*) schematic indication of the position of deflectors

3. Three or four blades, each of 60° projected angle, are better than two or six blades for the modified axial-flow impeller.

An additional test made with this pan was a comparison between the 4×60°-blade axial-flow impeller and a 2×90°-blade impeller of otherwise similar specification. Both impellers have tip angles of inclination of 44° and 25½° at the roots and tips of the blades respectively. The 2 × 90° impeller was slightly superior.

(2) *The calandria pan* (*C pan*)

The scale of the model was 1/7·5.

Fig. 23 shows the flow pattern at 430 poises. The flux of material is very uniformly distributed across the tube plates on account of the high resistance of the calandria, and there is a large region near to the surface where the massecuite is almost stationary.

Only the axial-flow impeller was tested in this model. Measurements of impeller power and massecuite circulation rate were made according to an experimental scheme which constituted a full factorial design with the following values of the parameters

Equivalent full scale viscosity:	34, 136, 430, 1130 and 1540 poises
Number of blades on the impeller:	2, 3, 4
Equivalent full scale speed:	50, 75, 100 r.p.m.
Projected angle of the blades:	60°, 90°
Position of the impeller:	Intermediate

Additional measurements were made at each of the 15 viscosity-speed combinations, over a range of impeller positions, with the 4 × 60°- and the 2 ×90°-blade impellers.

Conclusions indicated by the observations are:

1. The 4-blade impellers are slightly superior to the 2- and 3-blade ones.
2. The 90° projected angle blades are better than the 60° blades, especially at the higher viscosities (Fig. 24).
3. Although the efficiency of an impeller under these conditions is much less sensitive to position in the downtake than is the case at lower viscosities, the effect of position was measurable and the intermediate position was found to be within the optimum range.

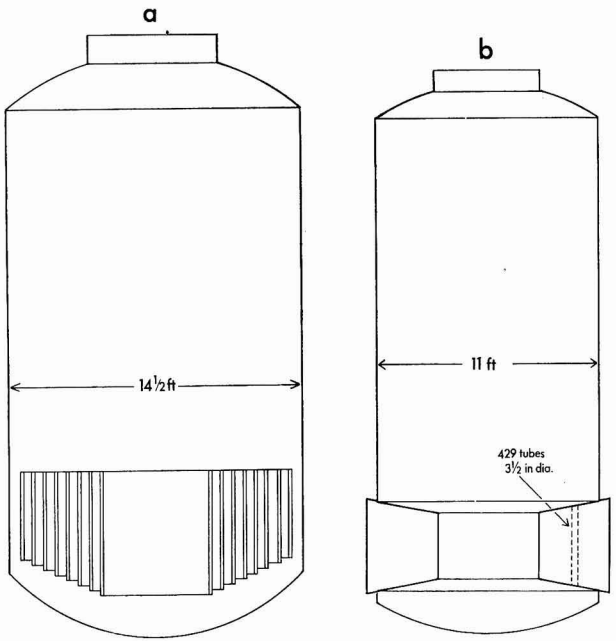

Fig. 21. (*a*) Recovery pan SR1, (*b*) Raw sugar pan for *C*-strikes

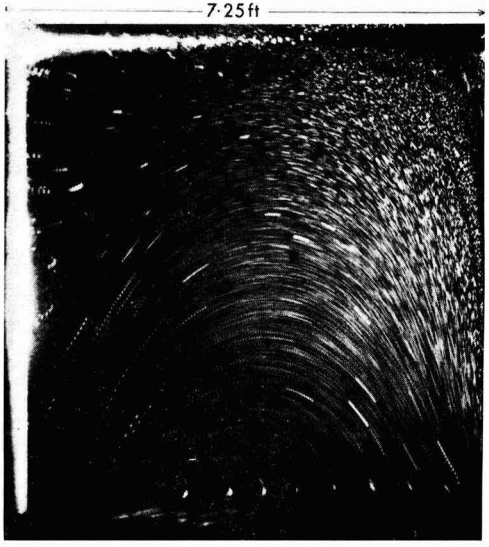

Fig. 22. Typical mechanical circulation flow pattern in SR1 pan

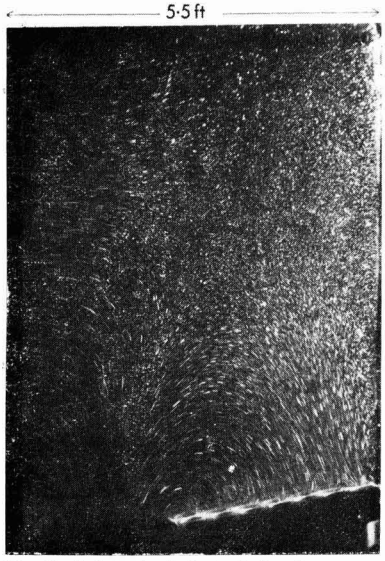

Fig. 23. Typical mechanical circulation flow pattern in *C* raw sugar pan

Discussion

Nicklin and Beale[8] defined impeller efficiency as

$$\frac{\text{(head generated)} \times \text{(volumetric flow rate)}}{\text{shaft horsepower}}$$

From their experiments with high-viscosity massecuite they concluded that the mixed-flow impeller (Fig. 3c) gives greater efficiency than the other two designs which they tested. This result is probably applicable only to calandria pans, in which the com-

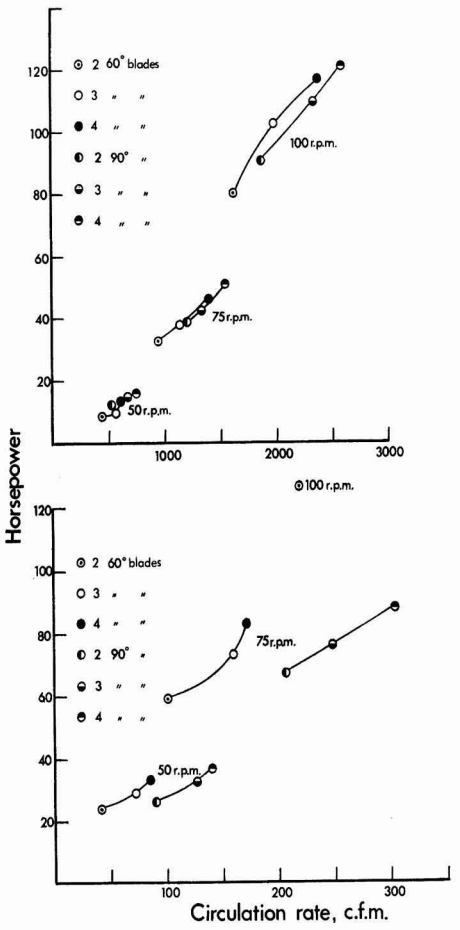

Fig. 24. Effect of the number and projected angles of blades of an axial-flow impeller in the *C*-strike raw sugar pan in massecuite of (above) 136 poises, (below) 1130 poises

paratively high resistance to circulation is equivalent to a substantial opposing head of fluid. In the present investigation, which has covered a fairly complete cross-section of impeller and pan design, we have found that differences of efficiency between impellers in high-resistance calandria pans tend to be rather small when the viscosity of the massecuite is high. However, under these conditions the $4\times90°$ impeller is the best, although a 90°-blade might be considered to be unduly large and there is the operational uncertainty of discharging a strike when the projected area of the blades completely fills the area of the downtake. This latter objection would not, of course, apply to a $2\times90°$ impeller.

In all other cases the modified axial-flow impeller, operating in the intermediate position, is at least as good as any of the other arrangements tested. For all high- and medium-purity pans we recommend this design in which four 60° blades are mounted on a hub, the diameter of which is $\frac{1}{3}$ of the overall diameter. For convenience the essential features of this impeller are shown in Fig. 25.

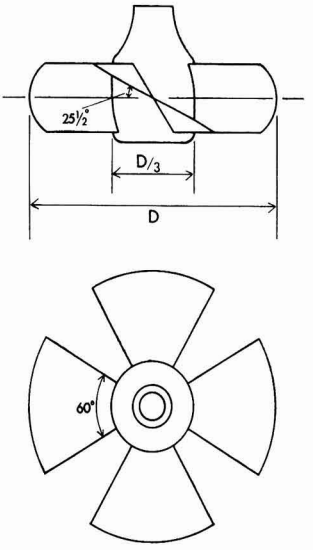

Fig. 25. Axial-flow impeller

Summary

In order to design vacuum pan impellers of high efficiency, experiments have been made on scaled-down models of stirred vacuum pans. The investigation covered a wide range of calandria and ribbon element pans, and observations were made at viscosities corresponding to massecuites of high and low purity.

The most efficient general purpose impeller is of the axial-flow type. A comparatively small boss carries four helicoidal blades, each of which covers an angle of 60° when projected on to a plane perpendicular to the shaft (Fig. 25). Its best position is at the bottom of the downtake, with the lower halves of the blades protruding below the downtake.

At high massecuite viscosities, particularly in calandria pans, which offer high resistance to circulation, differences of efficiency between impellers tend to disappear.

It is important to minimize the area of those parts of the rotating impeller surface which do not contribute to the useful thrust.

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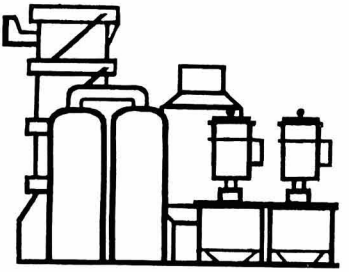

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Planning and construction of complete beet and cane sugar ... plants, ... for the pr... of alcohol, yeast, acetaldehyde, glacial acetic acid, acetone, gl... ...cos... stai...

Sugar cane agriculture

Diesel engine fuels. C. C. LIM and T. C. SOLIVEN. *Proc. 14th Conv. Philippines Sugar Tech.*, 1966, 82–92. The discussion covers types of diesel engines and their service conditions (which will often influence the choice of fuel), classes of fuels, fuel specifications, general and specific requirements, cleanliness, ignition quality and minor properties. The performances and fuel consumptions of gasoline and diesel fuel are compared for a typical case, showing an overall efficiency of 29% for diesel fuel compared with 21% for gasoline and a better fuel economy for the former.

* * *

"Cigarrinha" pest in Brazil. ANON. *Brasil Açuc.*, 1968, **71,** 223–227.—The incidence of this pest (*Mahanarva indicata*) in parts of Brazil and the measures now being taken to combat it (i.e. dusting by aircraft) are discussed.

* * *

Deterioration due to frost in some sugar cane varieties. F. A. FOGLIATA. *Rev. Indust. Agric. Tucumán*, 1967, **44,** (2 & 3), 35–64; through *Plant Breeding Abs.*, 1968, **38,** 368.—Of 6 varieties N:Co 310 was outstanding for resistance to frost damage. The deterioration in juice purity and factory sugar yield was moderate in the varieties CP 34-120 and NA 56-30.

* * *

Maize dwarf mosaic virus recovered from commercial varieties of sugar cane. A. G. GILLASPIE. *Plant Disease Reporter*, 1967, **51,** 761–763; through *Plant Breeding Abs.*, 1968, **38,** 368.—Tests with 9 varieties showed that CP 44-101, CP 48-103, N:Co 310 and possibly CP 52-68 can be symptomless hosts.

* * *

A method of obtaining quick infection with *Sclerospora* species. R. S. SINGH, R. N. KHANNA and H. S. CHAUBE. *Plant Disease Reporter*, 1967, **51,** 1009; through *Rev. Applied Mycology*, 1968, **47,** 234. Young leaves of sugar cane in the field were inoculated with *Sclerospora sacchari* by fixing infected maize leaf fragments in place with moist cotton wool and enclosing the sugar cane leaf in a black polyethylene bag. Chlorotic streak appeared on the inoculated portion after 3 days.

* * *

Sugar cane (in Sarawak). ANON. *Ann. Rpt. Research Branch Dept. Agric., Sarawak*, 1966, 81.—Reference is made to the establishment of a collection of 34 varieties which will be used in trials on both residual and peat soils to test their suitability as a smallholders' crop under Sarawak conditions.

* * *

Variety trials (in Kenya). ANON. *Kenya Dept. Agric. Rpt.*, 1966, **1,** 55.—In ratoon trials under rain-fed conditions the variety N:Co 293 easily outyielded all other varieties, yielding 57 tons/acre. The variety Co 678, noted for its quick maturity, was next with 48 tons/acre. The old favourites Co 602, 421, 617 and 331 all gave somewhat similar yields. In irrigated trials N:Co 293 easily topped the list with 91 tons/acre, B 41227 being second with 76 tons/acre and N:Co 292 a good third with 71 tons. Some other trials were abandoned because of smut attack.

* * *

Storage of sugar cane cuttings. D. M. BROADHEAD. *Agron. J.*, 1967, **59,** 477–478; through *Hort. Abs.*, 1968, **38,** 575.—Storage experiments were carried out after treatment with various fungicides ("Captan" 0·36%, mercuric chloride 0·1%, phenyl mercuric acetate 0·025%) and storage in polyethylene bags or exposed. After one year of storage 8% of the buds from cuttings which had been enclosed in polyethylene bags after treatment with phenyl mercuric acetate grew into shoots. This treatment gave the highest percentage of bud survival. Storage temperatures were 3°C and 5°C and the variety used CP 36-111. Unbagged cuttings dried out considerably compared with bagged cuttings.

* * *

Influence of environmental factors on the efficiency of pre-emergence "Diuron" applications. J. E. BOWEN. *Weeds*, 1967, **15,** 317–322; through *Hort. Abs.*, 1968, **38,** 578.—A study is reported on the environmental and physical factors influencing the effectiveness of pre-emergence applications of "Diuron" at 4 lb/acre under field conditions in 10 Hawaiian sugar cane plantations. Rainfall, soil pH, organic composition, time lapse between harvest and herbicide application and temperature were among factors dealt with. The only important factor was considered to be the lapse of time between harvest and application, a factor within the control of the planter.

* * *

Further notes on chlorotic disease of sugar cane in the Philippines. U. R. RIVIERA and I. B. CANO. *Philippines Sugar Inst. Quarterly*, 1966, **12,** 121–124; through *Hort. Abs.*, 1968, **38,** 582.—Chlorotic streak disease has only been recorded in the Philippines in recent

years. Preliminary transmission studies confirmed that the disease is transmitted through infected cuttings. Surveys and field visits in Occidental Negros showed only 4 varieties to be affected.

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Yield of sugar cane varieties. F. DÍAZ BARREIRO. *Rev. Agric. Cuba*, 1967, **1**, (2), 34–44; through *Plant Breeding Abs.*, 1968, **38**, 609.—More than 400 varieties, both commercial and experimental, are being evaluated. Of the 18 varieties at present recommended, PR 980, C 87-51 and C 236-51 have given the highest yields of sugar. Cane yield has been greatest in PR 980, C 236-51 and My 5465 and sugar percentage in C 87-51, C 86-51 and B 4362.

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Determinations of the normal leaf and top content in some sugar cane varieties. J. A. MARIOTTI. *Rev. Indust. Agric. Tucumán*, 1966, **44**, (1), 1–7; through *Plant Breeding Abs.*, 1968, **38**, 611.—Among 10 varieties studied at the beginning and end of the harvest period the variety NA 56-79 was outstanding for its consistently low proportion of leaf trash in relation to topped cane. Other varieties that gave good performances and which are adapted to mechanical harvesting are indicated.

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Stomatal movement in relation to drought resistance in sugar cane. K. M. NAIDU and K. V. BHAGYALAKSHMI. *Current Sci.*, 1967, **36**, 555–556; through *Plant Breeding Abs.*, 1968, **38**, 611.—Studies showed that in the drought-resistant hybrid Co 1312 all the stomata closed within 7 days after watering, but in the susceptible variety Badila about 50% closed in 9 days. It is suggested that stomatal closure is one of the useful criteria for screening varieties from drought resistance.

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Studies on the incidence of sugar cane smut (*Ustilago scitaminea*) in relation to ratooning. N. J. AHMED and D. PADMANABHAN. *Madras Agric. J.*, 1967, **54**, 651–652; through *Plant Breeding Abs.*, 1968, **38**, 611. The incidence of the disease was investigated over 5 years in 5 varieties. Co 527 was completely resistant.

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Cytology of Chinese and North Indian sugar canes. S. PRICE. *Econ. Botany*, 1968, **22**, 155–164.—Varieties or clones of *Saccharum sinense* in the world collection of the United States Department of Agriculture are classified on the basis of chromosome number and gross morphology. Six separate groups are recognized.

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Root competition between cane and intercrops for fertilizer tagged with P-32. T. C. JUANG, C. H. CHANG and L. KONG. *Rpt. Taiwan Sugar Expt. Sta.*, 1967–1968, 10–16.—Results are given of experiments on the use of ^{32}P as a radiotracer to evaluate root competition between cane and intercrops for fertilizer. Fertilizer was placed in different positions, i.e. under the cane row, under the intercrop row and between the cane and intercrop row. It was found sweet potato competed seriously with cane for the uptake of nutrients, much more so than other intercrops such as peanuts and soybeans, and caused the largest loss in cane yield.

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***Mycoplasma* or *Mycoplasma*-like microorganism in white leaf disease of sugar cane.** S. LIN and C. LEE. *Rpt. Taiwan Sugar Expt. Sta.*, 1967–1968, 17–19. Sugar cane leaves infected with white leaf disease were found to contain *Mycoplasma* or a *Mycoplasma*-like microorganism in the phloem tissue. Previously the disease was throught to be due to a virus. The studies here reported were carried out with the aid of an electron microscope. Some interesting microphotographs (×10,000–160,000) are included.

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Feeding nymphs of *Mogannia hebes* and the growing of cane in Taiwan. Y. J. HSIA. *Rpt. Taiwan Sugar Expt. Sta.*, 1967–1968, 25–27.—Ratoon cane in parts of Taiwan has been seriously affected by this pest in recent years. Results of pot experiments to find out more about the insect are reported. Feeding of the nymphs may induce dormancy of many of the buds or they do not develop for a long time. The effect of sunshine, soil and quantity of fertilizer used are shown in tabular form.

* * *

Studies on the parasitic nematodes of sugar cane. ANON. *Rpt. Taiwan Sugar Expt. Sta.*, 1967–1968, 39. A brief summary is given of some of the results of an extensive investigation carried out in 1966 and 1967. The root-knot nematode, stunt nematode, root-lesion nematode, spiral nematode and stubby-root nematode were recorded. The two root-knot nematodes, *Meloidogyne incognita* and *M. javanica* were most prevalent in the sandy soils. Nine varieties of sugar cane were tested against them. None showed resistance but F 147 and F 154 showed the least injury.

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Studies on sugar cane white leaf disease of Taiwan, with special reference to transmission by a leaf-hopper *Epitettix hiroglyphicus*. T. MATSUMOTO, C. S. LEE and W. S. TENG. *Rpt. Taiwan Sugar Expt. Sta.*, 1967–1968, 72.—Twenty-nine different species of leaf hopper were collected from cane in Taiwan, fed on white leaf diseased cane and then colonized separately on healthy cane. Only one species, *Epitettix hiroglyphicus*, could transmit the disease and the percentage of infection was not high. (*See also I.S.J.*, 1968, **70**, 367.)

Sugar beet agriculture

Achievements in sugar beet breeding. N. I. ORLOVSKII. *Sakhar. Svekla*, 1967, (9), 7–10; through *Plant Breeding Abs.*, 1968, **38**, 369.—An outline is given of the present organization of sugar beet breeding and variety testing in the Soviet Union. It includes details of improved Soviet cultivars adapted to particular regions. In recent years over 600 hybrids have been tested in station trials. The first monogerm form was approved in 1956.

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Nitrogen manuring experiments on sugar beet in the Netherlands. J. JORRITSMA. *J. Int. Inst. Sugar Beet Res.*, 1967, **2**, 69–85; through *Soils and Fertilizers*, 1968, **31**, (1), 95.—On silt soils the optimum rate of N averaged 100 kg/ha. Excess N reduced yields and quality. Crops producing over 40 tons/ha fresh tops were over-fertilized. Nitrate N was used more efficiently than ammonium N. Part of the latter may volatilize from the calcareous polder soils.

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A look at spring labour reduction in Ontario. C. E. BROADWELL. *Sugar Beet J.*, 1968, **31**, (2), 6–7.—The change from multigerm to monogerm seed that has taken place in the last few years and the changes that go with it are regarded as one of the highlights of the sugar beet industry. Chemical weed control is another of the keys to a successful labour reduction programme. "Pyramin" and TCA are the herbicides mainly used. Another aspect of labour reduction in Ontario has been the use of mechanical thinners.

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Sugar beet, a supplementary sugar producing crop. B. K. KARMARKAR and D. J. MEHTA. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (1), (iii), 43–48.—Reasons are given why commercial sugar beet production in India is desirable. Reference is made to experimental work with sugar beet at the Sugar Cane Research Station at Padegaon and details are given of a small trial at the Belapur Company's farm.

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Selection of type 0 character in *Beta vulgaris*. K. NIELSON and J. NEMAZI. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 368–376.—Sugar beet plants with genes which cause cytoplasmic male sterility in crosses are regarded as type 0. An account is given of a testing programme which was established to attempt to produce perfect type 0 lines.

Occurrence of double ovules in sugar beets. J. NEMAZI and K. NIELSON. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 389–395.—A drawback with the use of monogerm sugar beet seed to make hand-weeding unnecessary is the occurrence of two or more ovules in single cavity fruits and two or more embryos per seed. Two or more ovules are common in many monogerm lines. Twin embryos occur rarely, are usually weak and not of economic importance. The paper deals primarily with double ovules.

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The effect of alfalfa in a rotation on yield and quality of sugar beets. D. W. ROBERTSON, R. E. DANIELSON, W. R. SCHMEHL and R. S. WHITNEY. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 405–412.—This paper is a continuation of an earlier report as a result of an additional 8 years of observation at the Colorado State University Agronomy Farm. Sugar beet was grown twice in an 8-year rotation with 3 years of alfalfa (or lucerne), maize, barley and wheat. The principal benefit of alfalfa for sugar beet was to increase available soil nitrogen. It reduced the nitrogen fertilizer requirements by 103 lb per acre but the use of phosphate fertilizer was still necessary for maximum effects. With alfalfa in the rotation the beet sucrose content was lowered by ½–1%. This was more than compensated by the increase in root and sugar yield.

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Effect of simulated hail damage on sugar beets. O. C. SOINE. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 424–432.—Sugar beet areas in parts of Minnesota and North Dakota are subject to hail damage and information on this damage has been needed for some time. The simulated hail "damage" was accomplished by cutting off 0, 25, 50, 75 and 100% of each individual leaf from each plant. Average reduction in yield was 3, 8, 11 and 24% for the 25, 50, 75 and 100% damage. Percentage sucrose and purity was seriously affected only with 100% damage.

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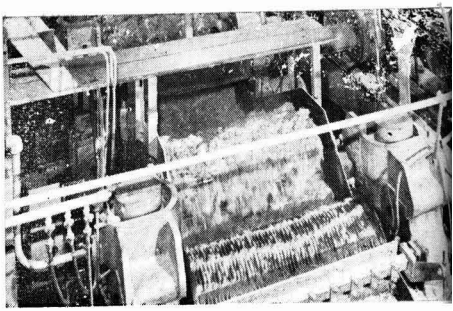
New sugar beet pest control. ANON. *Sugar J.*, 1968, **30**, (9), 28.—Reference is made to the discovery of a natural sex attractant for sugar beet wire worm, called click beetle in the mature stage. It also infects other crops such as potatoes, onions and lettuce. The discovery was made by the U.S. Department of Agriculture and Canadian scientists. Details of laboratory tests are given.

Cane sugar manufacture



Investigation of continuous crystallizers for low-grade massecuites. T. MORITSUGU. *Paper presented to the 13th Congr. ISSCT*, 1968.—Details are given of tests carried out during 1966 at Puunene sugar factory (Hawaii) on continuous crystallization of low-grade massecuite, which was pumped to two banks, one of 12 continuous crystallizers in series and the other of 14 crystallizers. Results showed that molasses exhaustion was adequate when the massecuite flow was such as to permit proper cooling, but when flow was too rapid, cooling and hence molasses exhaustion were inadequate. The extent of channelling was not determined. Modifications have been made to the unit and further investigations were to be made in 1967.

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Technological aspects of the diffusion tower at Casa Grande. J. C. P. CHEN. *Anal. VII Conv. Asoc. Peruana Técn. Azuc.*, 1963, 285–287.—Operational data for the BMA tower diffuser, of 500 t.c.d. capacity, installed at Hacienda Casa Grande in 1960, are presented in graph and tabular form. With preparation using one mill, extraction reached 96% at a feed rate of 16·0 t.c.h., 95% at 23·8 t.c.h. and 94% at 26·2 t.c.h. With two mills for preparation, an extraction of 98% was achieved with a feed of 22·8 t.c.h. The juice obtained was clearer and contained less soil than that from cane from the same field which had passed through a mill, and the juice purity was 83·58 on average against 82·77.

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Rapid cooling of massecuites. E. DE BREET. *Anal. VII Conv. Asoc. Peruana Técn. Azuc.*, 1963, 296–301. Aspects of massecuite handling are discussed with references to the literature and the conclusion reached that optimal results will be achieved using rapid crystallizers, reheaters and high-speed centrifugals.

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The installation of the diffusion system in Nanchow mill. ANON. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1967–68, 83–84.—Details are given of the Silver ring diffusion unit and ancillary equipment at Nanchow sugar factory.

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Automation in Taiwan Sugar Corporation. ANON. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1967–68, 84–85. Information is given on the centralized control system at Kaohsiung sugar factory which permits control of all processes from cane unloading to sugar drying. Yamatake-Honeywell instruments and control panels are incorporated in the scheme.

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The principles of the DDS milling-diffusion process. H. BRÜNICHE-OLSEN and N. J. LOFT. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 12–17.—The DDS diffuser is described and recent results reported[1].

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The De Smet continuous cane diffuser process and its applications. P. H. ADAM. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 30–34.—The De Smet diffuser is described and the types of unit, cane preparation equipment, cane characteristics and results at five different installations are tabulated and discussed.

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The Honiron "Hi-Extractor". J. W. BERSCH. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 58–60.—An account is given of the use of the "Hi-Extractor" unit[2] at Honokaa Sugar Co. in 1967. The unit was operated in bad conditions of drought followed by excessive rainfall but produced a sugar loss in bagasse such that it would pay for itself very quickly. The savings possible by reducing bagasse loss from 3·4% with milling to 1·4% with the "Hi-Extractor" are calculated for a typical Hawaiian sugar factory.

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Progress report on the development of the French bagasse screw press. B. STARRETT. *Rpt.* 1967 *Meeting Hawaiian Sugar Tech.*, 61–68.—A report is presented on the operation of screw presses used to dewater and deliver bagasse to the furfural production chamber of the Quaker Oats Co.'s plant located at the Glades Sugar House in Florida. A press was used to recover further sugar from bagasse; using 11·5% moisture on cane the pol loss in bagasse was reduced by 50·9%. A faulty pinion broke and a temporary substitute limited power application but with only 9·72% maceration the pol loss was cut by 33·0%. Advances in design and new installations of presses of various types are described.

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The Silver cone press. H. B. MOSER. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 69–76.—An illustrated description is given of the Silver press[3] which has

[1] *I.S.J.*, 1964, **66**, 187–189; 1967, **69**, 116.
[2] *ibid.*, 1968, **70**, 244.
[3] *ibid.*, **220**.

been installed at C.V.F. Central Cumanacoa in Venezuela; using 4¼ h.p. per short ton, bagasse containing 86% moisture was reduced to under 47% moisture. The 72-inch machine will handle 19·5 tons/hr on a dry fibre basis using a 250 h.p. motor.

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Cane drycleaning. W. GIBSON. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 77–78.—A dry-cleaner for cane has been built by Honolulu Iron Works Co. on a non-profit basis, in co-operation with the HSPA Experiment Station, at Laupahoehoe Sugar Co., where it is to be operated for comparison of losses with those of wet cleaning, for determining the effects of dry-cleaning on bagasse quality and aspects of sugar house operation, to develop necessary modifications to give a final design with reasonably firm costs, to determine operating, repair and maintenance costs, and to study the potentials and research direction for eventual rock removal. The cleaner is briefly described and illustrated.

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Atlas storage bin and reclaim conveyor system. W. P. EDNIE. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 83–84.—The system described includes a silo which receives bagasse direct from the mill and from which it is withdrawn through under-floor conveyors to the boiler. This ensures an ininterrupted flow of fuel to the boilers which are then independent of mill stoppages. The reclaim system involves a rotating ring encircling the bin at its base and having four strings of open-sided and open-bottomed buckets which trail from their attachment points and fill with bagasse as they move round the bagasse pile; as they pass over the conveyors the buckets discharge their contents and then refill as they continue round. The speed of the conveyors and ring can be varied to match the bagasse fuel requirement of the boilers.

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The Atlas bagasse bin at Waialua Agricultural Co. Ltd. G. B. FRASER. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 85–87.—A description is given of the Atlas system (see previous abstract) at Waialua, together with operating experience, costs, power requirements, and proposed modifications.

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Cane diffusion and the BMA system. P. FREUND and H. DANNEIL. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 95–99.—An account is given of the characteristics and advantages of the BMA system of cane diffusion and results quoted of operations in South Africa, Egypt and Nicaragua.

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Digital computer applications in the factory—Simulation. E. J. LUI. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 156–162.—A mathematical model based on the materials balance of a two-boiling system in steady-state was constructed and programmed for a digital computer, when syrup handling and sugar production capacities could be obtained at various syrup purities and the maximum obtainable recovery computed under a set of variable parameters. A preliminary mathematical model has been constructed for dynamic simulation of the boiling process but this has not yet been examined using the computer.

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Digital computer applications in the factory—Optimization. P. K. TAKAHASHI. *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 163–171.—The reasons for and means of utilizing a computer installation for optimization of sugar factory operation are explained and the rôles of the HSPA and plantation managements discussed. The construction of a mathematical model should follow the acquisition of necessary data, and 94 variables measured at Waialua factory in 1967 are listed; collected data (some 37,500 values) are being processed by the HSPA computer to obtain the particular factors and constants for Waialua.

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Application of the two-boiling system to Louisiana. T. R. RAY. *Sugar J.*, 1968, **30,** (10), 10–11, 15, 17, 20.—Imposition of penalties for poor raw sugar quality in Louisiana has stimulated the suggestion that the *A-C* two-boiling system be adopted in place of the currently-used 3-boiling system. In the *A-C* system, the *C*-sugar is boiled only on *A*-molasses, using full seeding, and is partly used for graining the *A*-strikes and partly remelted for use with the syrup feed to the *A*-strikes. No recirculation of impurities occurs and the *A*-sugar is boiled at high purity, giving good quality. A detailed account is given of the system and a comparison drawn with the current system, while possible variations to overcome opposition among pan boilers in Louisiana are suggested. The system was used at Cinclare in 1967 and results from that season and from 1966 are tabulated.

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Progress in the DDS cane diffuser in the last five years. H. BRÜNICHE-OLSEN. *Sugar y Azúcar*, 1968, **63,** (3), 26, 28, 30, 32.—Experience with DDS cane diffusers during the past five years has shown that the risk of foam formation is slight with cane juices, by contrast with beet juices, so that the scrolls can be rotated at up to 3·2 r.p.m. as against the original maximum of 1·8 r.p.m., giving a 33% increase in rated capacity. To match the increased throughput but allow adequate drainage, the bagasse discharge is now in the form of two scrolls instead of a scoop wheel, and these have been found to give a higher dry matter content in the bagasse (15–20% *vs.* 10–15%). The retention time is reduced from 30 to 20–25 minutes but the expected improvement in juice purity has not been confirmed analytically. The reasons for using only a crusher for cane preparation are discussed and operational results from existing installations reported and analysed.

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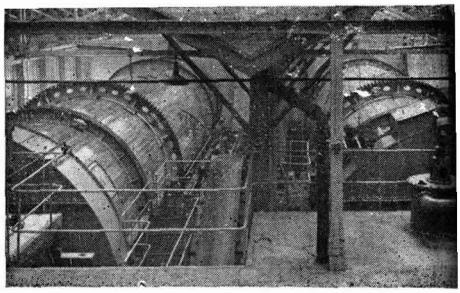
Taiwan's sugar industry. ANON. *Sugar y Azúcar*, 1968, **63,** (3), 56–59.—A brief survey.

Beet sugar manufacture



Calculation of (the parameters of DDS) twin-scroll diffusers. A. K. BURYMA. *Sakhar. Prom.*, 1968, **42**, (3), 23–26.—Equations are presented for calculation of the various factors involved in estimating the daily throughput of a DDS diffuser. Two worked examples are given.

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Prevention of scale formation by means of ultrasonics. F. F. MATIENKO and YU. A. KAZANTSEV. *Sakhar. Prom.*, 1968, **42**, (3), 31–32.—The use of ultrasonics to inhibit scale formation in boilers is discussed. It is mentioned that their effectiveness will depend on the degree of water hardness.

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Determination of beet dirt content on a "net" weigher. A. E. POPOV. *Sakhar. Prom.*, 1968, **42**, (3), 35–37.—A weigher is described which has a scale calibrated in % dirt. How to use the weigher is explained, and laboratory and factory tests are discussed. The results showed that the weigher gave sufficiently accurate values of dirt content.

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Technico-economic results of the operation of an S-17 diffuser at Novotroitskii sugar factory. E. D. KAZANSKAYA. *Sakhar. Prom.*, 1968, **42**, (3), 54–56.—Some performance data are given for an S-17 twin-scroll sloping trough diffuser of 1500 tons/day throughput. The economics are also discussed.

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A scientific approach to determining beet campaign starting times. YU. P. CHERNOV and I. D. STEPANENKO. *Sakhar. Prom.*, 1968, **42**, (3), 57–59.—The optimum time at which to start the beet campaign in Kirgiziya is discussed from the economic, agricultural and processing viewpoints. A date in the last ten days of August is considered most suitable.

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Mechanical stirrers in controlled vacuum pans. J. TYLE. *Zeitsch. Zuckerind.*, 1968, **93**, 182–184.—The effect of mechanical stirrers in pans is examined. It is recommended to force the massecuite up the downtake rather than down it. Equations are presented for calculating the quantity of massecuite to be circulated and its dependence on the amount of water to be evaporated. The difference between the isotherms for the boiling point of the massecuite and the partial pressure of the water vapour above the massecuite is considered an important factor in boiling control. A new method is proposed for boiling control, which depends on the massecuite concentration, partial vapour pressure above the massecuite and the average temperature difference between the massecuite and the heating steam.

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Water in the sugar factory. I. Reduction of pollution and fresh water consumption. P. DEVILLERS. *Sucr. Franç.*, 1968, 95–99.—The subject is considered with regard to recirculation of press and wash waters, use of condensate and condenser water, disposal of filter muds, and means of reducing the amount of dirt introduced into a beet factory, as well as methods of separating the dirt from wash water. A water flow scheme for a sugar factory is presented. The use of condenser water in diffusion and maximum recirculation of decanted muddy water can, it is claimed, reduce the amount of waste water for disposal from 10 cu.m. to 0·2–0·8 cu.m./ton of beet.

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Maturation of 2nd carbonatation juice. Z. D. ZHURAVLEVA, F. N. DOBRONRAVOV, A. M. GERASIMOVA and R. V. VOSKOBOINIKOVA. *Sakhar. Prom.*, 1968, **42**, (4), 14–16.—Tests in which unfiltered 2nd carbonatation juice was kept for up to 30 min in a tank at 75°C and 100°C, respectively, showed that there was no change in purity, the colour content either remained unchanged or rose by only 2–8°St, while the Ca and Mg salts contents fell slightly. Although re-crystallization of the $CaCO_3$ and flocculation took place, complete crystallization of the mud was not achieved.

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Reception and storage of liquid SO_2. B. S. ZHALOV. *Sakhar. Prom.*, 1968, **42**, (4), 16–19.—Guidance is given on the most suitable means of receiving, storing and transferring liquid SO_2 to its place of use in a sugar factory.

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Replacement of rotary diffusers with scroll diffusers (thermotechnical calculation). V. A. KOLESNIKOV. *Sakhar. Prom.*, 1968, **42**, (4), 20–23.—Comparison of the steam usage of juice heaters and preliming plus an RDA rotary diffuser with that of a similar system incorporation an S-17 sloping-trough diffuser showed that the latter system uses some 2·3% less steam (on weight of beet) than the former. However, this in turn means insufficient water vapour for bleed from the 4th evaporator effect, which is used particularly to heat the raw juice. Means of overcoming the problem are suggested.

Automatic cleaning of electrodes in pH meters used for 2nd carbonatation juice control. V. V. ZLAMAN and A. N. CHERKASOV. *Sakhar. Prom.*, 1968, **42**, (4), 24–27.—Two schemes for automatic acid cleaning of electrodes in automatic systems for control of 2nd carbonatation juice pH are described.

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Mechanization of removal of foreign bodies and catching of beet tails. A. A. MAZUR, E. B. KATS, YA. A. KRIVUNETS and V. A. MORGUN. *Sakhar. Prom.*, 1968, **42**, (4), 28–30.—Details are given of the arrangement used at Chernovitskii sugar combine for removal of foreign bodies and trapping of beet tails. Modifications to the washing section have reduced the amount of beet waste in the form of pieces and tails from 2–3% to 0·24–0·30% by weight.

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Prevention of damage to the shafts of S-17 diffusers. B. V. LEONT'EV and A. T. PANIN. *Sakhar. Prom.*, 1968, **42**, (4), 33.—Causes and prevention of shaft breakage in S-17 trough diffusers are discussed.

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Some results of processing mechanically-harvested beet. YU. F. TSYUKALO, I. S. CHERKAS, V. T. RUD' and B. I. KATS. *Sakhar. Prom.*, 1968, **42**, (4), 44–47. Results of two-months' processing of mechanically-harvested beet showed that, provided the amount of leaves still adhering to them in storage did not exceed 1·7% by weight and storage was not prolonged, the beet offered no difficulties in processing. Washing must be well organized. Guidance on certain features of processing is given.

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Tests on purification of second product run-offs by ion exclusion using a chromatographic technique. J. HOUSSIAU. *Sucr. Belge*, 1968, **87**, 423–428.—An ion exclusion technique was used for the purification of second product run-off of 72 purity which was diluted to 40°Bx and applied at room temperature to a column of "Dowex 50-X 4" cation exchange resin in the K^+ form; 50–300 ml of run-off were added per litre of resin and the column then eluted with water. Recovery of 65–89% of the sugar content was achieved in fractions of purity between 80 and 90. No inversion occurs since the medium always remains alkaline, and no regeneration of the resin is necessary since its ion exchange characteristics are not employed.

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The lime salts contents of sugar factory juices. K. VUKOV. *Sucr. Belge*, 1968, **87**, 407–415.—Lime salts in sugar juices include permanent hardness and temporary hardness; the latter is due to bicarbonates of Mg and Ca formed in over-saturated solutions and may be reduced by maintaining optimum alkalinity in the second carbonatation or reduced entirely by mixing with $CaCO_3$ crystals during and after 2nd carbonatation. The permanent hardness is proportional to the content of invert sugar and amino-nitrogen in the raw juice, the ratio depending on the method of juice clarification, the amount of lime added in relation to non-sugars, and on the end-point of first carbonatation. The ratio of permanent hardness in thin juice to the amino-acids and acids formed by invert degradation is a measure of the clarification efficiency. For a given content of amino-nitrogen, thick juice alkalinity is inversely proportional to the hardness:ash ratio of the thin juice. When the alkalinity is low, hardness should be reduced, not by addition of soda but by addition of lime, raising the end-point of first carbonatation, etc., while too high an alkalinity should be corrected by sulphitation.

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Determining unknown sugar losses in diffusion. A. T. SNISAR'. *Sakhar. Prom.*, 1968, **42**, (5), 35–36.—Tests at a beet sugar factory showed that determining the sugar content of pressed juice and raw juice samples was of no help in determining the extent of unknown sugar losses in a continuous diffuser, since they were very high despite maintenance of normal pH and temperatures in diffusion. The difficulty is attributed to bacterial activity during diffusion.

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Changes in the technological qualities of mono- and multi-germ sugar beet as a function of the fertilizers applied. I. K. YAREMENKO. *Sakhar. Prom.*, 1968, **42**, (5), 41–43.—Results of tests showed that application of 20 tons of organic manure plus N, P and K (60, 90 and 60 kg, respectively) per hectare increased beet sugar content, raw juice purity and sugar yield and decreased molasses sugar, compared with 20 tons/ha of organic manure on its own or reinforced with 45, 60 and 45 kg/ha of N, P and K. The results were always higher with multigerm than with monogerm beet.

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Effect of vapour pressure on heat exchange intensity during forced circulation evaporation. V. V. MAIOROV. *Izv. Vuzov, Pishch. Tekhnol.*, 1968, (2), 117–118. Tests showed that in forced circulation evaporation of sugar solutions, the vapour pressure had less effect on changes in heat transfer than it did during natural circulation evaporation in a large space. In both cases the relationship was linear.

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A dynamic model of a DDS diffuser based on the temperature channel. V. G. OMEL'NITSKII and E. K. SHIGIN. *Izv. Vuzov, Pishch. Tekhnol.*, 1968, (2), 119–123.—A method is described for establishing a dynamic model of a twin-scroll DDS diffuser based on temperature channels; its application to a mathematical study of the kinetic diffusion processes involving temperature is discussed.

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Decolorization of juices and sugar products by the column bed method. H. ZAORSKA. *Gaz. Cukr.*, 1968, **76**, 105–111.—See *Ind. Sacc. Ital.*, 1965, **58**, 324–347; *I.S.J.*, 1964, **66**, 260, 285; 1966, **68**, 85, 119.

New books

Anuário açucareiro, 1967. 111 pp; $8\frac{1}{4} \times 11$ in. (Instituto do Açucar e do Alcool, Caixa Postal 420, Río de Janeiro, Brazil.) 1968.

This work, the latest in the series, gives a wealth of detail on a number of sugar crops up to the 1964/65 season, as well as figures for sugar production, factory and farmers' cane milled, yield and alcohol production from the 1965/66 season by individual factories and by states. The book is in four sections: agricultural, industrial, commercial and general, the first being tabulations of cane areas, productions, yields, values in the calendar years 1961–65 and distributions in the seasons 1960/61—1964/65. The second section covers sugar producers registered with the I.A.A. and sugar and alcohol production data over the seasons 1960/61—1964/65. The commercial section provides data on exports, stocks, consumption, prices and financing in Brazil during the same period, while the final section provides résumés of the production figures, numbers of factories, etc. The Institute has provided in its Anuário a tremendous amount of statistical information such as is not often available from many other countries. It is to be hoped, however, that future issues will contain data relative to crops less than three years previous.

* * *

Zuckerwirtschaftliches Taschenbuch 1968 (Sugar economic pocket book). 203 pp.; $4 \times 5\frac{3}{4}$ in. (Verlag Dr. Albert Bartens, Berlin-Nikolassee, Lückhoffstr. 16, Germany.) Price: DM 16; 34s 0d.

The 15th edition of this pocket book contains 75 tables and 14 graphs plus maps. The three sections are headed Statistics, Trade Regulations, and Addresses. The first part of Section I gives details of beet and cane areas and yields per ha in Europe and North America and of sugar production in different countries, as well as sugar consumption, imports and exports, balances and prices. Part 2 gives information on the EEC sugar industries and general data for EFTA countries as well as the USA and USSR. Parts 3 and 4 cover West Germany and East Germany, respectively. Section II gives details of international, EEC and West German sugar trade regulations, and, in the case of West Germany, molasses sales conditions. Section III gives information on international and German sugar organizations, and sugar factories in West and East Germany as well as Western Europe. Captions and headings to the tables in Section I are in English, French and German. The information is well presented in clear type; the small format of the book and its small thickness, plus the fact that the pages stay flat easily, make this a very handy reference book.

* * *

La industria azucarera Boliviana 1966. 135 pp.; $7\frac{1}{4} \times 10\frac{1}{2}$ in. (Comisión Nacional de Estudio de la Caña y del Azúcar, La Paz, Bolivia.) 1968.

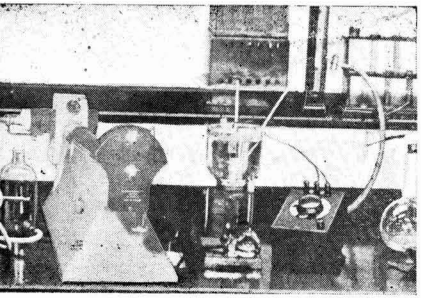
The Bolivian sugar industry has been regulated by CNECA, a department of the Ministry of National Economy, so that in 1966 it was possible to avoid the crises which occurred in other countries by adjusting production to domestic requirements and US quota, while promoting consumption within the country. In this way, a reduction was made in the excessive stocks from 1965.

In the first chapter of this book, the 1966 season is described and discussed in great detail, from cane harvesting area and organization, transport, yield, deterioration, etc. as well as rainfall and temperature records. The second chapter deals with sugar, molasses and alcohol production, and includes charts and tables giving data for 1961–1966. A note is provided on the new Stephen Leigh factory in Bermejo. The third chapter discusses domestic consumption in Bolivia, while the fourth is concerned with exports to the US under the Sugar Act. The last chapter records the various sugar laws enacted by the Government, while an appendix presents a condensation of a discussion on cane diffusion by J. R. MORENO K., superintendent of Ingenio Guabirá, which includes a brief evaluation of three diffusion systems.

* * *

Japan sugar year book 1968. 85 pp.; 4×6 in. (Japan Sugar Refiners' Association, 5–7 Sanbancho, Chiyoda-ku, Toyko 102, Japan.) 1968.

This pocket book is divided into 7 sections: general (sugar production and consumption, raw sugar imports and refined sugar exports); trade (raw sugar imports, prices, refined sugar exports and sugar import duties); production (cane, beet, refined and non-centrifugal sugar production); prices; consumption; other sweeteners; and world prices. The tabulated data cover varying periods, starting with 1957/58 at one end of the scale and ending with early 1968, and are broken down in great detail, e.g. refined sugar production covers 8 types of sugar. For those readers interested in the Japanese industry this publication provides a wealth of information.



Laboratory methods & Chemical reports

Insoluble impurities in white sugar. H. GRUSZECKA. *Prace Inst. Lab. Badaw. Lab. Przem. Spoz.*, 1967, **17**, (1), 33–43; through *S.I.A.*, 1967, **29**, Abs. 1149. Membrane filtration and spectrophotometry of 23 Polish white and refined sugar solutions show that they contained 43–266 mg of insoluble impurities/kg of sugar. About 20% of these impurities were inorganic (Ca, Na and Fe salts) and about 80% organic (fibres, cotton and jute threads, dust, caramelized particles). SiO_2 was not detected in any sample (test with hot 10% HCl).

* * *

Studies on determinations of sugars. Comparison of basic methods used for the determination of sugars in foodstuffs. S. KRAUZE, W. MISKIEWICZ and E. TOMICKA. *Roczn. Panst. Zakl. Hig.*, 1966, **17**, (1), 49–54; through *S.I.A.*, 1967, **29**, Abs. 1151.—The Lane-Eynon method gave better results than the Luff-Schoorl, Bertrand, Potterat-Eschman or Fellenberg methods with standard sugar solutions. The Luff-Schoorl method was second best. The Bertrand method gave lower (worse) results with Schott 3G4 glass filters than with quantitative filter paper. The effects of weak, strong and "classic" inversion and of heating with CaO on sugar degradation are tabulated.

* * *

Sensitive direct spectrophotometric determination of fructose and sucrose after acid degradation. E. R. GARRETT and J. BLANCH. *Anal. Chem.*, 1967, **39**, 1109–1113; through *S.I.A.*, 1967, **29**, Abs. 1152.—A method for the determination of fructose in solution by measurement of the U.V. absorption at 283 nm after heating with 1·0M HCl for 10 hr at 80°C is described. The absorbance was proportional to fructose concentration in the range 3×10^{-4} to 3×10^{-5}M, and was constant between 9·25 and 11·25 hr after the start of heating. The standard deviation of a determination was 2·6%. At lower temperatures (60–75°C) or lower acid concentrations (0·14–0·82M), maximum absorbance had not been reached after 10 hours' heating. The chromophore was only partially extractable with chloroform, and the extract had an absorption maximum at 278 nm. The absorbance of the residual solution was proportional to fructose concentration; fructose could thus be determined in the presence of chloroform-extractable chromophores. The chromophore in the acid solution was shown to be identical with hydroxymethylfurfural. On addition of NaOH, the absorption maximum shifted to 286 nm and decreased to a small v[illegible] [illegible] constants [illegible]. the reactions at various temperatures and acid and alkali concentrations are given. Sucrose, owing to its rapid hydrolysis to fructose and glucose under acid conditions, could be determined by the same method. The small absorbances due to glucose degradation products were subtracted from the values on a calibration curve.

* * *

Evaluation of white sugar quality by the CEFS (Comité Européen des Fabricants de Sucre) method of the EEC. L. KONOPKO. *Gaz. Cukr.*, 1968, **76**, 59–61.—Details are given of the points system used by the EEC for standard sugar evaluation. Sugar is divided into 4 classes (one refined, two white, and one for sugar of 99·0–99·7 pol applicable only in French Overseas Territories). Three tests are used to determine ash content, colour type, and colour content of the sugar solution. Tables indicate the symbols and dimensions used in the system as well as the permissible limits for the two top classes (refined and consumption white sugar).

* * *

Inversion of concentrated sucrose solutions in fixed beds of ion exchange resin. N. LIFSHUTZ and J. S. DRANOFF. *Ind. Eng. Chem., Process Design Dev.*, 1968, **7**, 266–269.—Kinetic studies with "Dowex 50W-X8" resin showed that it was possible to carry out inversion of sucrose solutions of up to 45% concentration (by weight) at temperatures in the vicinity of 60°C. The reaction loses its first-order character because of degradation of the product, and the need for caution because of these secondary degradation reactions is emphasized.

* * *

Sucrose crystal growth. I. Rate of crystal growth in pure solutions. II. Rate of crystal growth in the presence of impurities. III. Relative growth rates of faces and their effect on sucrose crystal shape. B. M. SMYTHE. *Austral. J. Chem.*, 1967, **20**, 1087–1131; through *S.I.A.*, 1968, **30**, Abs. 68–75, 68–75, 68–77. I. A method and apparatus are described for the measurement of the growth rate of sucrose crystals from aqueous solutions under controlled conditions of temperature, supersaturation and relative velocity of the solution with respect to the crystal. Rate of crystal growth increased with stirrer speed up to 500 r.p.m., and at high growth rates even at >2000 r.p.m. The rate varied linearly with supersaturation at high supersaturations, but deviated from this relationship at l[illegible] supersaturations. A graph of log (growth rate)

against 1/temperature was not linear. The results can be explained qualitatively in terms of a two-step rate process, involving mass transfer and a surface step, which are inter-dependent, neither being solely rate-controlling under the conditions studied.

II. Growth rates of sucrose crystals in solutions containing various concentrations of a wide range of impurities were measured at 41°C and 60·5°C and at stirrer speeds of 0 and 3000 r.p.m. Results, which are shown in graphs, are consistent with a two-step process. The impurities fell into two main groups. Those of the first group reduced the growth rate, but its relation to supersaturation was similar to that in a pure sucrose solution, i.e. approximately first-order. Increasing the stirrer speed from 0 to 3000 r.p.m. doubled the growth rate. The effect was explained by the increase in the viscosity of the solution, which inhibited mass transfer of sucrose to the crystal surface. Substances in this group included invert sugar, calcium sucrose phosphate, urea, aconitic acid, KCl and Na_2HPO_4. Dextran and high concentrations of $CaCl_2$, which markedly increased the viscosity, strongly retarded the growth rate. In the presence of impurities of the second type, the relation between growth rate and supersaturation was approximately of the second order, and stirring influenced the growth rate only at high concentrations. These results are consistent with a surface adsorption effect which hinders the incorporation of sucrose into the crystal lattice. C_6 oligosaccharides, i.e. those substituted at the C_6 atom of the glucose moiety of sucrose, e.g. raffinose, stachyose, neo-kestose, gentianose, showed this effect. Other oligosaccharides, e.g. kestose, l-kestose, melezitose, were less effective inhibitors. The effect of a mixture of the two types of impurity, e.g. invert sugar + raffinose, was additive. Turanose, trehalose and dianhydrofructose had no significant effect on growth rate.

III. Sucrose crystals were grown for several days under free fall conditions at 40°C from sucrose solutions of the same initial supersaturation containing known concentrations of raffinose, gentianose, stachyose, neo-kestose, kestose, l-kestose, melezitose, invert sugar or one of three new oligosaccharides isolated from sugar cane and syrups derived from cane. The growth rates of the 8 principal pairs of faces, expressed as % normal growth rates in pure sucrose solutions relative to that of the face which grew fastest in impure solutions, are tabulated. Projections of the shape of the original and final crystals along the 3 axes are shown. In the presence of C_6 oligosaccharides, the (110)(1$\bar{1}$0) faces in general grew fastest, and growth was inhibited most on the (100)($\bar{1}$00) and (110)($\bar{1}$10) faces. Other oligosaccharides, except kestose, caused less retardation of crystal growth, None of the impurities greatly retarded the growth of the (101)($\bar{1}$0$\bar{1}$) or (011)(01$\bar{1}$) faces, and in many cases they grew out. Kestose caused twinning about the *b*-axis in ~50% of the crystals, and irregular development of the (011)(01$\bar{1}$) faces. Photographs of crystals nucleated in the presence of impurities are given. Projections of sucrose crystal structure, based on the data of BROWN & LEVY[1] are shown. The effect of substituent position on the ease of incorporation of oligosaccharide molecules at kink sites on different faces, and hence on the growth rates of these faces, is discussed in detail.

* * *

Consecutive reaction of sucrose decomposition. S. E. KHARIN and A. R. SAPRONOV. *Sakhar. Prom.*, 1968, **42**, (3), 26–29.—Two equations are derived for calculating the quantities of intermediate and final products of dextrose and levulose decomposition when sucrose solutions are heated. Calculated values, shown in graphs and tables, of the quantities of invert sugar, dextrose and levulose as well as sucrose after 12–400 hours' heating were in good agreement with experimental values.

* * *

Distribution of potassium and sodium in granulometric fractions of white sugar. S. KH. SHEREMET'EV. *Sakhar. Prom.*, 1968, **42**, (3), 30–31.—Analytical results show that the concentrations of K and Na increased as the size of the crystals decreased, and were much higher in the fractions containing the smallest crystals. There was considerably more K than Na in the fractions.

* * *

Amino acid composition of molasses at Novotroitskii sugar factory. O. I. BELOVA. *Sakhar. Prom.*, 1968, **42**, (3), 37–39.—Details are given of the procedures used to determine the amino acids in beet molasses. Both quantitative and qualitative determinations were made, and results are tabulated for each month from October to March, inclusive.

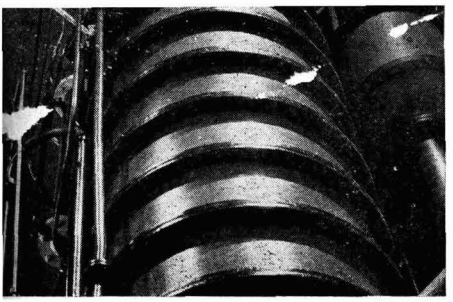
* * *

Polarography in the sugar industry. I. Survey of potential uses of polarography in sugar factory laboratories. J. BURIÁNEK. *Zeitsch. Zuckerind.*, 1968, **93**, 165–170.—The survey includes applications in refined sugar analysis, determination of invert sugar, copper, lead (and other heavy metals) and sulphite (in sulphited thin juice), and studies on concentrated sucrose solutions, including determination of depolarizer diffusivities. The literature cited includes 22 references.

* * *

The Java ratio and the fibre content of cane. R. R. FOLLETT-SMITH. *Proc. 1966 Meeting B.W.I. Sugar Tech.*, 397–399.—The Java ratio is affected by pol % cane, fibre % cane (F) and by the intensity of the first crushing, and the results of calculations using data from a factory having highly consistent data showed that the factor 1·4 in the equation J.R. $= 100 - 1{\cdot}4F$ was the result partly of the influence of fibre on the absolute juice content of the cane and partly the effect of fibre on the crusher extraction. It agrees with the Queensland formula at a value of $F = 11\%$, probably normal in 1888 when the ratio was introduced.

[1] *I.S.J.*, 1964, 66, 240.



By-products

Surface and submerged fermentation of citric acid from cane molasses. K. SCHOEDLER. *Zucker*, 1968, **21**, 121–122.—Colloids which inhibit fungus growth and hence citric acid formation can be removed by pre-treatment of the cane molasses solution with calcium hydroxide at pH 9–10 (9·1) and 80–100°C. This also removes a large part of the iron and manganese present. After precipitation and separation of the colloids, the molasses is acidified to pH 6–7 and sterilized by heating at 0·5–1 atm for 20–30 min. Further newly-formed floc can be removed in the same way. For removal of trace metals, the molasses is treated with 0·3–0·7 g of potassium ferrocyanide per litre. Ammonium nitrate (1–1·5 g/litre) and phosphoric acid or potassium hydrogen phosphate (0·025–0·10 g/litre) are added for fungus growth, while addition of 0·001–0·010% (5 mg/litre) of an organic zinc compound such as zinc-"Titriplex" will considerably accelerate fungus growth and acid formation. The method described will permit citric acid yields of about 56–64% on original sugar.

* * *

Dextran—manufacture and use. F. H. FOSTER. *Process Biochem.*, 1968, **3**, (2), 15–19, (3), 55–57, 62. A survey, with 40 references to the literature, is presented of dextran production by sucrose fermentation with *Leuconostoc mesenteroides*, with details of each stage in the manufacture. Both high and low molecular weight dextran is covered, as is the production of dextran sulphates, used successfully as anti-coagulants. The properties of dextran and of other plasma substitutes, including levans, are compared. Dextran is the only one which has met the requirements.

* * *

Removal of potassium in molasses. F. ONDA, H. ITO, M. KAMODA and T. ANDO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, **19**, 62–74.—Molasses was diluted with water to 70°Bx, adjusted to pH 1·57 with 1:1 sulphuric acid and heated at 60°C for 30 min. After cooling to room temperature, it was neutralized with 30°Bé milk-of-lime to pH 7·9–8·2, then heated at 30°C for 5 hours in a water bath. The solution was then centrifuged at 7500 r.p.m. and the potassium-containing mud removed. Under these conditions, found by experiment to be optimum, the maximum potassium removal from refinery, cane and beet molasses was 61·6%, 67·0% and 65·9%, respectively. No increase in the amount separated was obtained when "Collactivit" was used instead of sulphuric acid nor when the double salt, potassium pentacalcium sulphate, was used. The amount of potassium separated fell with increase in the NaCl content in the molasses. The most economical method of separating the potassium from the mud was 5-times digestion of the mud with twice its quantity of hot water (50°C).

* * *

Scaling: a problem in (the) alcohol distillation industry in India. B. B. PAUL. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (1), (ii), 65–72.—See *I.S.J.*, 1969, **71**, 27.

* * *

Clarification of waste molasses for preventing scaling in distilleries. J. P. SHUKLA, K. A. PRABHU and K. N. VAISH. *Sharkara*, 1967, **9**, 6–10.—While it was found possible to remove calcium and ash from molasses intended for fermentation by treatment with a cation exchanger in H^+ form, and thereby reduce scaling, the pH of the treated molasses falls, so that acid-resistant equipment in the distillery is necessary. However, it was found that the fermentation efficiency rose with fall in the calcium and ash contents to certain limits, after which further reduction in the contents was accompanied by a fall in the fermentation efficiency. Comparison of the ion exchange method with other clarification methods showed that it is the calcium content or sugar:calcium ratio and *not* the ash content that determines the fermentation efficiency. Partial deionization of molasses wort by increasing the flow rate through the resin bed or by mixing with fully-deionized molasses wort will also reduce scaling.

* * *

Pulp drying in the age of automation. E. BRETTING. *Zucker*, 1968, **21**, 152–154.—A number of measures which could be adopted for the control of beet pulp drying are suggested for the guidance of pulp dryer manufacturers. They are aimed at obtaining a constant pulp moisture content even with considerable fluctuations in the operating factors.

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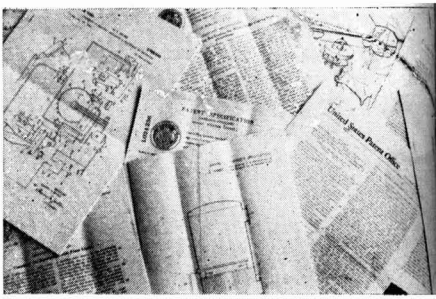
Yeast, a by-product of sugar cane—its manufacture at Casa Grande. C. BICKEL. *Anal. VII Conv. Asoc. Peruana Técn. Azuc.*, 1963, 309–313.—A description is given of the process used at Casa Grande for manufacturing fodder yeast. A project exists for making yeast for human consumption, requiring strict control of the fermentation and hygiene throughout the process.

Patents



UNITED KINGDOM

Beet harvester haulm collector. ALMABAL G.M.B.H., of Basel, Switzerland. **1,127,502.** 12th April 1966; 18th September 1968.

* * *

Massecuite treatment for crystal separation in a continuous centrifugal. AMERICAN FACTORS ASSOCIATES LTD., of Honolulu, Hawaii, USA. **1,127,692.** 11th January 1966; 18th September 1968.—Viscous massecuite can ball up on the screen of a continuous centrifugal and is then not distributed evenly so that crystal separation efficiency is impaired. To avoid this the massecuite is aerated in a trough from which it is fed to the centrifugal, this trough having a longitudinal shaft carrying radial beater arms which rotate in a vertical plane. The level of massecuite is such that the greater lengths of the beater arms emerge into the air space above the massecuite and entrain air with them when they re-enter. This level is maintained by valves controlling the rate of feed and discharge to and from the trough. The air space may be filled with CO_2 in the case of a beet sugar factory where this gas is readily available, and part of the mother liquor separated in the centrifugal may also be returned to the trough for diluting the massecuite and aiding viscosity reduction.

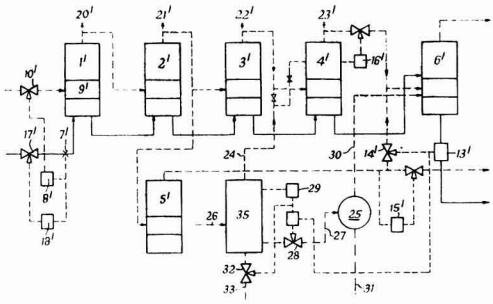
* * *

Bagasse panel board manufacture. S. A. VERKOR, of Lauwe-bij-Kortrijk, Belgium. **1,127,700.** 25th November 1966; 18th September 1968.—Bagasse is (freed of deteriorated cells and detached fibrillae and) dried (to 15–20% moisture content by weight) with the fibres and parenchymatous tissue retained in association with each other. It is fragmented into tablet-like particles (having a length:thickness ratio of 100–200 and having at least 50% with an area of 20–40 sq.mm) (8% by weight of a 50% concentrated solution of) a synthetic (urea-formaldehyde) resinous bonding compound added with a hardening agent and the mixture shaped into a panel and heated (to 140°C for 8 min) to produce a panel.

* * *

Multiple-effect evaporator regulation. SOC. FIVES LILLE-CAIL, of Paris 8e, France. **1,129,171.** 12th October 1965; 2nd October 1968.

The multiple effect evaporator 1′,2′,3′,4′ is operated with an auxiliary evaporator 6′ of the trickling or falling-film type the heating vapour for which comes partly from a pan 5′ and partly from a heat storer 35. The concentration of the liquor coming from evaporator 6′ is measured by regulator 13′ which, through valve 14′, governs the vapour from pan 5′ which is itself heated by vapour bled from body 2′. Condensates from bodies 1′,2′,3′ and 4′ are collected and fed through pipe 26 to heat storer 35, which has a level regulator 29 which governs valve 32 in the evacuation pipe 33. The heat storer is also connected to flash vessel 25 which provides vapour for evaporator 6 through pipe 30, the intermediate valve 28 also being controlled by regulator 13′. Residual condensate in the flash vessel 25 is removed through pipe 31.



Juice enters body 1′ through valve 17′, controlled by regulator 18′, and the steam flow through valve 10′ to calandria 9′ is controlled by regulator 8′ to maintain the correct proportionality to the juice flow. The juice passes through the four bodies and then through evaporator 6′. Vapour from body 1′ is partly removed at 20′ and partly used to heat body 2′. Vapour from this body is partly removed at 21′, partly bled to heat pan 5′ and partly to heat body 3′. Vapour from this body and body 4′ is partly removed at 22′ and 23′, and partly used to heat body 4′ and evaporator 6, respectively.

The amount of vapour used by pan 5′ varies with its operation, and this produces variations in the concentration of juice leaving body 4′. This is compensated and the concentration of juice leaving evaporator 6′ held constant by the regulator 13′ which, e.g., in the case of a fall in concentration, adjusts valve 14′ to increase pan vapour flow and if necessary opens valve 28 to allow condensate from heat storer 35 to flow to flash vessel 25 to provide

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).

further vapour, closing them in reverse order when the concentration of juice leaving evaporator 6' reaches the desired level.

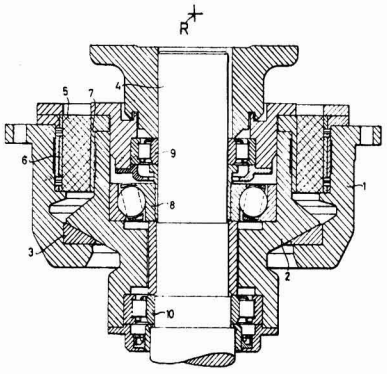
* * *

Beet harvesters. (1) E. WEICHEL, of Heiningen, Kr. Göppinger, Germany. **1,129,803.** 22nd October 1965; 9th October 1968. (2) NATIONAL RESEARCH DEVELOPMENT CORPORATION, of London S.W.1, England. **1,131,161.** 1st November 1966; 23rd October 1968.

* * *

Suspension unit for a centrifugal. SALZGITTER MASCHINEN A.G., of Salzgitter-Bad, Germany. **1,131,609.** 30th November 1966; 23rd October 1968.

The spindle 4 of the centrifugal is supported by means of an axial supporting bearing 8 arranged axially between two radial bearings 9 and 10 which are located in cavities in an annular member 2 through which the spindle passes. The member 2 has a down-



wardly facing spherical bearing surface supported on a corresponding concave surface formed in bearing ring 3 of housing 1, these surfaces having a common centre R. A pre-stressed rubber damping ring 5 is vulcanized to the internal and external steel rings 6 and 7 and absorbs radial and longitudinal forces during oscillatory movements of the drum, thus damping such movements.

* * *

L-Glutamic acid fermentation. AJINOMOTO CO. INC., of Tokyo, Japan. **1,132,855.** 15th November 1965; 6th November 1968.—A L-glutamic acid-producing bacterium, e.g. *Brevibacterium* spp., is cultivated in a medium, e.g. a beet molasses or cane molasses medium, containing a growth-promoting agent, e.g. biotin, polyoxyethylene sorbitan monostearate, etc., in an amount greater than the sub-optimum amount for bacterial growth, whereby a seed culture in which bacterial cells include the growth-promoting substance in more than the specific amount for growth control is obtained. This seed culture is inoculated into a main culture medium containing nutrients other than the growth-promoting substances, and aerobic fermentation carried out at pH 5–9 while maintaining the content of the growth-promoting substances at the specific amount for growth control, after which the glutamic acid is recovered.

* * *

Starch reduction in sugar solutions. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **1,133,046.** 15th February 1967; 6th November 1968.—Starch is removed from a sugar solution (clear juice, evaporator syrup or refinery syrup) by adding at least one thermo-stable bacterial amylase (an α-amylase derived from a *Bacillus subtilis* strain) at a temperature above 160°F (above 175°F) but below the deactivation temperature of the amylase(s).

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Cane harvester. MASSEY-FERGUSON (AUSTRALIA) LTD., of Sunshine, Victoria, Australia. **1,134,061.** 9th June 1966; 20th November 1968.

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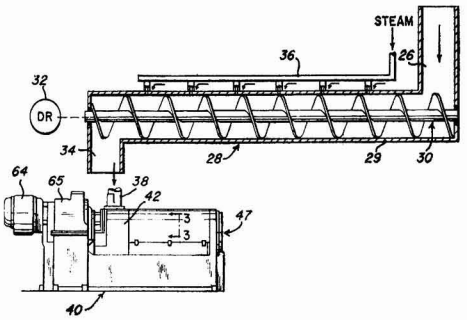
UNITED STATES

Bagasse press. A. W. FRENCH, *assr.* THE FRENCH OIL MILL MACHINERY CO., of Piqua, Ohio, USA. **3,373,679.** 27th September 1965; 19th March 1968.

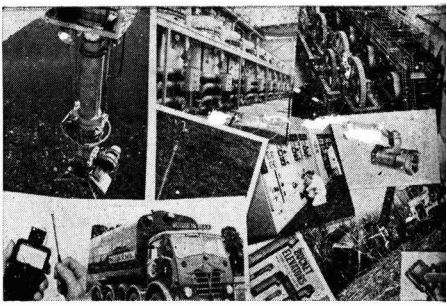
Bagasse leaving the last mill of a tandem, or from a diffuser, or cane which has passed through a shredder, is brought by conveyor to the inlet 26 of a conveyor 28 in the form of a tube housing a worm



driven by a variable-speed drive 32. During its passage the bagasse is subjected to the action of steam and/or hot water, admitted together or separately through pipe 36 and another pipe. The temperature of the bagasse is thus brought to 180–200°F, at which it is delivered from the exit port 34 to the inlet 38 of a screw press preferably of the type described in US patent 3,246,597[1], the power requirement for its motor 64 being reduced by e.g. 15% as a result of heating the bagasse or cane.

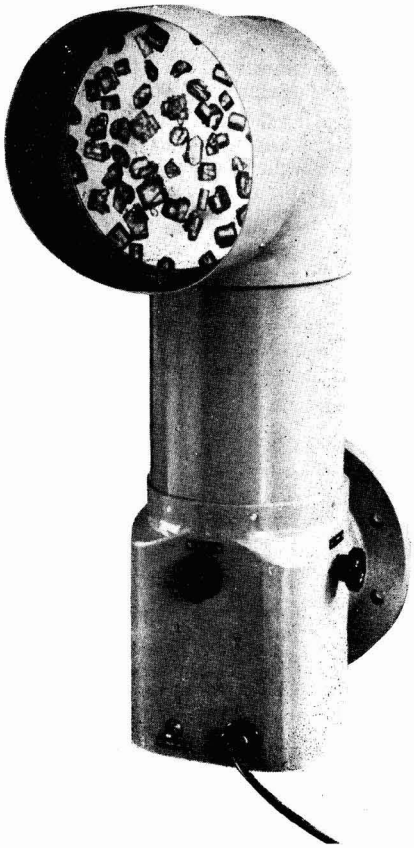
[1] *I.S.J.*, 1967, **69**, 284.

Trade notices



"Crystaloscope". The Sugar Manufacurers' Supply Co. Ltd., 196–204 Bermondsey St., London S.E.1, England.

The graining point in pan boiling can be watched on the 8½-in diameter viewing screen of the "Crystaloscope" pan projection microscope announced by The Sugar Manufacturers' Supply Co. Ltd. The overall magnification of ×30 allows the pansman to check false grain easily without eyestrain. The instrument has a fitting diameter and flat facing requirement exactly the same as for the "Panoscope", which it is designed to replace, so that there is minimum disturbance to existing arrangements. It is provided with a tapped transformer having a range of 100/125 volts in 5-volt steps and 200/250 volts in 10-volt steps.



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.

PUBLICATIONS RECEIVED

TECHNIK. Maschinenfabrik Buckau R. Wolf A.G., 4048 Grevenbroich, P.O. Box 69, Germany.

Among items included in "Technik", 1967, (1) is information on the development of the Buckau-Wolf centrifugal. Issue No. 2 of 1967 contains details of a vibratory cube sugar plant installed in a Finnish sugar refinery and information on Tadla sugar factory in Morocco.

* * *

ATLAS SURFACTANTS. Atlas Chemical Industries Inc., Chemicals Division, Wilmington, Del., 19899 U.S.A.

Tables are presented of the properties of numerous Atlas surface-active agents.

* * *

LIQUID LEVEL CONTROLS. L.T.H. Electronics Ltd., 203 Leagrave Rd., Luton, Beds., England.

Literature is available giving information on a new range of liquid level controllers which operate on the principle of electrolytic conductivity and use the latest techniques in solid state circuitry. The controllers are housed in dust- and moisture-proof cases of exceptionally small size, single and dual tank models being available with adjustable sensitivity incorporated. The A.C. units are designed for use with liquids having up to 50,000 ohms resistance, while the D.C. units are for application with liquids having up to 1 million ohms resistance (or 20 million ohms for ultra-pure water). The control circuit is rated at 7½ amp 240V A.C.

* * *

NEUMO PUMPS, MOTORS, FILLING AND PROPORTIONING SYSTEMS. Neumo Ltd., South Coast Road, Peacehaven, Sussex, England.

A new publication gives details, specifications and illustrations of the Neumo range of air-operated motors, pumps, filling machines and proportioning systems. The pumps have outputs up to 45 gal/min, while the filling machines dispense from 1 c.c. to 5 litres per cycle, it being possible to set them for specified numbers of repeated cycles. The liquid proportioning systems can handle up to 50 streams at a time with ratios in the range 1:1–5000:1. Individual steams can be introduced, modified or stopped during operation. Accuracy of dispensing is ± 0·5% by volume or even better.

* * *

Silver Engineering Works Inc. ownership change.—Silver Engineering Works Inc., of Denver, Colorado, USA, has been purchased from Amfac Inc. by CF & I Steel Corporation, and is now to be known as CF & I Engineers Inc. The change of name is to emphasize an increasing capability in diversified equipment design and construction within the sugar industry and in other directions as well. All officers and staff personnel remain in the same capacities. Licensing and sales agreements around the world continue in force. The former owner, Amfac Inc., has just placed an order for a complete Silver Ring diffuser system costing more than $2,000,000 which will be built by CF & I Engineers Inc. and is scheduled for completion in late 1970 at the Puna Mill in Hawaii.

The late Professor J. Dubourg

Professor JEAN DUBOURG died suddenly on the 18th February when leaving the Ecole des Arts et Manufactures where he had held a professorship since 1938. He had continued to give lectures in the college although he had recently retired from the Technical Directorship of the Laboratories of the Syndicat National des Fabricants de Sucre.

At the research headquarters of the Syndicat, DUBOURG and his colleagues carried out studies of a fundamental nature, particularly into the chemistry underlying the manufacture of sugar from beet, the results of these studies being published for the most part in the journals *Industries Alimentaires et Agricoles* and *Sucrerie Française*.

DUBOURG was also responsible for a wide range of studies of immediate importance to the beet sugar industry of France and his services were duly recognized when he was appointed Officier de la Légion d'Honneur.

His profound knowledge of the industry is evident to all who have read the volume which he compiled entitled "Sucrerie de Betteraves", published in 1952. In the introduction to this work he wrote: "En élaborant cet ouvrage, le désir de servir m'a constamment inspiré, servir l'industrie qui m'a adopté et m'a fait confiance .... Servir, c'est faire don de soi-même...." Truly the words of a dedicated man!

DUBOURG's activities were by no means confined to France. For many years he was a leading participant in the affairs of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) and of the Commission Internationale Technique de Sucrerie (CITS). Of the latter body he was made a Vice-President in 1969; of ICUMSA he was elected a Vice-President in 1949 and President in 1962. After he had presided over the 14th Session with great distinction he was re-elected to the office for a further period of four years but sadly he will not be present to take charge of the 15th Session in London in 1970. However, the memory of this brilliant and sympathetic colleague will long remain with all those whose privilege it was to know him.

A.C.

UK ex-refinery sugar price.—The Minister of Agriculture, Fisheries and Food, after reviewing with the Sugar Board the latter's probable receipts and outgoings in 1969, has decided that the range in which the basis ex-refinery price of granulated sugar in 1-cwt paper sacks can be expected to be held, after adjustment of the surcharge, is now 73s to 78s per cwt. The range for the greater part of 1968 was 69s to 74s. The average prices in recent years have been 79s 7½d in 1964, 72s 2d in 1965, 68s 11d in 1966, 70s 8d in 1967 and 72s 7d in 1968, while at mid-March 1969, the current price was 77s 9d.

Brevities

New Pakistan sugar factory[1].—At the beginning of December 1968 a sugar factory having a daily capacity of 1500 tons of cane came into operation at Chistian in Bahawalnagar District, West Pakistan. It was built in Poland.

* * *

Moroccan sugar plan[2].—During Morocco's new five-year plan (1969–73), it is envisaged that, in order to meet consumption which is expected to increase from 372,000 metric tons, raw value, in 1968 to 432,000 tons, production is to be increased from 110,000 to 244,000 tons, while imports (currently from Cuba, Madagascar, Poland and Taiwan, in the main) will be reduced from 267,000 to 193,000 tons. In addition to the existing four sugar factories (at Sidi Slimane, Souk-es-Sebt, Mechra Bel Krisi and Sidi Allal Tari), the plan includes construction of three more, at Sidi Bennour (2000 tons beet/day), Zelovan (1500 tons/day) and Berkane (1500 tons/day).

* * *

Pakistan sugar expansion plans[3].—The East Pakistan Industrial Development Corporation plans to put two new sugar factories into operation by mid-1969, and to erect a further six factories during the next two or three years with a total annual capacity of 50,000 tons. In West Pakistan, two co-operative sugar factories are planned.

* * *

Dominican Republic expansion[4].—In order to meet its obligations, the Dominican Republic envisages setting the production target for 1969 at 953,000 tons, 119,000 tons more than in 1968. Domestic consumption is currently 125,000 tons per annum, the initial US quota for 1969 is 444,138 short tons, and the Dominican Republic has a quota of 75,000 tons for the world market under the terms of the new International Sugar Agreement.

* * *

Zambia 1968 sugar crop[5].—Zambia's first full-scale sugar crop was very successful, production exceeding expectations. Cane production was 202,175 tons, including 8000 tons grown by private farmers in the Mazabuka district, and the estate cane yield averaged more than 60 tons/acre from the 3450 acres cropped, while the average yield of private farmers' cane was nearly 46 tons/acre from 183 acres. Sugar production was 23,709 tons.

* * *

US sugar quota import limitations removal[6].—The strike of longshoremen which started on 19th December and ran for over two months resulted in a cessation of some refinery operations and exhaustion of stocks. Following the return to work, replenishment of stocks has been slow because of reduced arrivals from Puerto Rico where the crop start has been slow, and from other Caribbean areas because of the tight freight market, and this has led to higher prices paid by final buyers. This situation, and a strike of 9000 workers in 23 Hawaiian sugar factories, led to the USDA's announcement on the 28th February of the removal of limits upon imports of sugar from foreign quota holders during April/June.

* * *

New South Vietnam sugar refinery[7].—A sugar refinery with a daily production capacity of 200 metric tons is to be erected in Saigon. Equipment will be supplied by Toyo Menka Co. and the plant is to be completed within 17 months.

---

[1] *Zeitsch. Zuckerind.*, 1969, **94**, 49.
[2] *Consudel*, November 1968; through *Sucr. Belge*, 1969, **88**, 54.
[3] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (2), 6.
[4] *Agence France-Presse*, 28th December 1968.
[5] *S. African Sugar J.*, 1968, **52**, 1057.
[6] C. Czarnikow Ltd., *Sugar Review*, 1969, (908), 42.
[7] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (6), 4.

Brevities

New Iran sugar factory[1].—According to a Polish press report, a new sugar factory supplied and erected by a Polish firm has been put into operation in Istfahan. Two further factories in Khoy and Lorest will soon be completed.

* * *

West Germany 1968/69 campaign[2].—Final figures for the 1968/69 campaign in West Germany have appeared. The beet processed amounted to 13,951,140 metric tons, as against 13,688,807 tons in 1967/68, and was produced from an area of 302,050 ha (298,213 ha in 1967/68). Sugar production included 1,563,040 tons as white sugar, 232,327 tons as raw sugar and 110 tons as syrup, compared with 1,623,655 tons, 250,640 tons and 2765 tons, respectively in the previous campaign, total production being 1,795,477 tons, tel quel, against 1,877,060 tons in 1967/68.

* * *

Iran self-sufficiency plans[3].—The Iran Government plans to become self-sufficient in sugar by the end of 1973, according to a US Department of Agriculture report. In the crop year 1967/68 Iran imported 200,000 metric tons of sugar and is expected to import 100,000 tons in 1968/69. Sugar cane areas and yields have risen rapidly in recent years and by 1972 a total 24,710 acres will be in production. Sugar consumption is expected to rise to 700,000 tons by 1973 if the annual 5% gain continues; the existing factories could produce about 600,000 tons/year at capacity levels and the expanded cane area is expected to provide the 100,000 tons needed to achieve self-sufficiency.

* * *

New Cambodia sugar factory[4].—A tender for the construction of a new sugar factory is expected in Cambodia. The factory will be built in Kompong Kil in the Battambang province and will have a daily capacity of 1000 or 1200 tons of cane.

* * *

Argentina sugar exports[5].—Exports from Argentina during 1968 reached 133,092 metric tons, tel quel, as against 65,105 tons in 1967 and 52,330 tons in 1966. They included 667 tons sent to Chile (6538 in 1967) and 22,578 tons to Uruguay, while exports to the US were 103,837 as against 58,567 tons in 1967. All Argentine exports in 1966 were to the US.

* * *

New Italian sugar factory.—It is reported[6] that Eridania Zuccherifici Nazionali S.p.A. is to have a new sugar factory built at Trecasali, in Parma, Italy. The factory is to have a daily slicing capacity of 8000-10,000 metric tons of beet, with possibilities for expansion.

* * *

Taiwan sugar exports, 1968[7].—According to the Taiwan Sugar Corporation, sugar exports from Taiwan were raised to 646,000 metric tons in 1968. Principal buyers were South Korea 168,000 tons, Japan 167,400 tons, and US 74,000 tons while 127,000 tons were sold to South-East Asian countries. The overall average price realized was $64.60 US per ton f.o.b.

* * *

Costa Rica sugar production[8].—Sugar production in the 1967/68 season amounted to 2,800,000 quintals, an increase of 100,000 quintals over the previous season's output, but 115,000 quintals less than forecast. (One quintal = 46 kg). The Liga Agrícola Industrial de la Caña de Azúcar has fixed 1968/69 sugar output at 3,100,000 quintals, of which 1,200,000 quintals will be exported.

Europe beet and sugar production, 1968/69*

Beet sliced	1968/69	1967/68	% *change*
	(metric tons)		
Austria	1,935,791	2,006,379	— 3·52
Belgium	4,500,000	4,000,000	+ 12·50
Denmark	2,243,000	2,122,000	+ 5·70
Finland*	440,630	498,687	— 11·64
France†	16,500,000	11,950,000	+ 38·08
Germany, West‡	13,951,140	13,688,807	+ 1·92
Holland	5,262,000	5,156,265	+ 2·05
Spain	4,300,000	4,282,325	+ 0·41
Sweden	1,972,000	1,773,000	+ 11·22
Switzerland	453,070	423,449	+ 7·00
Turkey	4,675,000	5,253,492	— 11·01
UK	7,100 000	6,883,797	+ 3·14
Total IASS Members	63,332,631	58,038,201	+ 9·12
Sugar production	*(metric tons raw value)*		
Austria	292,665	306,889	— 4·16
Belgium	580,000	579,000	+ 0·17
Denmark	340,000	329,000	+ 3·34
Finland**	50,178	63,740	— 21·28
France	2,432,000	1,767,124	+ 37·62
Germany West††	2,017,440	2,105,055	— 4·16
Holland	740,000	772,286	— 4·18
Spain	600,000	599,786	+ 0·04
Sweden	298,000	265,000	+ 12·45
Switzerland	68,400	65,464	+ 4·48
Turkey	700,000	791,205	— 11·53
UK	985,000	985,700	— 0·07
Total IASS Members	9,103,683	8,630,249	+ 5·37
Greece	98,000	122,822	— 20·33
Ireland	159,000	145,487	+ 9·66
Italy	1,322,000	1,671,187	— 20·88
Jugoslavia	389,000	508,212	— 23·43
Total West Europe	11,071,683	11,077,957	— 0·06

* Including processing of Danish beets: 74,100 tons in 1968/69 and 74,148 tons in 1967/68.

† Excluding beet processed for alcohol manufacture.

‡ October/September, excluding beet processing to dried pulp: 26,113 tons in 1968/69, 95,390 tons in 1967/68.

** Including sugar from Danish beets: 10,222 tons in 1968/69 and 10,152 tons in 1967/68.

†† October/September, including production by desugaring of molasses.

* * *

Bagasse paper plan in Argentina[10].—The Provincial Government of Tucumán is considering a plan to set up a plant to process cellulose and paper from bagasse in the San Ramón sugar mill in the Department of Río Chico.

* * *

Rumanian beet crop[11].—According to official statistics, the 1968 beet crop in Rumania amounted to 3·7 million metric tons, compared with 3·8 million tons in 1967.

---

[1] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (4), 6.
[2] C. Czarnikow Ltd., *Sugar Review*, 1969, (906), 34.
[3] *Public Ledger*, 22nd February 1969.
[4] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (6), 4.
[5] C. Czarnikow Ltd., *Sugar Review*, 1969, (908), 43.
[6] *Die Lebensmittelind.*, 1969, **16**, 33.
[7] *Agence France-Presse*, 11th January 1969.
[8] *Bank of London & S. America Review*, 1969, **3**, 100.
[9] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (4), 1–2.
[10] *Bank of London & S. America Review*, 1969, **3**, 18.
[11] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (4), 5,

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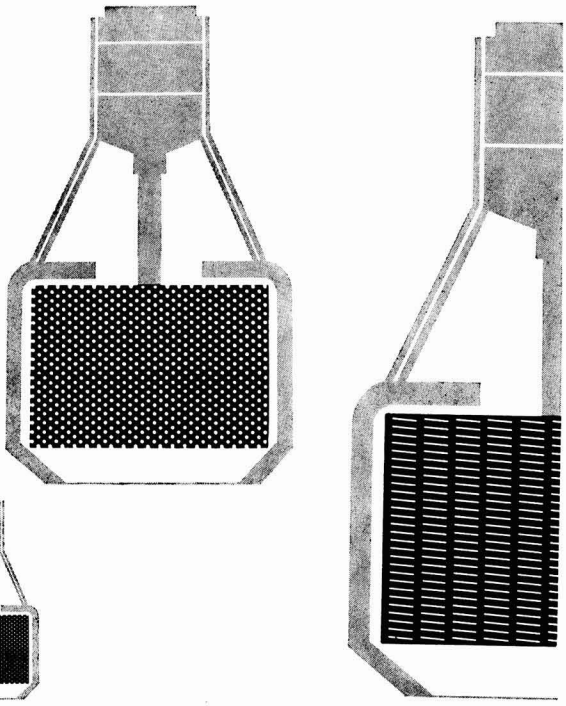

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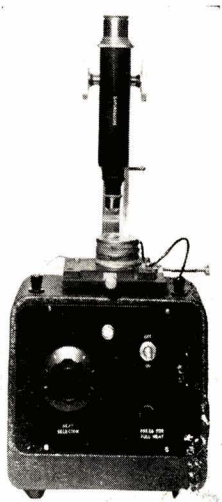

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