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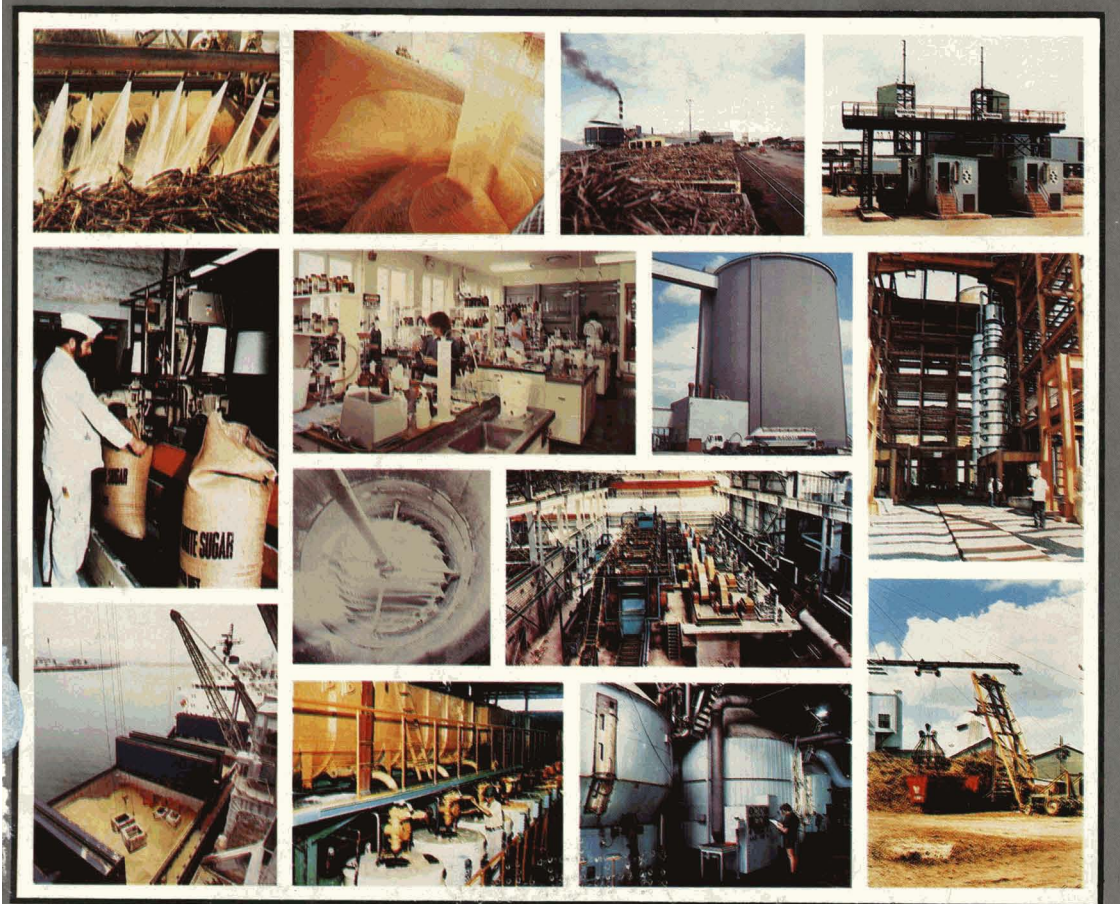

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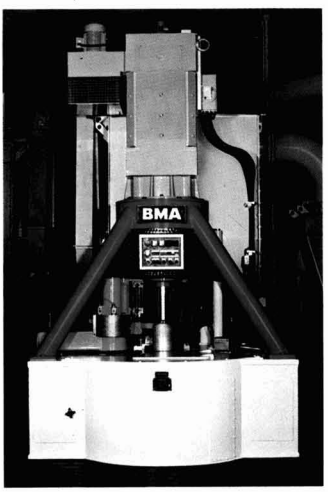

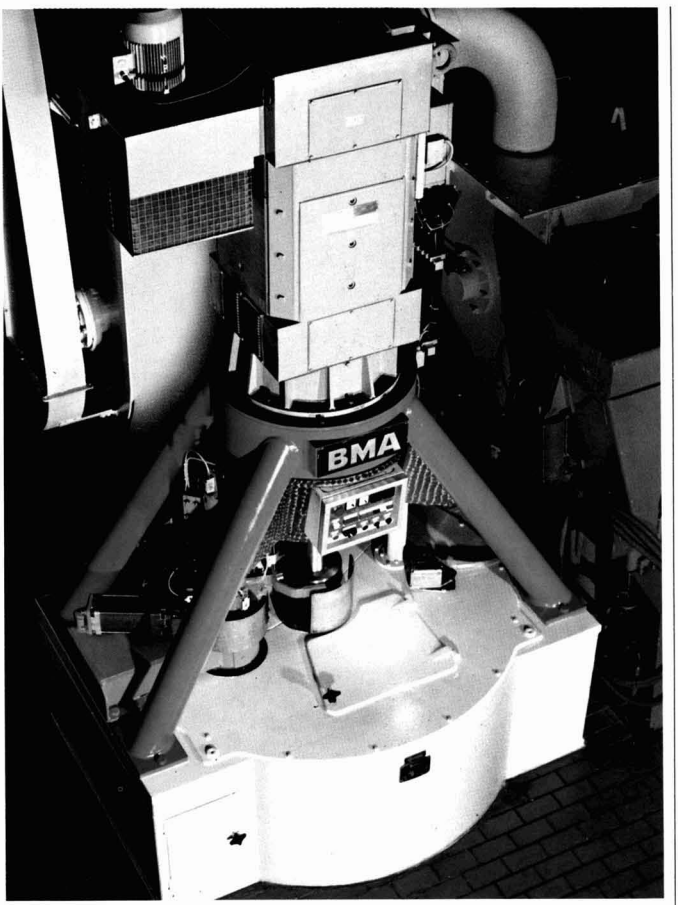

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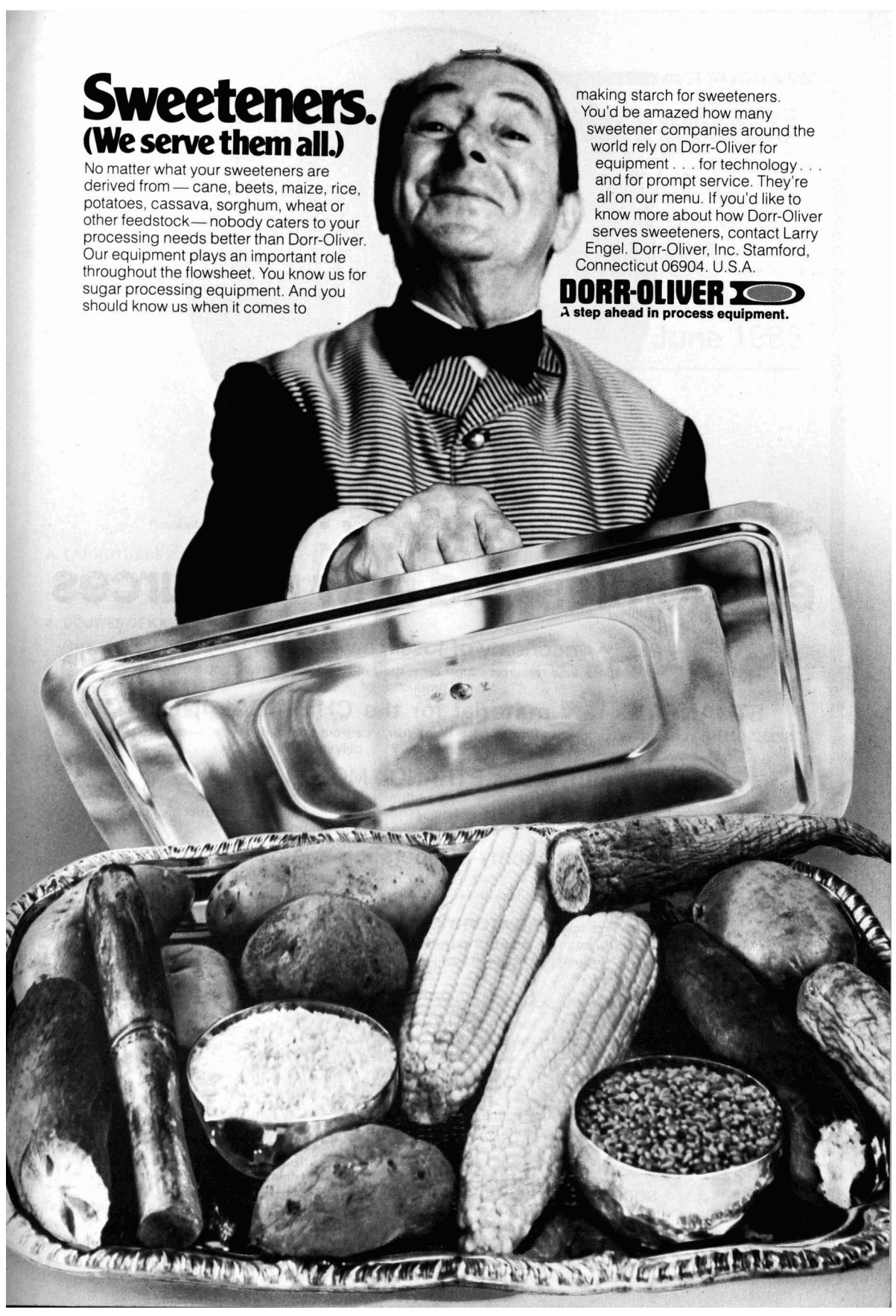
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NOTES AND COMMENTS

International Sugar Journal and Sugar Cane

It was under the latter title that our publication started its existence in 1869, adopting its present title thirty years later, as a consequence of the amount of material to be published concerning the beet sugar industry. *International Sugar Journal* has now been published for some 85 years, and we have decided to revive our former title. *Sugar Cane* will serve as a vehicle for the increasing amount of agricultural information on the crop, much of it of interest to specialist readers rather than all subscribers to *ISJ. International Sugar Journal* will, of course, continue but will be concerned with processing matters, engineering and chemistry, economics, etc., space for which is being expanded.

To mark this change of interest we are introducing a new montage of photographs on our front cover, as readers will have noticed. We would like to express our thanks to a number of sources for permission to use their photographs including Australian Sugar Producers' Association, Cocksedge & Co. Ltd. and Süddeutsche Zucker-AG.

We are also pleased to announce that Dr. K. J. Parker, Consultant and former Chief Scientist of Tate & Lyle Ltd., has kindly agreed to join our Panel of Referees and to advise us on the suitability of submitted manuscripts for publication in *ISJ.* We and our readers will be most grateful to Dr. Parker for allowing us the benefit of his knowledge and experience.

International Sugar Agreement

The Executive Committee of the International Sugar Organization was reported[1] in April to have accepted the agenda proposed by the Council for the International Sugar Conference to be held in Geneva during May 2-20. The Committee also accepted requests by Argentina, India, Malawi, Nicaragua and Zimbabwe to consider their 1982 export quota shortfalls to be considered as due to *force majeure.* It was decided that Peru could delay its special stocks obligation until the end of 1984 and that El Salvador should stock 40% of its obligation by June 30, 1984 and the remainder by the end of the year.

Norway's application for increased imports from non-member countries was opposed by Austria and the issue was deferred; Norway wishes to increase imports from the EEC because of the price advantage in shipping from nearby locations. Jamaica also asked to import white sugar from non-members but action on this request was also deferred. The next ISO Executive Committee was expected to be on May 19 in Geneva, where members were attending the Conference, and was expected to discuss estimated import requirements for 1984.

F. O. Licht recently discussed the Geneva Conference and mentioned the working document prepared by the ISO and submitted to the Secretary-General of UNCTAD[2]. "The document, of course, does not commit delegations, even where they may have been responsible for the inclusion of specific proposals. Indeed, it will be recalled that the agreement which emerged at the end of the 1977 conference differed in many important aspects from the working draft. Nevertheless, much work has gone into its preparation and areas where there can be little contention have been clearly specified. This will greatly speed up the work in Geneva. Where there are differences of opinion, these have been clearly defined so that governments can consider the ramifications of the differing options and can decide where their national interest can best be served in advance of the actual conference.

"Probably the most fundamental difference of opinion which is likely to arise is over the type of regulatory mechanism to be adopted as a measure to stabilize the free market price. In earlier agreements the favoured procedure has been to establish export quotas for all except the smallest exporters, backed up in recent agreements with stocking or supply commitments, and it seems to be the arrangement which is most supported. This is one approach; an entirely new proposal has been submitted which, if adopted, would free the major exporters from quota limitations but would oblige them to undertake stocking obligations when necessary for the health of the market.

"A third variation, based on the traditional quota approach, but also involving the need for higher stocking levels, would allot export quotas annually on the basis of predetermined basic export tonnages, but geared to the estimated free market outlet. In the existing agreement some countries are excluded from export quota provisions but they are nevertheless permitted to export up to 70,000 tonnes a year. It has been suggested that it would be realistic to expand the group to include those exporting a somewhat larger tonnage; various quantities have been mentioned up to 140,000 tonnes.

"The whole question of the levels of price at which action should be taken to increase or decrease quotas, or adjust stocks as the case may be, is one which will surely occasion much discussion in Geneva. Whether the price range should be ten cents per pound, as at present, or whether it should be expanded, and whether quite so many trigger points are needed, will also have to be decided. Then, again, consideration will have to be given to whether there should be a range at all, for reference has been made to replacing the whole spread concept with a single pivotal price.

"The current arrangements provide for the establishment of special stocks amounting eventually to 2.5 million tonnes and for these to be released only when needed so as to augment supplies at a time of high world market prices. There has been a suggestion that a higher tonnage would make this facility more effective.

"The concept that sugar exported in accordance with certain pre-arranged conditions established on a government-to-government basis should be excluded from the provisions of the ISA has been enshrined in previous arrangements. These are the special arrangements and they currently embrace exports to the EEC under the provisions of the Lomé Convention and also most of the trade between the socialist group of countries. In the past, exports to the USA under the terms of the Sugar Act were also classed as a special arrangement but since its expiration exports to the USA have been treated as part of the world free market. There have now been suggestions that, since shipments to the USA currently come within specific quota provisions, they should once again be treated as a special arrangement.

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[1] F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 208.
[2] *ibid.,* 223-224.

"On the other hand, it has also been suggested that *all* international sugar trade should come within the orbit of the agreement, including tonnages exported under special arrangements. It is not intended that there should be any interference with the quantities moving and prices paid within such procedures, but it is felt that advantages would flow from the inclusion of the quantities involved within the overall ISA quota provisions. Whether the scope of the special arrangements provisions is to be enlarged or whether they are to be included within the arrangements governing quota procedures, there has also been a call for a greater clarification of what tonnages are actually covered by such arrangements, so that a clearer view of the overall market may be obtained.

"It is apparent that the current agreement has not been a successful instrument with which to influence world market prices and a new ISA will have to incorporate different and more effective provisions. Many new ideas have been put forward and no doubt others will emerge in Geneva, but it also has to be reckoned with that national interests have frequently been well served by one or other of the various provisions where amendments or basic alterations are now being suggested. Many will call for changes but it will not be easy to decide upon which ones to make". Nevertheless, the hopes of most people in the sugar industry will be with the delegates in Geneva and we add our best wishes for a successful outcome to their deliberations in the form of an effective agreement which can restore prosperity to our industry.

GEPLACEA meeting

In the middle of April the Group of Latin American and Caribbean Sugar Exporters met in Mexico City to try to work out ways in which they could seek a common proposal for the International Sugar Conference to take place in Geneva in May. At the end of the meeting the Group had adopted the position that the member countries would like to see a new Agreement taking effect from January 1984 and based on the same control mechanisms as the existing Agreement, i.e. a combination of export quotas and special stocks. They believe that a new Agreement should make a distinction between cane and beet sugar exporters and should provide preferential treatment for developing countries which were exporters. Of course, this classification would include the members of GEPLACEA themselves, although they include major exporters such as Brazil and Cuba, and the Philippines as an associate member of the Group. However, the importance of the Group lies in their role as suppliers of almost half the sugar entering the world market.

World sugar prices

The London Daily Price for raw sugar, which had ended the month of March on a buoyant note, slid from its £115 level at the beginning of April with quiet trading after the Easter holidays. Sterling's recovery against the dollar and low-priced Dominican Republic selling tenders were mainly responsible for a slide to £107 on April 7. Further fluctuations in sterling led to some variation in the LDP between £107 and £110 during the next week while fears of liquidation of the prompt position on the New York Futures Exchange leading to distressed sugar resulted in a fall to £102 per tonne on April 14.

New reports of further flooding and waterlogging of fields, with consequent delays in beet drilling, strengthened the market and the LDP started to rise, reaching £114 on April 21. After a drop the next day to £111 the rise resumed and the LDP ended the month at £122 per tonne, its highest level since July 1982. Factors influencing this rise included the reports of potential nearby tightness of supplies, deferment of shipping of 150,000 tonnes of Thai sugar, currency speculation and the effect of enthusiasm in other commodity markets.

White sugar prices were much more stable during the month, although partly affected by raw sugar values. However, from an initial £147 per tonne, the LDP(W) slid only to £140 on April 13, rose again to £146.50 on April 26 and ended the month at £145 per tonne.

London sugar futures market currency

The meeting of the United Terminal Sugar Market Association referred to in our last issue[1] took place as scheduled and decided that, from June 1, a new raw sugar contract, designated the No. 6 Contract, will come into operation in which prices will be quoted in US dollars, with October 1983 as the first trading month. At the same time it was decided to launch a new dollar-based white sugar contract, to be called the No. 5 Contract, and it is hoped that trading on this contract will begin in July.

US sugar policy study[2]

The Sugar Users Group has released a report on US sweetener markets and policies prepared by Schnittker Associates, Washington analysts. The study considers current US government policy as economically inefficient; it imposes a cost on consumers that is out of proportion to the benefits provided to producers. Moreover, it ensures that the domestically produced share of US sweetener requirements will continue to climb, rising from 58% in 1970 to a predicted 78% in 1990. It is also considered inconsistent with many other government farm, trade and economic policies.

A variable cost option would provide a safety net for efficient domestic producers and a viable domestic sweetener market where supplies of every type of sweetener could compete. This would impose some capital losses on domestic producers, and reduce consumer costs by $1200 million per year. It would result in domestic production of 73% of sweetener needs and 52% of sugar needs and would be consistent with other government farm and economic policy.

A no-program option would be the most economically efficient approach, the report says. It would impose a capital loss of about $1000 million on domestic sugar producers but save US consumers $2000-$3000 million per year. Moreover, this would return sugar imports to accounting for 39% of US sweetener consumption and represent a less interventionist approach than most other government farm and economic policies.

The report also forecasts an increase of world sugar consumption during the 1980's but at about half the rate of the 1970's. Prices are also expected to rise during the 1980's, with a peak in 1985/86, depending on policies and other events influencing price. It also considers that sugar will account for a smaller share of world sweetener consumption during the decade as use of starch-based sweeteners and low-calorie sweeteners increases. It estimates sugar use will decline to 85.4% in 1990 from 89.4% in 1980, with starch-based sweetener use increasing from 8.8% to 11.4% and that of low-calorie sweeteners from 1.8% to 3.2%.

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[1] *I.S.J.*, 1983, **85**, 130.

[2] F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 161-162.

Sugar boiling theory and practice

By CHRISTIAN MOLLER
(A/S De Danske Sukkerfabrikker, Gorlev)

Introduction

Indispensable conditions for being able to produce a good quality sugar are: (A) good quality feed syrup, (B) well-designed pans and (C) a pan boiling technique giving uniform grain quality with a minimum amount of conglomerates. Really, the combating of conglomerate formation is the central point of sugar boiling; conglomerates promote formation of false grains, they lower the rate of crystal growth and they make the washing of the sugar crystals during spinning very difficult and thereby (A) lower the quality of the final sugar and (B) increase the steam consumption of the pan station.

The sugar boiling technique used today in DDS factories and the DDS pan design are based on a conception of the formation of conglomerates first published in this journal in 1947[1] and described later in 1954[2].

Types of conglomerate

A careful investigation of the conglomerates which occur shows two quite different types (Figs. 1, 2).

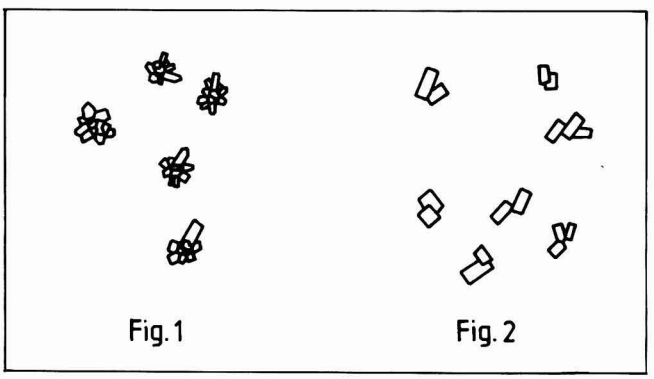


Fig. 1. Starlike conglomerates
Fig. 2. Double-grain conglomerates

The first is the starlike type with radiated structure (Fig. 1) which arises from imperfect distribution of the seeding material in the supersaturated juice.

The second kind of conglomerate (Fig. 2) is the double-grained type. These start as single crystals but very soon, in an extremely well defined interval of grain size between 50 μ and 150 μ, become linked irreversibly with other crystals, whereafter they grow together and form the double grains.

Double-grain formation theory

The tendency of single crystals to form double grains is explained by the graph in Figure 3. This tendency is strongly dependent on the grain size; as long as the crystals are very small and the speed of crystal growth is high, the probability (p) of collision and double-grain formation is proportional to the concentration of grains (c), the velocity of circulation (v) and to the square of the grain size l^2, i.e. $p = k_1 l^2 vc$. Here we have made the assumption that all crystal collisions are inelastic and result in formation of double grains.

Laboratory experiments have shown us that under these circumstances, with small grain sizes and purity levels about 92, it requires only about 2 seconds for two single crystals to grow together, forming a double grain. Above a certain grain size l_1 the increasing kinetic energies of the growing crystals will influence the formation of double grains. Under favourable collision conditions two colliding crystals might separate from each other again without growing together. These favourable circumstances are in practice supported further by a reduction of the rate of crystal growth obtained by a systematic thinning of the strike.

Beyond this point of grain size l_1, the probability of conglomerate formation is also inversely proportional to the crystal kinetic energies, that is:

$$p = \frac{k_2}{l^3 v^2}$$

Consequently the resulting conglomerate formation probability will now be:

$$p = \frac{k_3 c}{lv}$$

From this we see that, above a certain grain size, the probability of conglomeration is negligible.

Consequences of the theory of conglomeration

By using seed material of nucleus size coarser than about 150 μ it is possible to avoid conglomerates

C. Moller

[1] *I.S.J.*, 1947, **49**, 182-183.
[2] *Sugar*, 1954, **49**, (11), 49-50.

completely – a method we have tested with good results on coarse-grain boiling. As the formation of conglomerates increases in proportion to the concentration of grains, it is clear that pan designs with extremely small graining volumes are disadvantageous as to the obtainable grain quality.

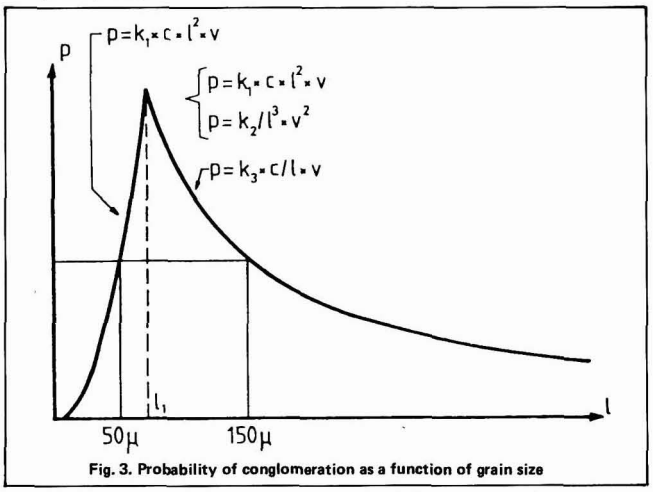


Fig. 3. Probability of conglomeration as a function of grain size

From Figure 3 we learn that pan circulation is important for reduction of conglomerate formation – not at the seeding point but above a certain grain size, where the crystal kinetic energies influence the colliding of the crystals. The fact that heterogeneous grain development increases the amount of conglomerates is easily understood by means of Figure 3, since the period of time when grains are found between 50 μ and 150 μ is correspondingly lengthened.

The zones in the pan with the poorest circulation determine the quality of the final sugar, and thus characterize the quality of the pan. Extensive standard pan boiling tests on various types of pans taught us definitely to prefer calandria pans with ample downtakes and flat bottom design, as against pans with floating calandrias, the former giving the best quality sugar. These investigations were decisive to our present pan design. At the same time we realized that continuous sugar boiling could not give us the high quality grain for which we were aiming.

The DDS pan design

In 1952 we built a new pan with a stream-line bottom, and this was a great advance. However, the increase of circulation during the graining period still had to be done by means of injected steam, and in 1958 we first started our tests with stirrers. In collaboration with the Technical University of Copenhagen, we ran a lot of trials, resulting in the very effective stirrer we are using in all our pans today.

The stirrer meant an enormous progress in sugar boiling as the effect of water evaporation on pan circulation now became negligible compared with the effect of the stirrer. The need for increased circulation during the graining period could easily be met by means of a stirrer motor with adjustable speed. We fixed the speed of the stirrer on the basis of many pilot experiments and full scale pan boiling tests.

Sugar boiling control

In the early forties the sugar boiling control devices of DDS were a recording conductivity instrument and the DDS pan microscope. These accessories, together with the acquired knowledge on conglomerate formation, allowed a systematic and well-founded treatment of the strike during the critical period of graining – a great advance, compared with the haphazard sugar boiling of former days. However, valve operations were made by hand, involving the uncertainty of all manual operations.

Figure 4 shows a conductivity diagram from the forties with manually operated valves and a conductivity diagram from the 1980 campaign for an A-pan with a DDS pan boiling controller. Apart from the deviation in graduation, the two diagrams are very much alike. Once the optimum conditions are found, the controller enables us to duplicate indefinitely the optimum treatment of a strike, provided the feed syrup quality is constant. All variations to the controller adjustment have to be monitored regularly by the pan microscope and corrected if necessary.

An important detail in the diagrams shown in Figure 4 is the "waiting period" just after graining, during which we maintain the high graining supersaturation for several minutes, keeping in mind the very low probability of conglomeration, as long as the grain size is smaller than about 50 μ.

Graining material

The high supersaturation maintained during the previously mentioned waiting period is very important for even grain development and in turn for the combating of conglomerate formation. This is due to the fact that, during the very first period of crystal development, the velocity of crystal growth is strongly dependent on the grain size, i.e. if the supersaturation is lowered too early a more heterogeneous grain development will occur.

Icing sugar is a rather non-homogeneous material, and as a consequence of the above-mentioned phenomena the number of developed nuclei per gram of icing sugar must be increased at seeding for increasing at higher levels of supersaturation (Fig. 5).

The curve is obtained by weighing a quantity of thick juice at room temperature and seeding it at increasing supersaturation with a weighed amount of icing sugar; after even distribution in the juice the concentration of the developed nuclei is determined by means of a counter-chamber. The degree of supersaturation measured on the pan floor with automatic seeding at fixed controller-setpoint was found to be in the range 1.46 to 1.62. From Figure 5 we see that this corresponds to a factor of about 2 in the number of developed grains. Thus we will get a maximum deviation factor of the mean grain size from strike to strike from 1 to $\sqrt[3]{2}$ or about 1.26.

Conclusions

Our knowledge on the theoretical and practical side of sugar boiling has been increased considerably during

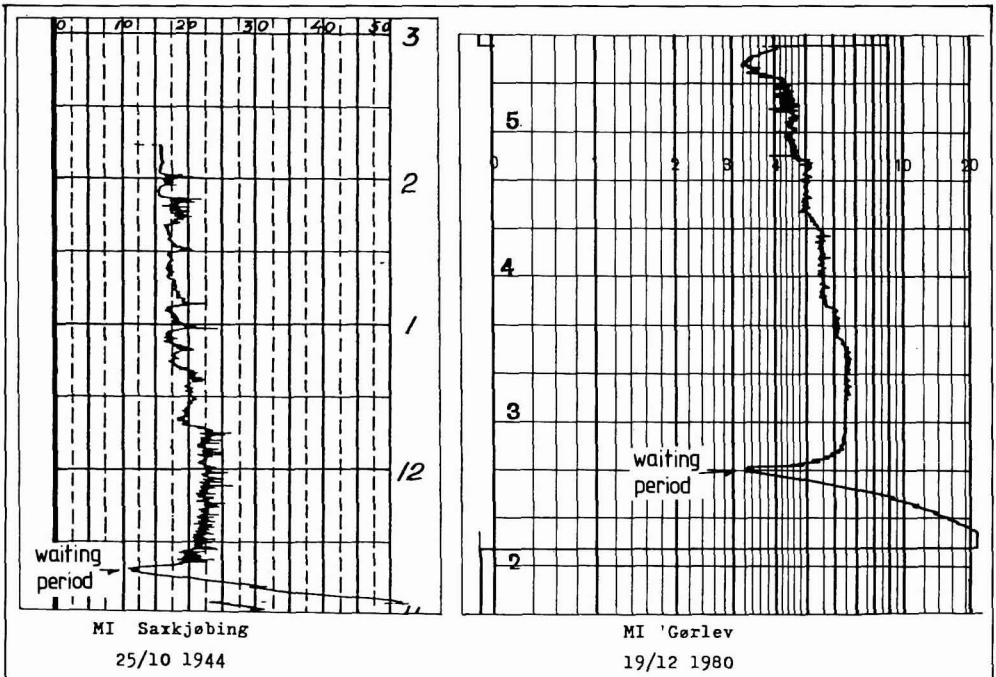


Fig. 4. Conductivity diagrams from 1944 and 1980

recent decades, and the work of the pan operator has been facilitated and systematized to a great extent. But further development of this basic process of the sugar industry can be foreseen. Improved seeding material with fewer fines and better reproducibility of the developed number of nuclei at graining is an obvious target. Sophisticated automatic control of massecuite temperature and vapour pressure in the calandria seems to give extremely promising results in respect of sugar quality, steam economy, constant rate of steam consumption, increased pan station capacity, and thus improved constancy of feed syrup consumption.

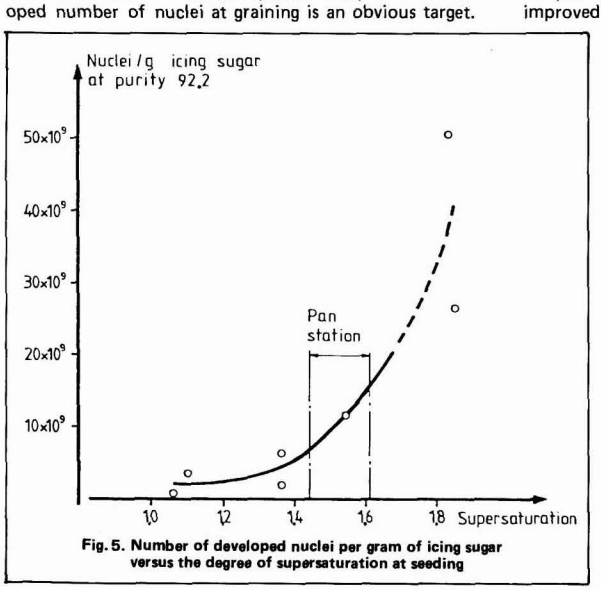


Fig. 5. Number of developed nuclei per gram of icing sugar versus the degree of supersaturation at seeding

Summary

The author discusses the theoretical basis for the DDS system of pan boiling and control and also areas where further development may be expected.

Théorie et pratique de cuisson de sucre

L'auteur discute la base théorique pour le système DDS de cuisson et de son contrôle. On énumère également les domaines dans lesquels on peut s'attendre à de nouveaux développements.

Theorie und Praxis des Zuckerkochens

Der Autor erörtert die theoretischen Grundlagen des DDS-Verkochungs und -Kontrollsystems sowie Bereiche, in denen weitere Entwicklungen erwartet werden.

Teoría y práctica en cocción de azúcar

El autor discute la base teórica de la sistema DDS de cocción en tachos y su control, y también áreas en que desarrollo adicional puede esperarse.

Removing insoluble matter from standard liquor

By N. R. TWAITE, M. SHORE and A. J. RANDALL
(British Sugar plc, Peterborough, England).

PART I

Introduction

All British Sugar factories use a three-boiling system, the majority sending the after-product sugar as a magma to the B-raw pans and producing standard liquor from evaporator thick juice, raw (and A.P.) sugar, remelt white sugar, and white centrifugal wash syrup.

The standard liquor is made in a system of compartmented or separate stirred dissolvers and normally the majority of the heat required is supplied by 2nd or 3rd effect vapour from a heater recirculation system.

Standard liquor is fed with filter aid, heated to filtration temperature (if required) and then passed through the appropriate filtration equipment. The standard liquor as produced and filtered last campaign in British Sugar factories is shown in Table I.

Table I

Factory	Quantity of standard liquor % white sugar	81/82 Campaign average	
		°Brix	Purity
Allscott	324	64.9	93.1
Bardney	291	70.1	91.0
Brigg	-	69.1	92.3
Bury	308	66.3	94.0
Cantley	317	66.0	93.2
Ipswich	-	66.9	92.6
Kidderminster	285	68.5	92.6
King's Lynn	291	67.2	93.4
Newark	311	67.5	92.5
Peterborough	339	65.2	92.4
Spalding	-	67.0	92.5
Wissington	331	67.7	93.1
York	-	67.1	92.0

The filtered standard liquor is the only feed to the A-white pans used to make the finished product.

The need for filtration

Sucrose is the purest chemical produced in bulk and used as a food, and it should be as free as possible from insoluble impurities. Historically, proper filtration with the correct use of good filter media and filter aid, with careful operation can lead to a level of 2-3 ppm of insolubles in the white sugar.

Carruthers, Oldfield & Shore[1] found that some 70-160 ppm of insolubles would be passed to the vacuum pans if standard liquor filtration were omitted. This was found to be mainly calcium oxalate, with other calcium salts, some oil and protein material.

Calcium oxalate was also found to precipitate in the later stages of the evaporators and also in the raw and A.P. pans and so was returned to standard liquor. For other than specialized users of sucrose, the type of impurities found would have no real significance and are in no way harmful at these levels.

The various sections of the sugar market have differing needs. The large domestic part of the market requires a good white sugar free from visual contamination, particularly black specks and unwashed brown sugar crystals. Quite a large part of the industrial market also wants this type of sugar. A much smaller market requires a very pure chemical grade of product and the liquid sugar market requires a completely clear solution with low colour.

The minimum requirement for the domestic and part of the industrial market would be to remove all solids down to around 50 μm size, below which visual identification of particles becomes difficult and almost impossible by most people. For the specialist market, filtration of solids down to 1 μm is required and in certain cases also sugars having low acid floc levels and low foaming properties must be specially produced. It is necessary to filter all liquid sugar solutions prior to despatch, so the requirements for the two factories dedicated to its production (Bardney and King's Lynn) again have a different product from the remainder.

Use of filtration

Sugar factories manufacturing white sugar generally use filtration to remove insolubles from the feed to the first product pans. This system is probably the best available for removing the majority of insolubles down to the 1 μm size but suffers from several disadvantages, including the following:

- High capital cost of installation.
- High operating cost in use of filter media, filter aid, labour, heat requirement owing to the dilution, restriction on concentration of feed and heat losses from the system.

Paper presented to the 26th Tech. Conf., British Sugar plc, 1982.

[1] *Paper presented to the 18th Tech. Conf., British Sugar Corp.,* 1966.

N. R. Twaite

M. Shore

A. J. Randall

– Dangers of getting filter aid leakage into product.

The equipment in use in Britain has traditionally been the plate and frame filter press and many factories are still so equipped as shown in the following table.

Table II

Factory	Average white sugar production tonnes/day	Filtration area		1981/82 ave. turbidity, ICUMSA units	Insolubles 4-year average	
		m^2	$m^2.tonne^{-1}$ white sugar		mg/kg	S.D.
Allscott	422	255	0.60	10.3	2.9	1.7
Bardney	615	350	0.57	17.7	4.1	3.3
Brigg	566	352	0.62	20.3	4.9	4.3
Cantley	881	552	0.63	14.2	6.2	2.0
Ipswich	648	263	0.41	8.3	4.6	4.7
Kidderminster	503	318	0.63	16.3	3.4	2.5
King's Lynn	634	317	0.50	11.9	4.3	3.9
York	515	436	0.85	3.9	3.7	4.0

The high operating costs and the need to replace some of the plate and frame presses led to a study of alternative types of filters for this duty towards the end of the 1950's. Both leaf filters and candle filters were tried (Fasflo leaf filters at Spalding and York, and Stellar filters at Newark).

Problems were encountered in the design and construction of both types, mainly with the fixing of the cloths or woven wire to the leaves of the Fasflo filters. There were also difficulties in washing the cake off the horizontal leaves and with the sealing and fixing of the candles and in maintaining a constant flow to prevent the filter aid falling off the candles.

Tests were carried out on a Funda filter at King's Lynn and a Schenk unit at Spalding. Both gave good results and it was decided to instal Schenk filters as part of the capacity increase programme at the reconstructed factories that needed additional filtration area. Installations at present in use are given in Table III.

When comparing turbidity figures it should be noted that certain factories used various antiscaling agents last campaign. The influence of these will be discussed below.

Table III

Factory	Average white sugar production tonnes/day	Filtration area		1981/82 ave. turbidity, ICUMSA units	Insolubles	
		m^2	$m^2.tonne^{-1}$ white sugar		mg/kg	S.D.
Bury	1018	364	0.36	2.3	3.4	2.0
Newark	629	260	0.41	4.9	4.6	2.1
Peterborough	669	260	0.39	6.9	4.3	1.8
Spalding	639	320 *	0.50	9.3	4.3	1.6
Wissington	952	364	0.38	4.7	3.2	1.8

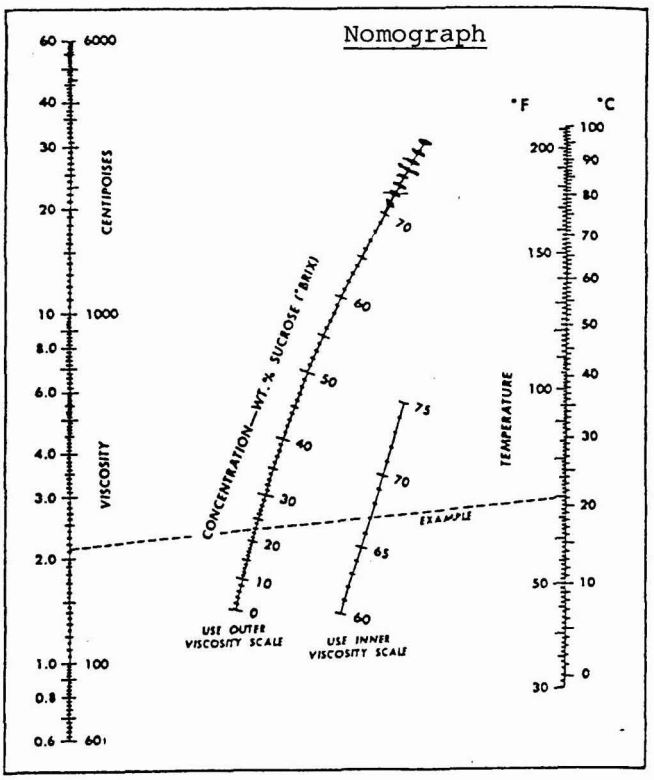
* includes 120 m^2 of area from three Fasflo filters.

Optimum conditions of filtration

(a) Maximum solution solids

For process heat economy it is necessary to do as much evaporation as possible in the evaporators and hence as little as practical in the vacuum pans. It is thus desirable to make the Brix of the standard liquor as high as possible subject to obtaining good crystallization conditions in the pans and a consistent white sugar product.

This consideration has led to a target Brix of 70°-72° for standard liquor and in order to reduce the viscosity to a reasonable practical level it is necessary to heat the filtrate to around 90°C. The dependency of viscosity on temperature is shown in the following nomograph[2] for pure sugar solutions.



Popov[3] gives the viscosity effect of lower purity juices at 80°C. In the standard liquor range of around 70% dissolved solids w/w and 92 purity, he found that the solution would have a viscosity around 1.3 times higher than that of pure sucrose. However, Bennett & Nees[4] found in their experiments which have been put in table form by McGinnis[5] that viscosities of impure sugar solutions were lower than those of pure sucrose under the same conditions. The nature of the impurities therefore determines the viscosities of the solutions and they have to be determined for the particular juice under the individual factory conditions.

(b) Filter media

The factories using plate and frame presses use filter media as shown in the following table:

Table IV

Factory	Cloth used	Cost £/100 tonnes sugar
Allscott	Double cotton 18oz	15.9
Bardney	Neotex 3670	8.1
Brigg	Neotex 3670	20.9
Cantley	Lainyl Mono	9.5
Ipswich	Lainyl Mono	9.6
Kidderminster	Neotex 3670	8.1
King's Lynn	Neotex 3670	5.8 *
York	Neotex 2133/ Propex No.3	17.9

* 75% of juice filtered through presses.

The five factories equipped with Schenk filters have 100 μm stainless steel mesh fabric fitted as the filter media.

(c) Filter aids

Two types of filter aid are available, perlites and diatomites. The perlite is obtained from a volcanic rock which has been expanded and milled whereas the diatomite is the skeletal remains of tiny aquatic plants.

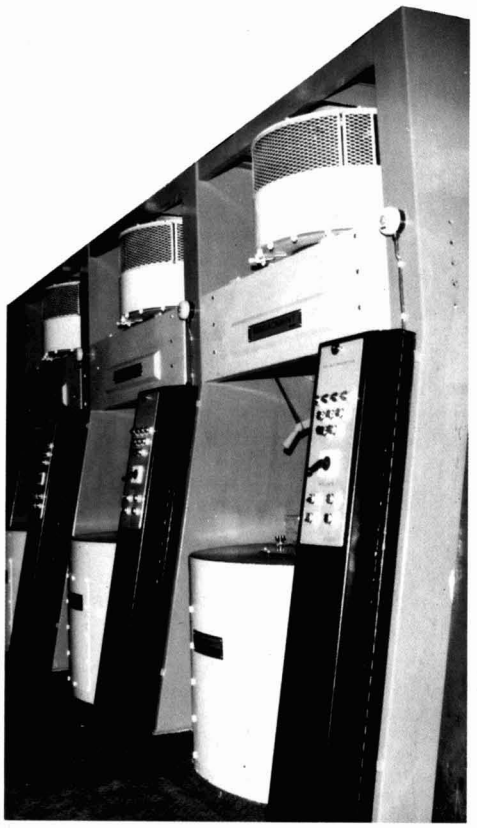
Perlite particles retain a more open structure with a regular shape whereas the diatomite have more intricately shaped particles. These latter filter aids allow a faster flow rate and retain insoluble particles better than perlite.

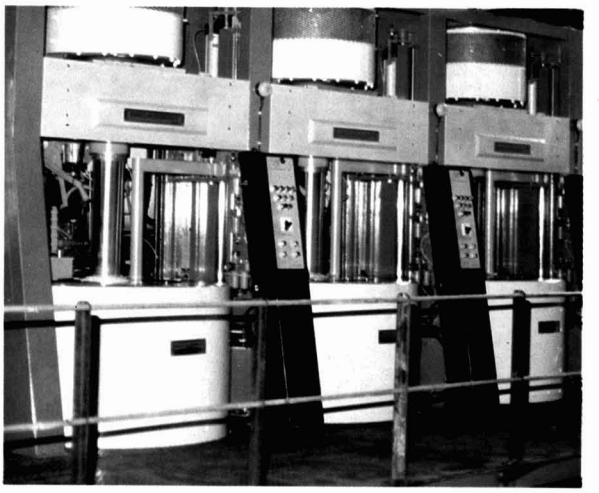
Johns-Manville manufacture both types of filter aid and in 1964 published[6] results of filtration tests carried out on standard liquor. In general the findings were that filtration with diatomite gave longer cycles and better clarity than with the equivalent size range of perlite.

Flux-calcined diatomaceous earth filter aids contain a considerable proportion of cristobalite, which on inhalation is a health hazard as it is known to be a cause of pneumoconiosis. The Threshold Limit Value (exposure over an 8-hour period per day) proposed by the UK Health & Safety Executive is, therefore, very low for these materials at 0.08 mg of respirable dust per m^3 of air, compared with the figure of 10 mg per m^3 for perlite filter aid dust.

Where it is necessary for such filter aids to be used, operations must be strictly controlled. Employees handling the material should wear suitable dust masks and exhaust ventilation should be provided in tipping areas to minimize the escape of dust.

[2] Nomograph of viscosity for pure sucrose solutions – adapted from "This is Liquid Sugar" (Refined Syrups and Sugars, Yonkers, N.Y.) 1955, p.138.
[3] *Derzh. Vid. Tekhn. Lit.* (Kiev), 1958, 106-121.
[4] *Ind. Eng. Chem.*, 1930, **22**, 91.
[5] "Beet Sugar Technology", 2nd Ed. (Beet Sugar Development Foundation, Fort Collins, Colo.) 1971, p.582.
[6] Smith: *Proc. Amer. Soc. Sugar Beet Tech.*, 1964.





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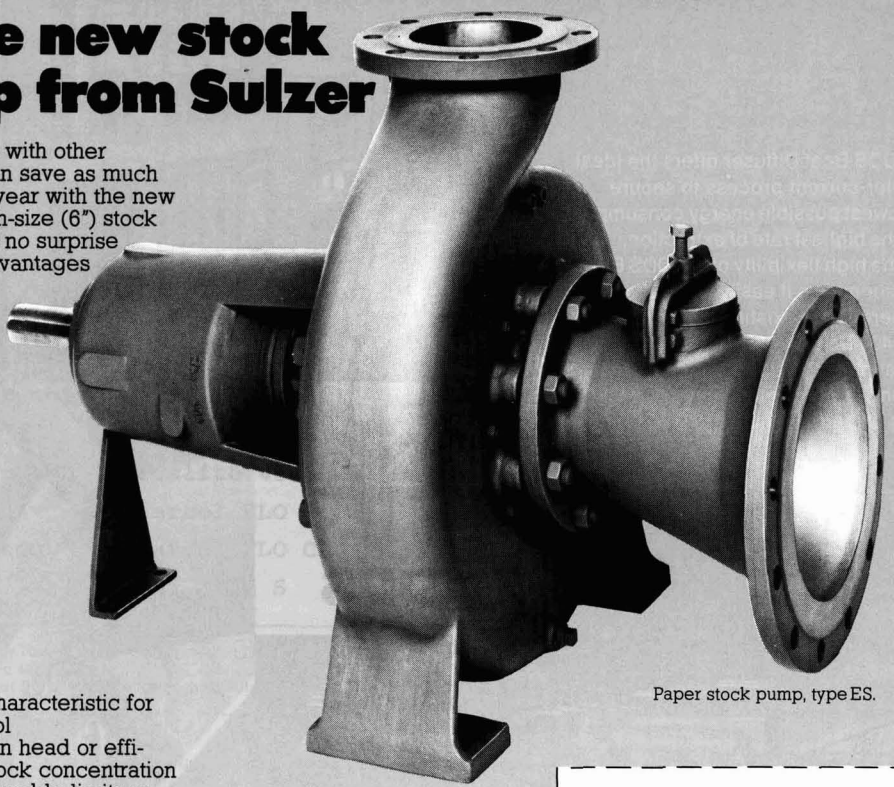

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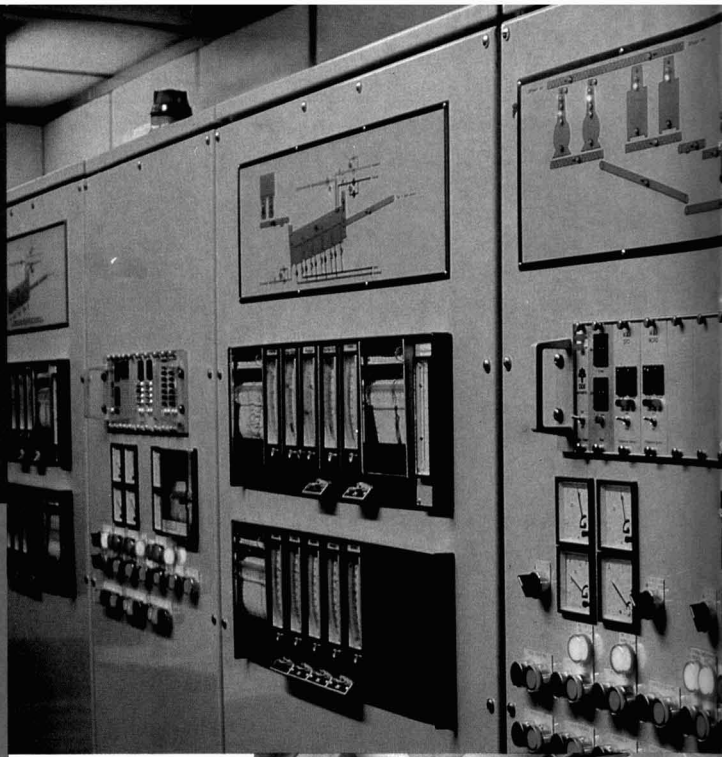

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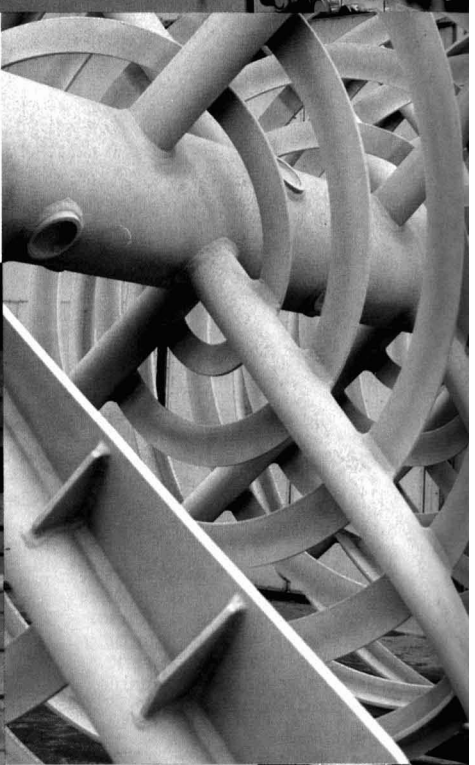

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The British Sugar usage of filter aid for the 1981/82 campaign is as given in the following table which shows that all factories except one use perlite for standard liquor filtration.

There is no significant evidence that the use of diatomite at Allscott factory gives a better quality of sugar. However, the results for that factory are very good both in terms of insolubles and turbidity, even when using antiscaling agents. It was also found necessary to use a diatomite to achieve reasonable filtration at one factory during the thick juice refining run to deal with a stored juice which contained fine calcium oxalate crystals in suspension.

Table V

Factory	Filter aid	Quantity used kg/100 tonnes sugar	Type	Cost £/100 tonnes of sugar produced
Allscott	Clarcel DIC	150	Diatomite	38
Bardney	Dicalite 4308	68	Perlite	19
Brigg	Dicalite 4208	57	Perlite	14
Bury	Dicalite 4258+	50	Perlite	17
Cantley	Clarcel CR or FLO1	50	Perlite	11
Ipswich	Dicalite 4258+	52	Perlite	14
Kidderminster	J.M. J150 S	71	Perlite	18
King's Lynn	Dicalite 4258	45*	Perlite	12
Newark	Dicalite 4308	29	Perlite	11
Peterborough	Dicalite 4308[x]	70	Perlite	19
Spalding	Clarcel FLO 1	68	Perlite	17
Wissington	Clarcel FLO CR	107	Perlite	35
York	J.M. J150 S	81	Perlite	21

+ Also some Randalite W24 and Clarcel FLO CR.
[x] Plus some Clarcel FLO-CR.
* 20-25% of the juice passed through an Alfa-Laval centrifuge without filter-aid.

Alternatives to filtration

There are a number of alternatives to filtration depending upon the size, shape and density of particles to be removed.

(a) Screening

With the correct equipment, standard liquor can be screened to remove particles down to 1 mm with ease and possibly down to 100 μm (0.1 mm). The automatically cleaned strainers at King's Lynn are supplied with 1 mm round hole screens.

Micro-strainers are also available with screen sizes down to 23 μm[7] but as yet these have not been tried on standard liquor by British Sugar.

(b) Hydrocyclones

The efficiency of these depends upon the difference in density between the insolubles and sugar solution. With a difference in density of around 0.5g.cm^{-3} it should be possible to remove particles down to 10-20 μm in size. Two types of hydrocyclone have been tried at King's Lynn, the Celleco and the Alfa Laval MOCL 112 cluster of "mini" cyclones. Each of these was protected with a strainer of the type described in (a) above.

Genappe factory, in Belgium, carries out solids removal with a battery of four Celleco hydrocyclones which handle the total juice flow.

(c) Centrifuges

High-speed bowl centrifuges have been used in a number of countries as an alternative to filtration. A number of Westfalia separators have been installed as follows.

Denmark	–	Nakskov	–	Six SA 60
	–	Stege	–	Four SB 60
	–	Nykobing	–	Six SA 60
			–	One SB 80
Yugoslavia	–	I.P.K.	–	Four SA 60

[7] Purchas: "Solid/Liquid Separation Technology", (Uplands Press) 1981, p.221.

France — Chevrier
— Colleville
— Germainmont

These machines run at 4500 rpm.

In 1978, an Alfa Laval AX 213 was installed in King's Lynn factory for trials and has since been purchased and used as a production unit. Three similar machines have also been installed in Artenay factory in France. Initially much damage was caused to the plastic drain plugs by solid particles such that a screen and hydrocyclone had to be mounted in front of the centrifuge. These removed the larger particles and much prolonged the life of the plugs, normally around 2 weeks. The other main problem was scaling up of the centrifuge bowl with oxalate. A chemical cleaning-in-position system using EDTA was installed and a daily treatment eliminated the scale formation. The units run at a speed of 6,000 rpm.

The main advantages compared with the filter presses were found to be:

(1) Standard liquor of higher Brix can be handled.
(2) Labour requirement is negligible.
(3) No filter aid or filter media is required.
(4) The system is very clean with potential for a reduced heat loss.

The only disadvantages were the high electrical requirement of 37 kW per machine and the noise.

Performance of alternative systems

(a) Screening

Results obtained using 1 mm Alfa-Laval automatic cleaning strainers are reported below in terms of the sugar produced using the screens.

Table VI

Sugar source	Amount/ No. of tests	Insoluble matter, mg/kg	Solution turbidity, ICUMSA units
Raffinade pan	260 tonnes	12.2	6
White pans	1 composite	10.3	8
From store	Sample	20.8	8

While the turbidity values were normal, the amount of insoluble matter was rather higher than normal.

(b) Hydrocyclones

Results obtained on the Celleco hydrocyclone were as follows for standard liquor:

Table VII

Campaign	No. of samples of standard liquor	Insoluble matter mg/kg					
		Average		Standard deviation		Range	
		IN	OUT	IN	OUT	IN	OUT
1978/79	22	10.37	10.43	6.52	8.21	3-24	1-36
1979/80	42	9.59	8.25	5.30	5.41	3-25	1-36

The hydrocyclones appear to have taken very little material out of the juice.

The sugar produced from the standard liquor treated by Alfa Laval MOCL 112 "mini" hydrocyclones gave the following analysis:

Table VIII

Sugar	Amount/ No. of samples	Insoluble matter, mg/kg	Solution turbidity, ICUMSA units
As produced in:			
Raffinade pan	186 tonnes	41.1	12
From store	1 composite	35.2	16

The insoluble matter is very much greater than normal whilst the turbidity is in the range normally experienced.

(c) Centrifuge(s)

Results obtained on standard liquor and sugar are reported as follows:

Table IX

Factory	King's Lynn						Nakskov[8]
Year	1978	1979	1979*	1980*	1981	1981*	
No. of samples	22	42	60	99	1	6	
Insoluble matter, mg/kg							
Average:							
in	10.43	8.25	–	–	–	–	13.4
out	6.09	5.31	4.52	5.14	5.6	2.4	9.2
Standard deviation:							
in	8.21	5.41	–	–	–	–	
out	4.69	5.17	2.74	3.85	–	1.25	
Range:							
in	1-36	1-36	–	–	–	–	
out	2-19	0-21	1-16	1-20	–	0.5-3.8	
Solution turbidity, ICUMSA units	–	–	–	5.7	3	3	

* on sugar.

The centrifuges produced a significant reduction in the insoluble material.

(d) Filter presses

Results obtained on the filter presses at the same time as the above tests were:

Table X

Sugar	No. of samples	Insoluble matter, mg/kg		Solution turbidity, ICUMSA units	
		Average	Range	Average	Range
Raffinade pan	1	2.2	-	3	-
White pans	3	5.5	3.8-7.8	3	2-4
From store	7	4.3	2.7-6.2	9	3-32

The insoluble matter is only slightly lower than the values in Table IX whilst the turbidity values are almost identical. *(To be contd.)*

[8] Nielsen: *Paper presented to Int. Sugar Tech. Staff Conf.* (Ireland), 1977.

Use of an energy model in sugar refining

By H. R. DELANEY, D. GOTTHARD
and J. B. NICHOLS
(CSR Limited, Sydney, Australia)

A computer-based energy model has been developed for use in CSR refineries. The model is able to predict total energy requirements for refining raw sugar according to specified process conditions and product mixes. The basic philosophy adopted during development of the model was that it should be able to account for such factors as raw sugar composition, product mix, processing variations and actual process conditions. The basic model has been modified to account for variations in the process for each individual refinery.

The model for one CSR refinery is described in this paper. It is, as are all the others, a stand-alone system which requires data entry from a terminal. Approximately one hundred and eighty individual items are required as input data and computations are made to:

1. calculate the overall mass balance on a dry basis per hundred melt, and
2. calculate total steam for heating and evaporation, based on the mass balance, and determine the total energy requirement.

Quantities of liquid sugars and other specialty lower purity products are specified as input data. The calculation of the mass balance then splits the remainder of the melt between white granulated crystal and molasses. A purity balance then allows the quantities of all streams to be calculated.

Steam for process heating and evaporation is then determined by applying heat and mass balances, station by station. The steam for hot water heating is determined by calculating hot water and sweetwater usages at each station. Amalgamation of all this information produces the total process steam requirement. The model does not take account of heat losses of any form or excess water added to the process. Boiler fuel is determined by correcting the steam requirements for boiler efficiency. Total energy requirement for the whole refinery is then determined by adding energy for the char kilns and actual electrical usage to boiler fuel.

Comparisons of actual and computed mass balances have shown that main course materials are accurately predicted by the model. Although boil-out (or recovery) materials are not accurately predicted by the model on a percentage basis, absolute errors are small and reflect the low absolute levels of boil-out massecuites and molasses made per hundred melt.

Comparisons of actual and computed energy usages are shown in Table I for various CSR refineries in decreasing order of melt for the year ended March 1981.

Table I. Comparison of actual and predicted energy usages (Total energy purchased in megajoules per tonne melt)

	A	B	C	D	E	F
Actual	4,403	3,864	3,804	3,685	3,896	3,259
Predicted	3,522	3,450	2,970	2,621	2,642	2,460
Predicted Usage % Actual	80	89	78	71	68	75

The deficiency between actual energy usage and that predicted by the model is accounted for by energy usages not considered, such as heat losses, inaccuracies in the model, and to inaccuracies in the input data.

The model has not yet been verified; thus we have no measure of how much the deficiency is due to inaccuracies of the model. Nevertheless the model has been used successfully during the past few years as one of the tools in our energy reduction campaign.

Sensitivity analysis data produced with the aid of the model has not only highlighted the important parameters, but also quantified expected changes in energy usage due to specified change in these parameters.

The use of the portion of actual energy usage predicted by the model figures has enabled us to judge how much the "unaccounted" energy usage was reduced by individual factories. The model, in conjunction with actual process data, has also enabled us to assess the degree of difficulty refineries will encounter in further reducing energy usage. The weighted mean average energy reduction achieved by all CSR refineries over the last two years was 4%.

Development of the model

Computer-based energy models have been developed as an aid to understanding energy usage. These models

Paper presented at the 41st Meeting, Sugar Industry Technologists, 1982.

H. R. Delaney

D. Gotthard

J. B. Nichols

all employ common calculation methods and algorithms as dictated by the actual process in the individual factories.

They have been used since 1980 as some of the tools in CSR's energy reduction campaign.

The purpose of this paper is to present a description of the structure of the model, a comparison between actual and computed data, and a description of the model's usage.

DESCRIPTION OF THE MODEL

Mass balance

The model computes a mass balance for the whole refining process, specifying quantities for all streams in dry tonnes per 100 tonnes of melt. The process which has been modelled is as shown in Fig. 1.

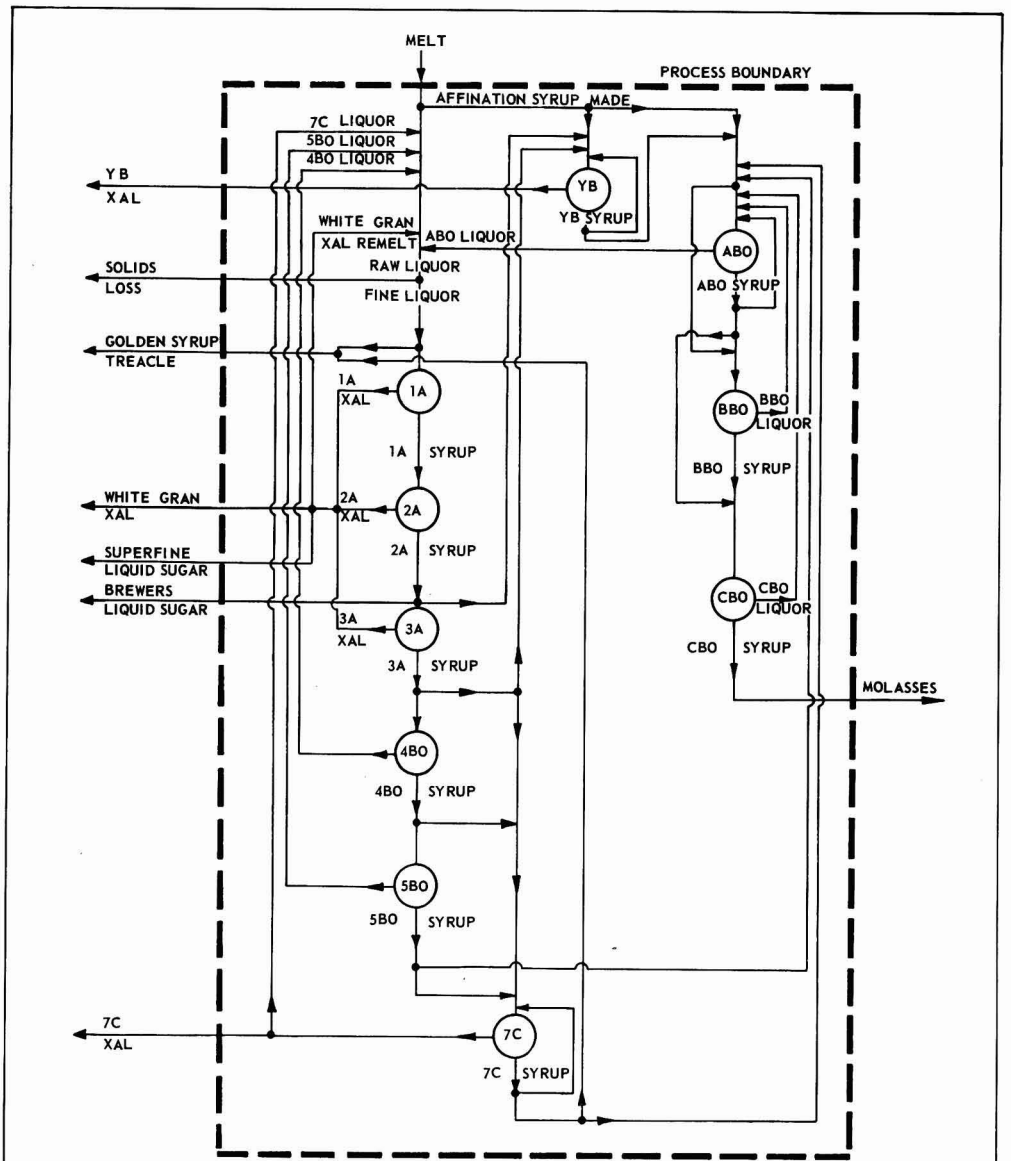

Fig. 1. Process mass balance (dry)

Specified input data include:

- raw sugar composition
- affination syrup production and purity
- black boil-out (recovery or remelt) purities
- crystal yields
- specialty product requirements and formulations, and
- residual refined syrup impurity levels

Assumptions made include the following:

- the ratio of (reducing sugar + ash) to (reducing sugar + ash + other organic material) is constant for all process materials and is numerically equal to that for raw sugar
- solids loss occurs from the raw liquor stream, and
- the recovery boil-out system has a homogeneous feed stream.

The computation performed relies on an iterative procedure designed to produce convergence from the specified initial conditions. The simplified flowchart of the method is shown in Figure 2.

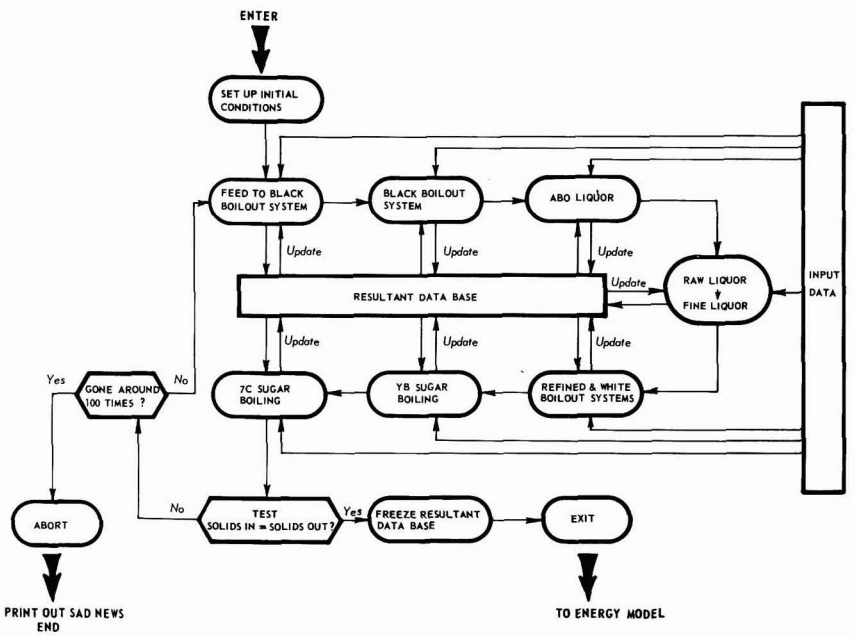

Fig. 2. Mass balance model structure

The white boil-out (high-grade recovery) syrup flow to the black boil-out (low-grade recovery) system is initially assumed to be zero. This enables the black boil-out system mass flows to be determined from the process material purities supplied as input data. Sufficient information is then known to calculate the refined and white boil-out system mass flows.

The quantities for the white sugar boilings (1A, 2A, 3A) and high grade remelt boilings (4BO, 5BO) are then calculated. Quantities of massecuites and syrups for coffee crystals (YB) and soft brown sugar (7C) boilings are calculated on the basis of actual crystal yields and quantities of these sugars produced. The computation for 7C boiling, which is more involved, is shown in more detail in Figure 3. That computation will determine the quantity of excess 7C (if any) to be exhausted in the black boil-out system, and the quantity of 7C liquor (if any) returned to raw liquor.

Convergence test data are then calculated using mass balance equations for total solids in and out of the black boil-out system, total impurities in and out of the black boil-out system, and total solids in and out of the process.

The difference between the total solids into and out of the process is tested for convergence. If the difference is more than 0.001%, the iterative calculation is repeated. Convergence is normally achieved within five iterations. If convergence is not achieved after 100 iterations, the model aborts and an appropriate message is given to the user.

Energy model

The energy model treats the process on a station-by-station basis to determine the total energy requirement of the factory.

Data obtained in the dry mass balance model are used in conjunction with actual operating conditions, such as Brixes, temperatures and other factory performance data. In order to calculate the various physical and thermodynamic properties of steam and sucrose solutions, etc., the model uses a number of statement functions. These functions were obtained directly from

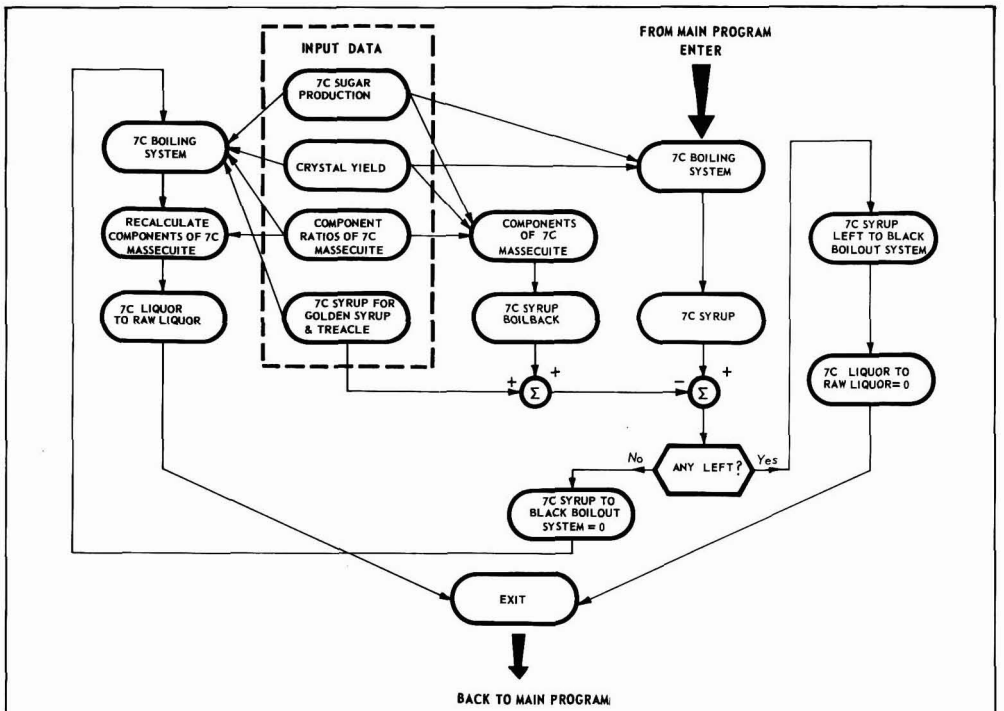

Fig. 3. Mass balance determination for 7C sugar boiling (soft brown sugar)

literature or derived by fitting quadratic curves to available tabulated data. Assumptions made include the following:

(i) there are no heat losses,
(ii) all crystal and sugar solutions are assumed to be pure sucrose and sucrose solutions for the calculation of their thermodynamic properties,
(iii) all steam used is saturated at the supply pressure,
(iv) steam heating for melting, carbonatation and syrup dilution is by live steam injection, and
(v) all steam condensed in closed heaters is returned to the process hot water/sweetwater system at the saturated steam temperature corresponding to the steam supply pressure.

Basically the energy model consists of ten basic process units, the hot water/sweetwater system, and the final energy summing unit as shown in Figure 4. Within each basic process unit the computation is performed using mass and heat balance equations to calculate heat energy requirements in the form of open steam heating, closed steam heating, and closed hot water heating as appropriate. Each process unit calculates quantities of hot water and sweetwater usages and/or generations. The hot water/sweetwater system collects all the information on hot water/sweetwater usage and generation from the basic process units and computes required cold water makeup, heat requirement of the hot water/sweetwater system, and energy returned to the boiler station in the form of hot water (if any).

Total process energy requirements are determined in the final energy summing unit as the sum of boiler fuel, kiln fuel and electrical energy. Boiler fuel is calculated from the measured boiler thermal efficiency and the calculated steam for the process.

Fuel for char regeneration is calculated from a linear regression which relates char usage to actual kiln fuel requirements as measured in CSR refineries between 1978 and 1980. Electrical energy is the reported actual electrical energy usage. Where a significant portion of electricity is self-generated, an equivalent purchased energy is determined by allowing for generator, alternator, turbine and boiler efficiencies.

COMPARISON OF ACTUAL AND PREDICTED RESULTS

Actual and model mass balances

A summary of representative data comparing actual and computed mass balances for various CSR refineries between years ended March 1978 and March 1981 is shown in Table II.

Table II. Comparison of actual and computed mass balances $\left(\frac{\text{Actual-Computed}}{\text{Actual}} \times 100\right)$

Refinery	Raw liquor tonnage	Refined massecuite tonnage	Boil-out massecuite tonnage	White granulated crystal tonnage	Molasses tonnage
A	−2.1	−5.4	−1.0	0.0	−8.6
B	−0.1	0.0	+8.0	−0.3	+18.7
C	−1.0	+2.0	+12.0	−0.2	+9.0
D	+0.2	−1.3	+7.4	−0.4	+16.1
E	−1.3	−0.5	−9.0	+0.2	−5.1
F	−0.9	+0.5	−17.4	−0.3	+4.5

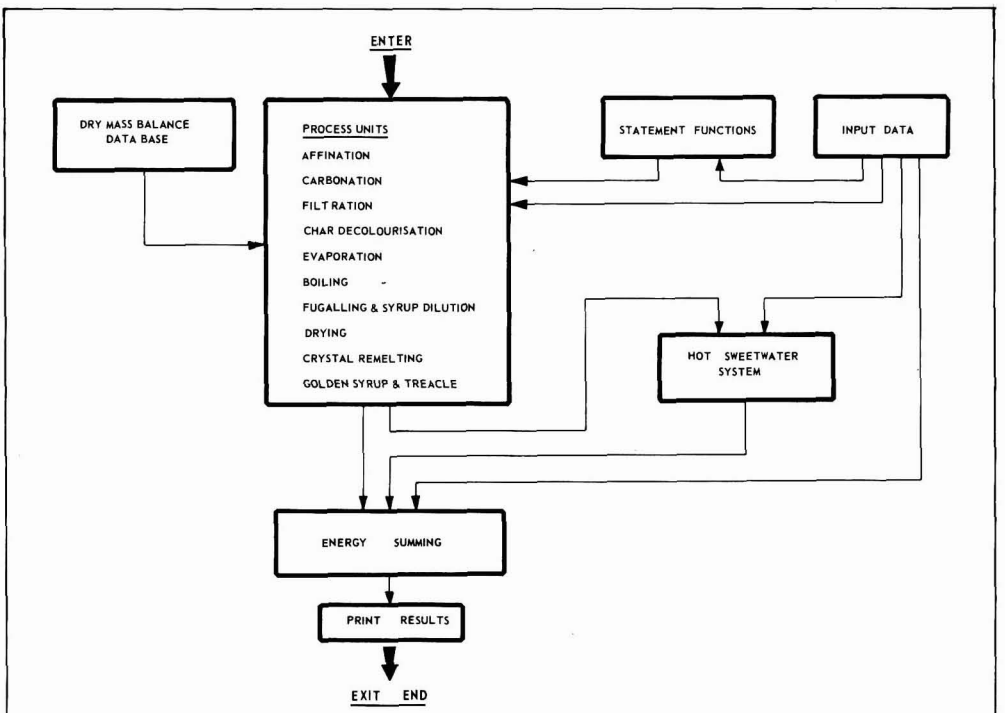

Fig. 4. Energy model structure

"Actual" mass balance refers to data reported in the Chemical Process Data Sheets. The actual mass balance for a given refinery could differ from the "true" mass balance because of factors such as errors in reading and recording massecuite.

The summary of the results as they appear in Table II shows the following:

1. *Main course materials* are accurately predicted by the computer model. Deviations above 2% were recorded at one refinery and this was probably due to the disturbances to measurements and recordings resulting from major capital works in the refined pan house undertaken during the period considered.
2. *Boil-out materials* are not accurately predicted by the computer model. Although percentage variations are large, absolute errors are small and reflect the low levels of boil-out massecuite and molasses made per hundred melt.

   The inaccuracies are not surprising if one considers that the model calculators refined massecuites from reported crystal yields which can be accurately determined while black boil-out massecuites are calculated from reported true purity levels (determined by double polarimetry and drying) and two main assumptions:

   (i) the feed to the black boil-out system is a homogeneous mixture consisting of affination syrup and excess white boil-out syrup

   (ii) the purities of white boil-out syrups and A boil-out liquor are calculated by assuming the ratio of (reducing sugar + ash) to (reducing sugar + ash + other organic materials) remains constant in all process streams and is numerically equal to that in the raw sugar.

Actual and model energy usages

Summarized data comparing actual and computed energy usages for various CSR refineries for a number of years are shown in Table III.

Table III. Comparison of actual and computed energy usages (% of actual usage predicted by model)

Refinery	Year ended March 1978	1979	1980	1981
A	81	74	77	80
B	73	75	82	89
C	79	80	80	78
D	77	74	75	71
E	70	74	70	68
F	77	75	75	75

Melt weighted average of all refineries = 78%

Unaccounted energy usages are due to factors such as normal radiant heat losses, evaporation of excess water additions to the process such as vacuum pan sight glass water, steam leaks and blow-off, condensate and hot

water losses, and start-up and shut-down heat losses. Apart from these factors, inaccuracies in both the input data and the model itself probably contribute to the difference between actual and computed energy usages.

APPLICATION OF ENERGY MODELS TO THE CURRENT ENERGY REDUCTION PROGRAMME

In general the energy model has been found useful and serves the following three purposes:

(1) The energy models have been used to determine the sensitivity of total energy usage to marginal changes in various operating parameters for each refinery. Sensitivities of some parameters on energy usage are shown in Table IV.

Table IV. Energy sensitivity of various operating parameters

Parameter	Change	Sensitivity, percentage of total energy usage due to specified change
Boiler station efficiency	± 1%	0.87
Affination syrup made % on melt	± 0.5%	0.22
Flue gas % CO_2	± 1%	0.47
CaO % on raw liquor	± 0.5%	0.35
Char % on melt	± 1%	0.70
Fine liquor Brix	± 1°Bx	1.55
Heavy fine liquor Brix	± 1°Bx	0.58
Refined syrups Brix	± 1°Bx	0.81
Affination syrup Brix	± 1°Bx	0.06
White boil-out syrups Brix	± 1°Bx	0.06
Black boil-out syrups Brix	± 1°Bx	0.13
1A massecuite yield	± 1%	0.60
2A massecuite yield	± 1%	0.28
3A massecuite yield	± 1%	0.12
Superfine liquid sugar % on melt	± 1%	0.09
Brewers liquid sugar % on melt	± 1%	0.67

Because of interactions through the process, the sensitivities as shown in Table IV are not necessarily additive. Nevertheless, the sensitivity analyses provides a clear picture of how important certain parameters are from an energy reduction point of view.

(2) The energy model has been used to determine how much the "unaccountable" energy has been reduced in a particular refinery. The percentage of actual energy usage which can be accounted for by the model provides a good indicator for this purpose. Although the energy model has not been verified and is therefore not necessarily a good yardstick for inter-refinery comparisons it should be satisfactory for inter-refinery trend analysis.

(3) The energy model has been used in assessing the degree of difficulty which individual refineries can expect in reducing energy usage further. Because the model does not optimize the process for energy usage, it has to be used in conjunction with defined values of the more important process parameters when required for this purpose.

Conclusions

The results presented in this report show that an established energy model was able to account for, on average, 78% of the total energy usage during sugar refining. The results strongly suggest that further energy reductions can be obtained by both improving current process parameters and reducing energy that is not accounted for by the model.

The energy model has also been used to help establish the viability of various alternative processing procedures. These include: varying the purity of exhausted molasses, varying the types of products produced, melting of high pol raw sugars, multiple-effect evaporation and vapour recompression.

The balance between capital expenditure and reduced costs through energy savings is continually changing and major processing changes of this type will need to be kept under constant review.

Acknowledgements

The authors wish to acknowledge the invaluable contribution of Messrs. D. T. Hawkins and W. J. Keast and the staff of CSR's sugar refineries.

Literature

Lyle: "Technology for Sugar Refining Workers" (Chapman and Hall, London) 1959.

Summary

An account is given of the development of a model for use in computer calculation of energy in the Australian sugar refineries. The average, melt-weighted relationship between predicted and actual energy usage is 78% and causes of the discrepancy are discussed. The model nevertheless allows identification of areas in the refinery where energy savings are possible and has permitted savings of 4% over the past two years.

Utilisation d'un modèle énergétique dans le raffinage du sucre

On présente le développement d'un modèle pouvant être utilisé dans des calculs sur ordinateur de l'énergie dans les raffineries à sucre Australiennes. En moyenne on observe une relation (dépendant du poids de refonte) de 78% entre la consommation prédite et réelle d'énergie. On discute les raisons de la différence. Le modèle permet néanmoins d'identifier des endroits dans la raffinerie où on peut économiser de l'énergie et il a conduit à une réduction de 4% durant les dernières deux années.

Die Verwendung eines Energiemodells bei der Raffination von Zucker

Berichtet wird über die Entwicklung eines Modells zur Berechnung der in australischen Zuckerraffinerien benötigten Energie mit einem Computer. Das durchschnittliche, auf den gelösten Zucker bezogene Verhältnis zwischen vorausgesagter und tatsächlich verbrauchter Energie beträgt 78%; die Gründe für die Abweichungen werden diskutiert. Das Modell erlaubt jedoch die Identifizierung von Stationen in der Raffinerie, in denen Energieeinsparungen möglich sind, so daß Einsparungen von 4% in den beiden letzten Jahren möglich waren.

Empleo de un modelo de energía en la refinación de azúcar

Se presenta un examen del desarrollo de un modelo para empleo en la calculación por computador de energía en las refinerías de Australia. La relación promedia, ponderado por la cantidad de azúcar refundido, entre consumo de energía pronósticada y vera es 78% y causas de la discrepancía se discuten. No obstante, el modelo permite identificación de áreas en la refinería donde es posible lograr economías de energía y ha permitido economías de 4% durante los dos años pasados.

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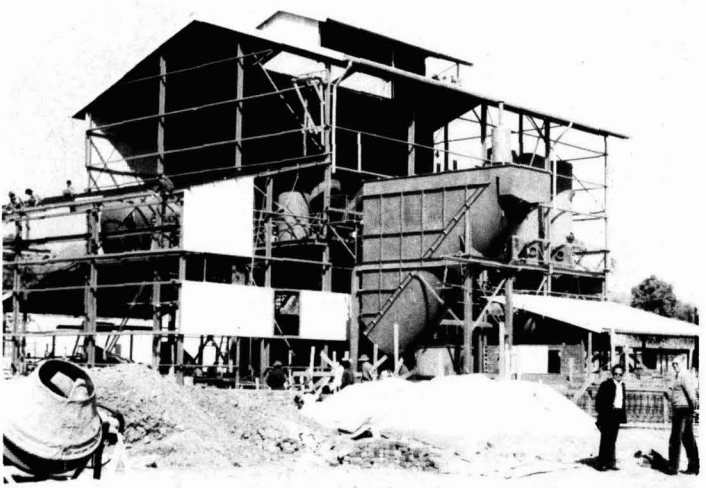

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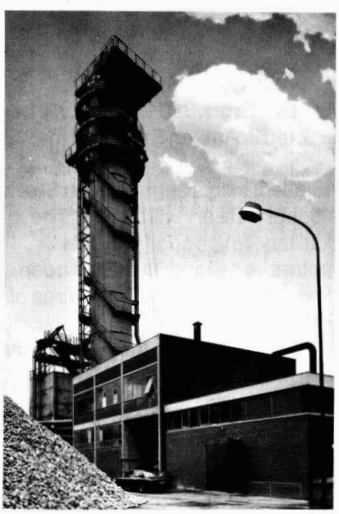

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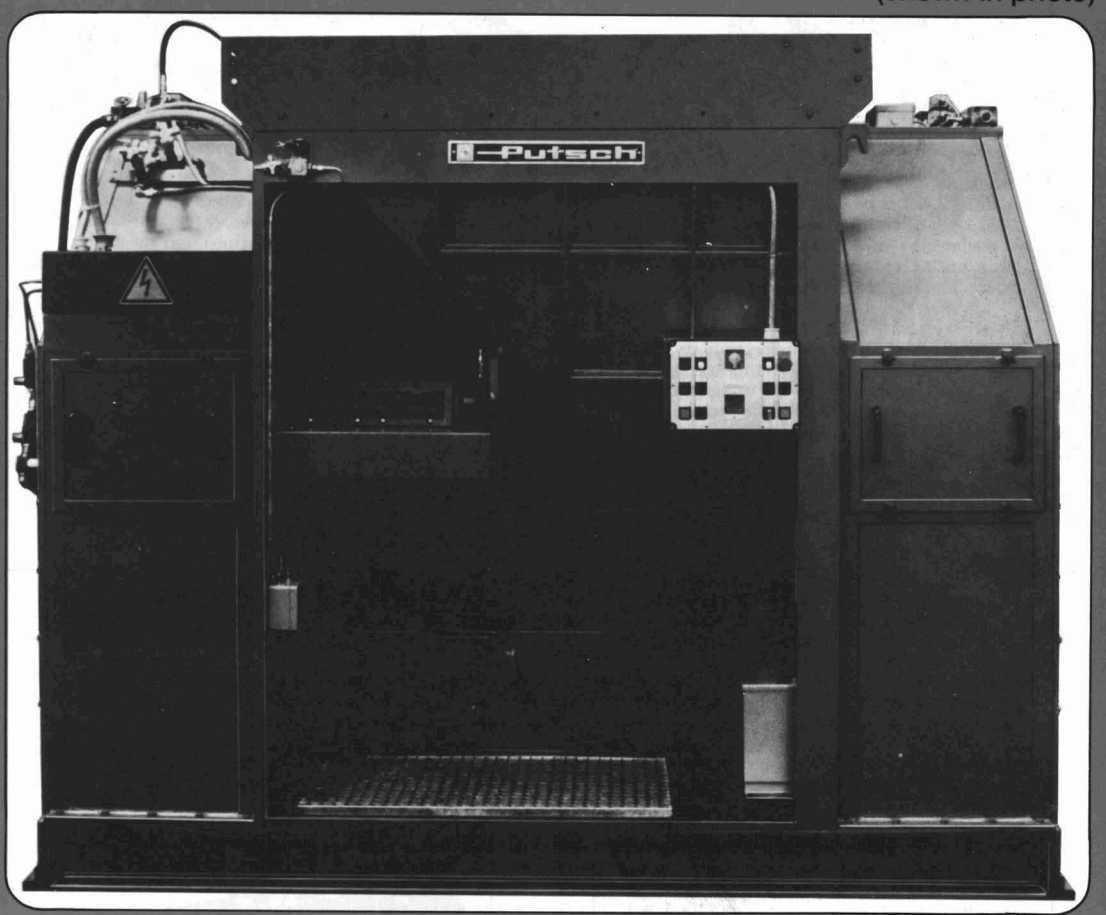

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CANE SUGAR MANUFACTURE

Initial experiences with boiling and purging low-purity *B*- and *C*-massecuites. W. A. Black and G. A. Wallace. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 389-393. After a steady increase in the purity of *B*- and final molasses and *C*-massecuite over a 20-year period, trials were conducted at Racecourse on boiling of lower-purity *B*-massecuites and a lower-purity *C*-massecuite. As a result of the success achieved in these tests, it was decided to modify the boiling process by (1) graining all the *B*-massecuites individually and treating them in air-cooled continuous crystallizers and in continuous centrifugals, (2) using *B*-sugar as footing for *A*-strikes to produce the only shipment sugar, and (3) remelting all the *C*-sugar for recycling to the syrup tank. Results showed no problems in the handling of the smaller-grained *B*-massecuite or in use of the *B*-sugar and *A*-massecuites, although further work is needed in order to improve exhaustion in the pan, while sugar losses in the centrifugals were very high – purging was unsatisfactory, and recirculation of impurities was such that all purities had to be raised to allow factory processing to continue. However, once these problems are overcome, the modified process is expected to give the desired results.

Effect of design variables on finned-tube massecuite heater designs. E. T. White, M. J. Sester and J. N. Ness. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 395-403. Tubular heaters have been found to require less supervision and maintenance than resistance heaters; the massecuite can flow inside vertical tubes (which are easily cleaned) or outside horizontal finned tubes, which reduce the size of the heater required while also decreasing residence time and crystal dissolution. Finned-tube heaters may have a surface area of up to 100 m^2 per m^3 compared with a normal 30 m^2/m^3 for internal tube heaters. With greater interest in finned-tube heaters, trials have been carried out, but only with one or two standard fin sizes, one fin thickness and one or two fin spacings. However, it is of advantage to consider fins of other sizes and spacings, and the authors describe a method of calculation which allows a designer to manipulate the various physical parameters so as to arrive at a suitable heater design.

An improved sugar reflectance unit. S. R. Reichard and R. C. Wearne. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 405-411. – Details are given of a reflectance meter and associated electronic circuitry used in trials on a low-grade centrifugal with the aim of measuring and controlling sugar purity. Results showed that, for a given massecuite, reflectance was directly related to sugar purity, and the unit was successful as a purity controller through operation of the feed valve, using the output signal of the instrument. No significant difference was found between the results of automatic and manual control. For complete evaluation of the instrument, further experimental work is needed to delineate the extent of variations in reflectance; variation in the reflectance-purity relationship between trials was possibly a results of change in massecuite quality, of variations in the crystal mat on the basket screen or of differences in experimental technique.

Revitalizing the sugar sector of Indonesia. –. Sartojo. *Proc. 1st World Sugar Farmers' Conf.*, 1981, VI.21-VI.25. Factors that have contributed to a fall in sugar production in Indonesia by comparison with the amount that used to be produced before World War II are examined, and measures that need to be carried out in order to improve the situation are discussed, covering both agricultural aspects and the processing side, including the need for more factories and the creation of sugar industries on islands other than Java.

Increasing mill capacity by adding feed rollers. Y. C. Yen, Y. K. Wang and F. J. C. Fong. *Taiwan Sugar*, 1982, **29**, 46-50. – After installation of heavy feed rollers on the 1st and 4th cane mills and of light feed rollers on the 2nd and 3rd mills plus pressure feed chutes at Jenteh sugar factory had adversely affected mill performance during two seasons (although eliminating chokes and stoppages due to slipping) because of failure to match the feed roller settings and speeds to those of the mill rollers, it was decided to test the effect of adding a single feed roller instead of the conventional pairs, and without a pressure feed chute. Upper feed rollers were installed on Nos. 1-4 mills, while under-feed rollers were installed on Nos. 5 and 6. Results obtained at Hualien factory showed that average daily milling capacity in 1976/77 was increased by 15.3% and the maximum daily capacity by 13.3% by comparison with 1975/76. There was less slippage, particularly with the under-feed rollers, pol extraction was increased by 0.4 units and the bagasse moisture reduced from 46.9 to 46.43%. As a consequence of the improved performance, under-feed rollers have also been installed on new tandems at four other factories in Taiwan. Meinecke-type chutes are not recommended for use with feed rollers, and should be replaced with another type of intermediate carrier.

Prospects and possibilities in application of membrane filtration systems within the beet and cane sugar industry. W. Kofod Nielsen, S. Kristensen and R. F. Madsen. *Sugar Tech. Rev.*, 1982, **9**, 59-117. – The fundamentals of membrane filtration, i.e. ultrafiltration and hyperfiltration (reverse osmosis), are described with reference to membrane, module and systems development by DDS. A review is presented of research and investigations conducted in both the beet and the cane sugar industries. Cane juice treatment by ultrafiltration has been the subject of pilot-scale tests in Tanzania, while similar results have been obtained in experiments involving syrup and molasses. Purification of raw sugar liquor at a refinery is also suggested. Within the beet sugar industry, juice purification and thin juice concentration by ultrafiltration have received attention. While, in the past, limitations have been imposed on the use of membrane filtration by the membranes available, a new generation of membranes is now available which increase the potential applications. The HR thin-film composite membrane of DDS has much better properties than cellulose-acetate membranes as regards resistance to temperature and chemicals.

Qualitative improvement in juice sulphitation. B. L. Mittal. *Indian Sugar*, 1982, **31**, 769-772. – An automatic system for regulating the milk-of-lime dosage in accordance with the weight of juice is described, in which tipping of the juice weigher actuates the electric-

ally operated valves on the feed and discharge ports of the lime doser, so that a given amount of milk-of-lime replaces that discharged from the doser. A continuous sulphur burner is also described with the aid of a diagram.

Whole reduced mill extraction. P. K. More. *Indian Sugar,* 1982, **31,** 773-781. – A new concept of mill extraction is introduced which is based on the effect of juice purity and the maceration factor. Comparison is made with the methods of Deerr and Mittal for evaluation of mill performance.

Some observations on the use of polymers in cane juice clarification and settling characteristics of Magnafloc LT-27. A comparative study. P. C. Johary. *Indian Sugar,* 1982, **31,** 783-788. – Laboratory trials are reported in which comparison was made between a number of flocculants added to sulphitation juice. Magnafloc LT-27 at 3 ppm gave the lowest mud volume and the fastest settling rate, followed by Sedipur TF-2 at 2 ppm, then Separan AP-30 at 3 ppm and finally Morarfloc at 4 ppm. However, it is pointed out that the performance of a given flocculant may vary between countries and juices.

Comparison between raw sugar producers. R. S. Patterson. *Sugar J.,* 1982, **44,** (12), 6-7. – Average values are given of raw sugar pol, % extraction, mixed juice and syrup purities, sugar yield % cane, molasses purity, molasses per tonne of cane and sugar, molasses reducing sugars content, filter cake pol and cane sugar content, as well as bagasse, molasses and filter cake losses in Louisiana, Florida, Hawaii, Texas, South Africa and Mauritius (for which no losses are given). The comparisons between states and countries are discussed.

Entrainment separators for vacuum pans and evaporators. D. M. Humm. *Sugar J.,* 1982, **44,** (12), 8-14. – The designs of the three main types of entrainment separator (centrifugal separators, zigzag baffles and wire mesh pads) are described and their operating characteristics indicated. Two variants of the last two were tested in pans and evaporators, and proved very effective in reducing entrainment when used within their design limitations. In all the tests, the condensate discharged from the condenser contained no more than 5 ppm sugar, and in most cases 2 ppm or less. The tendency of the mesh pad to become fouled by sugar deposits unless frequently washed is a major disadvantage.

Engineering and economic analysis for the utilization of geothermal fluids in a cane sugar processing plant. J. T. Humme, M. T. Tanaka, M. H. Yokota and A. S. Furomoto. *Rpt. prepared for U.S. Dept. Energy, Division of Geothermal Energy,* 1979, (SAN-1743-3), 283 pp; through S.I.A., 1982, **44,** Abs. 82-641. – A study is reported on the feasibility of geothermal resource utilization at the Puna Sugar Company cane sugar factory in Keaau, Hawaii. A possible site for a well was selected. In the proposed scheme, the flow from the well, containing a high proportion of liquid, enters a separator, which produces an acceptable quality steam for process use. H_2S in the well gases is incinerated and gives SO_2 which is recovered and used in treating the cane juice. An evaluation indicated that the bagasse should still be used to generate steam, which can be used to generate electric power for sale to the utility. The recommended system is entirely feasible from a technical viewpoint. An economic analysis is shown.

The consistency of the performance of polymer flocculants in cane juice clarification. B. A. Smith, R. V. Romo, J. J. Molina and J. C. P. Chen. *Sugar y Azúcar,* 1982, **77,** (7), 23, 26-27, 30-31. – Details are given of the method used in comparative laboratory tests on polymer flocculants added at 2-4 ppm, and results are indicated for three unnamed flocculants, one of which is currently in use at Cowley Sugar House. It is shown that one of the other two flocculants reduced juice turbidity by 50% compared with the one in use. Since the laboratory tests lasted only 20 minutes, by contrast with 1-2 hours of juice retention in a clarifier, mud volume and settling rate were of secondary importance, while clarity of the treated juice was the primary factor for polymer selection.

Innovations in maintenance. Puna Sugar Co., Hawaii. T. R. Davies and W. Ayala. *Sugar y Azúcar,* 1982, **77,** (7), 43, 46-47. – Since the cane supplied to the factory of Puna Sugar Co. in Hawaii is grown mostly on volcanic soil, with little or no topsoil, and the amount of leaf trash introduced in the factory is large because of high annual rainfalls and consequent poor field burns, wear of the hammers on the cane shredders is considerable, and the hammer service life used to be only about three days on a buster used as primary crusher and about seven days on the fiberizer used as secondary crusher. In 1977, the system that had been used for hammer reclamation was replaced with one incorporating the inter-alloying process of welding, in which specific quantities of alloys are applied to the hammers in carbide-bearing deposits. The alloys are melted continuously until the required hammer length and alloy composition have been achieved; thus, the alloy is positively attached to the substrate, and the very dense, evenly dispersed carbide structure has exceptional resistance to wear. The result is a life of about 3½ weeks for the hammers on the buster and 4½ weeks on the fiberizer. Application of a similar welding technique to the elevator and discharge scrolls of the Silver diffuser at the factory has given similar satisfactory results, increasing the service life of the elevator scrolls from three to at least fourteen weeks, and that of the primary discharge scroll to more than 15 months.

Considerations on the bursting of superheater tubes in our boilers. B. Malibisi. *Sukari* (Zaire), 1982, **2,** (2), 28-30, 41 *(French).* – It has been found that, 6-8 years after installation, superheater tubes in the boilers at Kiliba are systematically bursting, one after the other. Reasons for this are examined, and the basic cause found to be metal creep, with continuous reduction of the metal thickness and progressive increase in tension under pressure from the steam. The phenomenon was more marked at three lower bends in the hottest zone of the superheater. Possible solutions to the problems are listed.

Treatment of water for boilers. Anon. *Maharashtra Sugar,* 1982, **7,** (9), 47-48, 50. – Some advice is given on boiler water treatment and condensate utilization, with an explanation of reasons for the various measures.

Evaporation and steam balance. R. C. Piamonte. *Crystallizer,* 1982, **5,** (2), 14-15, 17-18. – Operation of a multiple-effect evaporator is explained, with advice on how to minimize scale formation and heat losses and obtain best performance. Establishment of an optimum steam balance for maximum energy saving is demonstrated.

BEET SUGAR MANUFACTURE

Decalcification of second carbonatation juice using the Gryllus process. J. Ponant. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 28 pp. — Details are given of the Gryllus ion exchange process of juice decalcification as used at Artenay sugar factory in France. Since the resin is regenerated with K^+ and Na^+ cations contained in 2nd product green syrup, the calcium ions bypass evaporation and 1st and 2nd strikes (so that scale formation is reduced), while there is no chloride-containing effluent to dispose of; the cations in the molasses are the same as those in filtered 2nd carbonatation juice, although purging in the centrifugals must be carried out at a lower non-sugars:water ratio because of the higher viscosity molasses resulting from the absence of Na addition — this is known as the "Gryllus effect". The other major benefit of the process is the greater white sugar recovery. One disadvantage is the limitation imposed on thick juice storage, where the high Ca content in the syrup used for the low-grade strike results in a shortage of regenerating ions; as a consequence, only a maximum of 45% of the thick juice produced should be stored.

Exhaustion of molasses. Saturation coefficient and melassigenic coefficient. F. Heitz. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 12 pp. — It is shown that, while both the saturation coefficient and the melassigenic coefficient have been widely used in approaches to estimation of molasses exhaustion, the melassigenic coefficient has to be corrected to take account of the melassigenic effect of water. The sugar in molasses may be considered as being formed in two parts — one corresponding to the melassigenic effect of the water (where the solubility of the sugar in the molasses water is 30% lower than in pure water), and the other corresponding to the melassigenic effect of non-sugars excluding water; this part corresponds to the saturation formula developed by Wiklund when the quantity of non-sugars is greater than that of water, viz. $K_{sat} = a.\frac{NS}{W} + b$, where a and b are two temperature-independent coefficients. A table is presented of melassigenic coefficients at 40°C (g sugar/g non-sugars) as determined by Silin, Silina and the present author for K, Na and Ca salts. The use of corrected coefficients may result in as much as 30% difference in the estimated molasses sugar where ion exchange processes are involved, so having a major effect on the calculation of the operating costs of such processes.

Some aspects of the economics of thick juice refining. P. S. Worthington. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 46 pp. — Bury St. Edmunds factory has a daily slice of 11,000 tonnes of beet, from which it produces 1150 tonnes of white sugar per day. It became a white sugar factory in 1971/72, and is more expensive to operate than other factories in the group. At present, 30% of the thick juice is stored for post-campaign processing. A study was made of the economics of two systems of operation: that as used currently, and processing of all the juice to white sugar during the campaign. Comparison of the individual cost factors and overall costs shows that conversion to complete intra-campaign sugar production would give a potential saving (based on 1980/81 prices) of some £450,000, assuming operation of the factory at its present level of fuel efficiency; however, when the effects of inflation, of potential savings resulting from introduction of a more economical overall process, of achieving theoretical fuel requirements and of the incorporation of taxation effects in the financial analysis are considered, results favour the thick juice storage scheme. Moreover, installation of new equipment and process modification led to a 36% reduction in fuel consumption in 1982 by comparison with 1981, so that the consumption is now lower than that of other factories. No difficulties have been experienced in storage and processing of thick juice, provided certain conditions are strictly adhered to, while the quality of the white sugar produced is at least as good as that produced during the campaign, while molasses losses tend to be lower than in the campaign, probably because of operation under steadier and near-optimum conditions.

Modern simplified production of white sugar. E. Svoboda. *Czechoslovak Heavy Ind.,* 1982, (7), 11-14. — A boiling system is described in which white sugar is produced from a massecuite boiled on a syrup footing to which is added run-off from the white sugar centrifugal and low-grade remelt. A 1st low-grade massecuite of about 82 purity and a 2nd low-grade massecuite of about 78 purity are boiled, and their products mingled for use in white sugar massecuite boiling. Results obtained in 1981 at Predmerice using the scheme are compared with 1979 results from conventional boiling, with theoretical target values and with data from Dormagen factory in West Germany; these demonstrate the considerable improvement achieved in the factory's performance.

New sugar factory in Syria from Czechoslovakia. J. Rohlena. *Czechoslovak Heavy Ind.,* 1982, (7), 15-18. Details are given of the equipment and processes used at the new Deir ez Zor sugar factory in Syria, which has a daily slice of 4000 tonnes of beet and is the seventh sugar factory to be built in the country.

Developments in computer and on-line control in the beet sugar factory. P. W. van der Poel, N. H. M. de Visser and C. C. Bleyenberg. *Sugar Tech. Rev.,* 1982, **9**, 1-58. Chemical and process control in beet sugar factory processes and the use of the computer to determine optimum parameters are reviewed, with 117 references to the literature. The importance of instrumental analysis, and its changing role within the overall process optimization, are examined, and the trend away from chemical analysis and toward data processing and information management in the control laboratory, coupled with on-line measurements in the factory, is discussed. Each process is considered in turn, plus waste water treatment and factory laboratory operations.

Juice extraction in the beet sugar factory. G. V. Genie. *Sugar Tech. Rev.,* 1982, **9**, 119-270. — A review, with 570 references, is given to the literature on beet diffusion, covering the period 1970-81. The survey includes the more important patents, recent theories on diffusion (with a discussion of mathematical models, beet slicing and the various methods used for cossette denaturing).

Commercial diffusers currently in use are classified under five types, and their performances, advantages and disadvantages discussed. Methods of fresh and press water preparation for diffusion and their effects on performance and pulp pressability are outlined. Chemical aspects of diffusion, including extraction of melassigenic ions, pectins and phenolic compounds, are examined, and bacteriological aspects of the process discussed (particularly development of thermophiles in continuous diffusers and methods of detecting and controlling them). Problems associated with diffuser corrosion and erosion are discussed, followed by a brief mention of work on diffusion thermodynamics, and finally a review of unconventional extraction methods.

Optimum technological parameters of a drum-type beet washer. V. G. Abel'yants and N. S. Karpovich. *Sakhar. Prom.,* 1982, (7), 18-21 *(Russian).* — Advantages of drum-type over trough-type beet washers are discussed and results of comparative tests tabulated. While one of the major benefits is the lower sugar losses in the drum, it is considered very important to maintain strict monitoring of the beet:water ratio in order to achieve maximum removal of extraneous material. Optimum is a ratio of between 1:0.10 and 1:0.15, but in no case should the quantity of water exceed 25% of the weight of the beets. The level of the moving bed of beets is also a critical factor.

Optimum period of hot preliming. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Sakhar. Prom.,* 1982, (7), 21-24 *(Russian).* — Investigations are reported which were aimed at establishing the minimum period of preliming at 60°C that would ensure adequate non-sugars separation and satisfactory settling and filtration properties. Best results were given by 7 minutes' preliming, to which was recycled partially saturated limed juice of 30-40% carbonatation.

The performance of 1st carbonatation juice settlers at Kobelyakskii sugar factory. I. A. Oleinik, I. G. Bazhal, V. A. Kuzenkov, S. D. Sobko and N. I. Nespryad'ko. *Sakhar. Prom.,* 1982, (7), 24-27 *(Russian).* — The performances of four different types of clarifier were compared in tests with 1st carbonatation juice. Results, given in tabular and graph form, are discussed and the relative efficiencies established.

Low-grade sugar affination in continuous centrifugals. A. R. Sapronov, V. I. Tuzhilkin, M. A. Karagodin, S. A. Nikiforov, L. M. Bochko and L. P. Buketova. *Sakhar. Prom.,* 1982, (7), 27-29 *(Russian).* — Tests were conducted on low-grade sugar affination in a BMA K-1000 continuous centrifugal operating at a nominal 1750 rpm. Molasses diluted to 70-76°Bx and heated to 90-95°C was sprayed onto the sugar at 2.4-7.8 litres.min^{-1}. Optimum conditions were a Brix of 73°, temperature of 90°C and a spraying rate of 2.4 litres.min^{-1}; under these conditions, sugar purity rose by 1.4-1.5 units (from 93.4), the colour fell by 8.3-8.6% and the reducing sugars content was slightly decreased. Molasses purity was lower than when the sugar was washed with water.

Experience in the operation of liquid-spray sulphitation vessels for juice and syrup. S. A. Zozulya, S. A. Chernyshev, V. P. Panchenko and T. A. Derevyanko. *Sakhar. Prom.,* 1982, (7), 29-31 *(Russian).* — Advantages of A2-PSK-6 and A2-PSM-6 sulphitation vessels (for juice and syrup treatment, respectively) are discussed on the basis of test results. It is recommended not to install a cooler common to both vessels because of vacuum differences which would lead to an inadequacy of SO_2 feed to the syrup sulphiter.

Milk-of-lime solids meter. Z. S. Voloshin, Yu. N. Kiyanitsa, V. A. Rastyapin, V. A. Fedyai and V. A. Nikolaenko. *Sakhar. Prom.,* 1982, (7), 34-37 *(Russian).* — A milk-of-lime density meter is described which is based on the relationship between density and solids content and between the latter and conductivity. Mounted on the vertical section of a pipeline, it covers the density range 1100-1400 kg.m^{-3} and has proved accurate to within ± 4% in tests. It has no temperature compensation, but fluctuations in the milk-of-lime temperature were found to be only slight, within the range 58-63°C.

Investigation of the composition of condensate from the MTIPP experimental film-type evaporator. V. D. Lazarev and M. S. Zhigalov. *Sakhar. Prom.,* 1982, (7), 45-47 *(Russian).* — Investigation of the composition of condensate from the experimental quadruple-effect film evaporator installed in the sugar factory at Korenovskaya was prompted by the proposal to adopt a scheme in which all the boiler feedwater was in the form of condensate. Results showed that the condensate from the 4th effect met requirements for boiler feedwater and was not substantially affected by temperature rise in the 1st effect to 140°C nor by changes in the juice composition when stale beets were being processed. A scheme is suggested in which a maximum amount of heat from flash-evaporated condensate is used, the temperature being raised by bled vapour in heat pumps preceding the boilers.

The use of artificial cold for sugar beet storage. B. A. Melent'ev, V. A. Fes'kov and V. L. Mar'yanchik. *Sakhar. Prom.,* 1982, (7), 47-50 *(Russian).* — The various parameters involved in storage of beet for 52 or 112 days at temperatures below or just above freezing, using forced ventilation (as suggested by Khelemskii *et al.),* are indicated and the daily losses, expected sugar yield and molasses sugar calculated for storage of 300,000 and 600,000 tonnes of beet. The costs are discussed, and show that it is economically better to increase factory size and/or throughput and maintain a campaign length of 110-120 days (thus reducing the storage period and associated costs) rather than extend the campaign to 180-190 days and rely on protracted storage.

Sugar storage in silos. VII. An experimental study on sugar stabilization in a 1:100 scale plant. V. Kavan and O. Mikus. *Listy Cukr.,* 1982, **98,** 152-160 *(Czech).* Experiments were conducted on white sugar preconditioning in a mini-stabilizer, of 750 kg capacity, comprising a vertical rotary vessel with an inverted conical hopper at the lower end provided with louvres for injection of warm air. Measurement of, among other parameters, total and surface moisture showed that 36 hours' retention in the stabilizer at a temperature of 38.9°C was minimum for preconditioning (reducing the total moisture content by some 60%), while 24 hours at 43°C was inadequate.

Instructions on melt liquor filtration by ZVU disc filters using 2nd carbonatation mud. E. Havlova. *Listy Cukr.,* 1982, **98,** 164-165 *(Czech).* — Details are given of the sequence of operations in melt liquor filtration using a FDP-40 horizontal disc filter in which 2nd carbonatation mud is used as precoat.

SUGAR REFINING

Adapting programmable controllers to a relay and pneumatic world. D. M. Bryan. *Paper presented at 41st Meeting, Sugar Ind. Technol.*, 1982, 16 pp. — Descriptions are given of modifications to the control systems at Savannah sugar refinery, including replacement of the affination station relay controls with Boolean logic cards and of the sequence and dilution system with a programmable controller. A system, also based on a programmable controller, was also installed for sequencing the affination centrifugals and the Sweetland filter-presses so as to prevent problems when flow rates were altered. Programmable controllers were also installed in place of press recycle timers and to replace relays on the white sugar pan, on the white sugar centrifugals (as well as the cycle timers) and on packaging equipment. In the 8-year period of modifications, the average daily melt has increased by some 25%. Advantages of the new systems are indicated.

Investigation of the possibility of refining granulated sugar without using an adsorbent for treatment of 1st refined sugar strike. S. A. Brenman, F. P. Alekseenko, L. V. Ogorodniichuk, N. D. Tereshchenko and K. V. Ukrainets. *Sakhar. Prom.*, 1982, (4), 26-29 *(Russian)*. Tests were conducted on boiling of 1st and 2nd refined sugar strikes without previous active carbon treatment of the syrups. Results showed that in both cases the final sugar purity of 99.95 was the same as that obtained with carbon treatment, while sucrose losses were greater with treatment.

Determination of lime consumption in raw sugar processing. L. G. Belostotskii, R. Ts. Mishchuk, V. M. Leshchenko and V. A. Lavrenyuk. *Sakhar. Prom.*, 1982, (5), 27-29 *(Russian)*. — Formulae have been developed for calculation of the lime needed for melt liquor treatment, allowing for the amount of sugar in the sweetwater fed to the melter as well as 1st massecuite run-off also recycled to the melter together with low-grade sugar. A worked example is given.

On the behaviour of soluble silicates in refinery processes and soluble silicate contents of granulated sugars. H. Yasufuku, S. Matsubase and T. Kanetika. *Proc. Research Soc. Japan Sugar Refineries' Technol.*, 1982, **30**, 44-52 *(Japanese)*. — The behaviour of soluble silicates in refining was examined, and a balance established showing the amounts removed by various processes and in different products and waste products. The quantity was increased by carbonatation as a consequence of re-utilization of filter washings. Of the silicate quantity in liquor before bone char filtration, 36.1% was adsorbed by the char and 18.5% was transferred to sweet-water and recycled; the rest remained in the liquor. Of that entering the boiling house, 25% was converted to insoluble silicates in the pan, while 71% was transferred to run-off in the centrifugals; the remainder was included in the sugar crystals. Granulated sugar contained 0.36-2.95 ppm soluble silicate.

Application of sucrose fatty acid esters to low-grade sugar boiling. A. Hanzawa, M. Kawamura, K. Yoshida, M. Iritakenishi and N. Kawase. *Proc. Research Soc. Japan Sugar Refineries' Technol.*, 1982, **30**, 53-63 *(Japanese)*. — Of five surfactants tested in a refinery and a cane sugar factory, a sucrose fatty acid ester (S-570) having a HLB (hydrophile-lipophile balance) of 5 caused a remarkable reduction in molasses viscosity, particularly at 60°C. When added at 50 or 100 ppm, it also reduced boiling and purging times, sucrose loss and consumption of steam and electricity, while increasing pol recovery and purity drop from massecuite to molasses. All of the ester was removed by carbonatation and decolorization.

Refinery syrup decolorization with AV-17-2P porous anion exchange resin. Ya. O. Kravets, V. N. Eremenko, G. V. Buzovetskaya and L. D. Naumova. *Sakhar. Prom.*, 1982, (7), 31-34 *(Russian)*. — Trials on the use of AV-17-2P macroporous resin for decolorization of three grades of syrup are reported, showing an average colour reduction of 65.9% with a 60.4°Bx syrup of 1.2 units initial colour over a 23.6 days' cycle, an average reduction of 53.6% with a 62.6°Bx syrup of 4.5 units initial colour, and 45.6% reduction with a 62.4°Bx syrup of 9.0 units initial colour. The economic effect of using the resin is indicated.

The TR 99/1 line for manufacture of liquid refined sugar. J. Jacakova. *Listy Cukr.*, 1982, **98**, 185-188 *(Czech)*. — Details are given of a TR 99/1 prototype line for manufacture of liquid sugar; it includes equipment for melting affined sugar, active carbon decloriz-ation of the sugar solution, filtration and cooling.

Hygienic handling and preservation of liquid sugars during prolonged storage. J. Smolik and L. Fassatiova. *Listy Cukr.*, 1982, **98**, 188-191 *(Czech)*. — Means of ensuring maximum possible sterile conditions for handling and storage of liquid sugar are discussed, including suitable disinfection of the space above the sugar with a 2% aqueous solution of Persteril (containing potassium permanganate as active ingredient) or with 10% alcoholic formalin solution sprayed as an aerosol. Also important is maintenance of sampling cocks, pumps and piping in a hygienic state.

Colouring matter in raw sugar processing. W. Kita. *Gaz. Cukr.*, 1982, **90**, 57-59 *(Polish)*. — The colour content of the raw sugar and intermediate products at Witaszyce sugar factory was measured as absorbance at 560 nm, and hence the points at which colouring matter was formed and separated, respectively, established. The results are tabulated and illustrated in the form of a Sankey diagram depicting the overall factory process; it is shown that most colour was formed during evaporation and boiling of *B*-massecuite.

Regeneration of granular active carbon in melt liquor decolorizing columns. J. Kubiak. *Gaz. Cukr.*, 1982, **90**, 60-62 *(Polish)*. — Pilot-plant tests are reported in which granular active carbon was regenerated with superheated steam at 500-530°C for 3 hours in an airtight system. After regeneration, decolorizing tests were conducted with melt liquor, and the regenerated carbon found to be almost as efficient (70.7% average decolorization) as fresh carbon (average colour removal of 75.2%), raising liquor purity from 97 to 98. It is recommended to use a battery of four columns, with one being regenerated while the others are being used for decolorization.

LABORATORY STUDIES

Free fall velocity of sucrose crystals. L. J. Kuijvenhoven. *Sucr. Belge,* 1982, **101,** 167-174. – In industrial crystallization, crystal growth is mainly diffusion-controlled and so can be influenced by disturbing the boundary layer around the crystal, i.e. by stirring. In normal practice, crystals will have a velocity relative to the circulation of the mother liquor; since large crystals will fall faster than small ones, they will grow more quickly. For a basic definition of crystal growth velocity, knowledge of the free fall velocity is required. The author describes experiments with single crystals in which the free fall velocity was determined as a function of crystal length L (m), solution viscosity η (Pa. sec^{-1}) and crystal content (porosity) ϵ. One crystal at a time was dropped in a cylinder filled with sucrose solution, and the time needed to cover a given distance measured. The terminal velocity v_t ($m.sec^{-1}$) was calculated as the average of about 100 single experiments with different crystals, and the drag coefficient established as a function of Reynolds' number Re. At $Re < 1$, $v_t = 0.065 \frac{(\rho_p - \rho_l)gL^2}{\eta}$, where ρ_p and ρ_l are particle density and liquid density, respectively ($kg.m^{-3}$), and g is acceleration due to gravity ($m.sec^{-2}$). This equation is very close to the Stokes formula, in which the drag coefficient is given a value of 0.055 instead of 0.065. In the case of many crystals falling at the same time, hindered settling occurs; experiments were conducted with 1.5 litres of a 1:4 w/w ethanol:glycerol mixture (having a viscosity in the same range as a saturated sucrose solution and in which sucrose is poorly soluble, so that the crystal length remains unchanged) to which a number of crystals of known length were added and the mixture then stirred thoroughly to give a homogeneous suspension. The settling velocity v' ($m.sec^{-1}$) was determined as a function of porosity. For narrow sieve fractions ($\epsilon > 0.8$ and $250 < L < 1200$ μm), $v' = v_t \epsilon^{5.1}$, in which the exponent is the value of the Reynolds number.

Studies on the change in non-sugar contents in the sugar refining process. I. The determination of organic acids by gas chromatography and the change in their contents in the sugar refining process. K. Hanada, T. Amano and Y. Horiki. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **30,** 1-10 *(Japanese).* – The quantitative determination of organic acids in sugar refinery products was studied. The acids in sugar solutions were isolated by ion exchange and then esterified with *n*-butyl alcohol before determination by GLC. Two column reagents were selected; a coating of 10% polyethylene glycol (PEG) 20M for determination of lactic and glycolic acids, and a coating of 15% silicone DC for determination of other organic acids. Ten organic acids were found in raw cane sugar, viz. formic, acetic, lactic, glycolic, oxalic, succinic, malonic, malic, aconitic and citric acids. Their contents were reduced by two-thirds by affination, whereas carbonatation caused hardly any decrease in those organic acids originating in cane, while formic, acetic, lactic and glycolic acids caused by alkaline degradation of invert sugar increased. Ion exchange was the most effective method of reducing the organic acids contents, while neither activated carbon nor bone char had any noticeable effect, contrary to expectation.

On a decolorizing enzyme of the Basidiomycetes group. T. Ebashi. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **30,** 33-43 *(Japanese).* – Of 32 strains of Basidiomycetes tested (most of them *Coriolus* spp.), *C. versicolor* IFO No. 4941 was selected as the most active strain for decolorization of affination syrup. The strain was cultured under optimum conditions to give a broth of high decolorizing activity. Crude enzyme solution was prepared from the cell-free culture broth by a process involving filtration on Sephadex G-100. Examination of caramel decolorization activity and of polyphenol oxidation activity of the enzyme gave similar results in regard to pH profiles, thermal stability and behaviour toward various inhibitors. While caramels and melanoidins were decolorized by the enyme, the colour densities of raw sugar, brown liquor, fine liquor, affination syrup and molasses increased initially in the presence of the enzyme, but later decreased. Ultrafiltration permeate was fractionated by filtration on Sephadex G-25 and the colour change in each fraction examined under the effect of the enzyme. The initial increase in colour density was greater, the lower the molecular size of the components of the fraction; some components having molecules smaller than sucrose, viz. polyphenols, were presumed to be responsible for the increase in colour. These components did not seem to be easily removed in the sugar refining process, and were even found in fine liquor.

Chromatographic separation of molasses constituents. IV. Separation and identification of nucleic related substances. K. Sayama, Y. Senba and T. Kawamoto. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **30,** 64-71. **V. On the manufacturing conditions of raffinose.** K. Sayama, Y. Senba, T. Kawamoto and T. Muratsubaki. *ibid.,* 72-80. **VI. Production of liquid sugar from molasses.** Idem: *ibid.,* 81-87 *(Japanese).*

IV. In attempts to recover, by ion exchange chromatography with resin in Ca^{++} form, the betaine contained in beet molasses, where the factory uses ion exchange demineralization, it was found that N compounds were precipitated with Reinecke's salt used. Investigation of the final mother liquor revealed that these compounds were nucleosides such as adenosine and cytidine. Adenosine was identified by standing the final mother liquor in a refrigerator for a few days, after which the crude crystals obtained were purified and identified from the U.V. spectrum, from the R_f value obtained in paper chromatography, from the R_t value obtained in liquid chromatography and from the I.R. spectrum. Although cytidine could not be crystallized, it was identified as such from the same three parameters as for adenosine, omitting the I.R. spectrum. Average adenosine and cytidine contents in the molasses from the 1972/73 campaign at Memuro sugar factory were 0.41 and 0.28% on refractometric Brix, respectively.

V. A study was made of raffinose recovery from a raffinose-rich molasses. Ion exchange chromatography using resin in Na^+ form proved superior to the same method using resin in Ca^{++} form for separation of raffinose. At a feed molasses Brix of 30°, a charge volume of 12.5% on resin, a flow rate SV = 1.25 and a column temperature of 80°C, raffinose was eluted two fractions earlier than sucrose. (Raffinose is more water-soluble than sucrose at >70°C and vice

versa at <70°C, so that recovery is possible on the basis of these solubility differences.) While raffinose crystallization was possible in the case of a raffinose syrup of higher purity, recovery by ion exchange chromatography was low, and was maximum at a sucrose:raffinose ratio in the syrup of about 2:1. Active carbon was used effectively to decolorize the syrups. The product met standard specifications for laboratory-grade raffinose.
VI. Production of high-quality liquid sugar (colourless and of long storage life) from molasses using ion exchange chromatography was investigated. Since active carbon is inadequate for molasses decolorization, colouring matter separation by ion exchange chromatography with resin in Na^+ form was attempted. The colouring matter in each fraction was studied by gel chromatography on a column of Sephadex, and the chromatograms compared with one another. In the ion exchange chromatography, Waste I fraction contained most of the high-molecular colorants responsible for decolorization difficulties, but little sucrose. The product stream contained a large proportion of sucrose, reducing sugars and readily separable colouring matter, plus a little of high-molecular colouring matter and low-molecular colour precursors. Waste II was a fraction containing most N compounds, such as betaine, a nucleic acid base and low-molecular colour precursors.

Contribution to the knowledge of colour formation in sugar beet juices. E. Reinefeld, K. M. Bliesener, E. Brandes and V. Borrass. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 31 pp. — Experimental investigations showed that glucose was more reactive than fructose in the Maillard reaction, explaining why molasses contains more fructose than glucose. However, in dilute aqueous solutions, hexose decomposition products participate in the reaction, so that fructose disappears more rapidly. Model melanoidins from systems of low water content contain intact hexose building blocks or longer C chains as structural elements. Apart from glycine and γ-aminobutyric acid, the concentrations of all amino-acids decrease throughout the factory process; their reactivities with regard to the Maillard reaction are: γ-aminobutyric acid and lysine > aspartic acid, proline and phenyl alanine > leucine, glutamic acid and glycine > alanine and valine. The expected fall in glycine concentration is more than compensated by reformation of the amino-acid from serine and threonine under process conditions. γ-Aminobutyric acid, a potent colorant, increases in concentration during evaporation as a result of its formation by degradation of glutamine conversion products (e.g. pyrrolidone carboxylic acid) via 2-pyrrolidone acting as intermediate. Practical experience has shown that other browning reaction systems also participate in colour formation. A method using HPLC was developed for determination of phenolic substances, and showed that the concentration of some phenol carboxylic acids in juices (e.g. vanillin, coumaric acid and ferulic acid) increased greatly after alkaline hydrolysis (saponification of the respective esters). Under liming conditions, an analogous reaction may be expected which could be the cause of colour formation during juice purification, although further investigations are needed. Dihydroxy phenyl alanine added to raw juice decomposed rapidly without forming colour under the experimental conditions. The different effects of aeration on juice coloration are briefly discussed: while aeration during liming may give a thick juice of lower colour content (because of oxidation of the carbonyl compounds and some inhibition of the Maillard reaction), juice aeration sometimes increases coloration, possibly as a result of phenolic compounds not removed by purification.

Separation of sugars on chemically modified silica gel. P. Orth and H. Engelhardt. *Chromatographia,* 1982, **15,** (2), 91-96; through *S.I.A.,* 1982, **44,** Abs. 82-752. Liquid chromatography of sugars on silica gel with chemically bound amino groups depends on partition of the solutes between a stagnant aqueous phase and a moving acetonitrile-water mixture; the amino groups cause the eluent to separate into these two phases. Graphs show the effect of eluent composition on the K' values of sugars and sugar alcohols, on Lichrosorb Si 100 reacted with amino-, diamino- and triaminosilane. The separation of eight sugars (rhamnose, xylose, fructose, mannose, glucose, sucrose, lactose and raffinose) obtained on a gel containing triamino groups, with eluent containing 40% water, is shown.

Separation of carbohydrates by means of chromatography on a thin layer of cellulose. N. I. Kovalevskaya. *Laborat. Delo,* 1980, (9), 565; through *S.I.A.,* 1982, **44,** Abs. 82-756. — The method comprises: preparation of a loose (binder-free) layer of powder by evaporation of a 1:9 aqueous suspension on a plate; application of 0.2-0.3 mg of the solution; ascending elution for 1-1½ hr with 4:1:1 *n*-butanol:glacial acetic acid:water; drying and spraying with aniline phthalate, and heating to 130°C for 7-10 min. Brown spots appear, 2-3 min later for disaccharides than for monosaccharides; R_f values are shown for three disaccharides (0.12-0.18) and six monosaccharides (0.24-0.43). Detection limits are 0.4-0.6 and 0.2-0.3 μg, respectively (0.01M).

Methods of extraction of free amino-acids in beet ***(Beta vulgaris* L.).** J. Abadia *et al. Anales Estac. Aula Dei,* 1979, **14,** (3-4), 459-468; through *S.I.A.,* 1982, **44,** Abs. 82-759. — The effects of different methods of sample preparation on values found for amino-acid contents of beet and on recovery of standard amino-acids were tested. Freeze-drying seemed better than oven drying or use of fresh material. Extraction by refluxing and by homogenization did not give significantly different results; the former is preferred because it is more rapid. Purification with Dowex X-8 resin in H^+ form could be carried out either in a column or by batch stirring: the latter method caused high losses of certain amino-acids, but a correction could be applied.

Determination of nitrates in molasses stillage. L. D. Il'ina and N. G. Sitnik. *Ferment. i Spirt. Prom.,* 1981, (2), 6-7; through *S.I.A.,* 1982, **44,** Abs. 82-760. — A modified photocolorimetric method for determination of nitrates in molasses and vinasse is based on nitration of salicylic acid by nitrates in the presence of H_2SO_4, the picric acid formed being alkalized to form a green-yellow picrate. The sample is first decolorized by activated C in a hot water bath. The procedure is described in detail. Nitrate contents of molasses ranged from 0.05 to 0.1%. The method is rapid (15 min), sufficiently sensitive (0.002 mg) and accurate (± 5%). It is suitable for quality control of raw material during the production of bakers' and fodder yeasts.

Industrial utilization of enzymes. P. Ducroo. *Ind. Alim. Agric.,* 1982, **99,** 401-416 *(French).* — A detailed survey is presented of enzymes and their applications in food industries. Tables are given of enzymes with their origins (microbes, moulds and yeasts) and fields of application.

Specific enzymatic reactions and enzymes used for particular purposes are described, and future developments are outlined. As regards sugar, mention is made of glucose isomerase, α-amylase, dextranase, α-galactosidase, amyloglucosidase and their uses.

Spectrophotometric determination of reducing sugars with aromatic nitro-compounds. R. Soloniewicz and M. Teodorczyk. *Microchim. Acta,* 1982, **1,** (1-2), 105-114; through *Anal. Abs.,* 1982, **43,** Abs. 2C14. – The use of 2-, 3- and 4-nitrobenzoic acids and Na 3-nitrobenzenesulphonate has been investigated for the determination of nine reducing sugars (aldopentoses, aldohexoses, ketohexoses and disaccharides). Reduction of these reagents by sugars yields a yellow product that can be determined spectrophotometrically. The effects of reagent concentration, alkalinity, temperature and reaction time have been studied and conditions have been optimized. The reagents can also be used for the determination of the molecular weight of dextran fractions in the range 1400-25,000, since the reduction capacity of dextran is inversely proportional to its M.W.

Enzymatic determination of the sum of fermentable sugars in sugar factory products. G. Pollach. *Zuckerind.,* 1982, **107,** 603-606 *(German).* – Details are given of a method for determination of the total fermentable sugars in sugar factory products (with a view to yeast and alcohol manufacture) in the absence of melibiase and/or α-glucosidase. Glucose and fructose are formed from oligosaccharides by α-fructosidase as well as already being present as free sugars. The two hexoses are then phosphorylated by hexokinase in the presence of ATP, and equilibrium established between the two resultant phosphates by means of phosphoglucose-isomerase. Glucose-6-phosphate is removed by oxidation, and the extinction of the NADPH thus formed is measured at 340 nm. Random error is reduced by making up the enzyme mixtures immediately before pipetting into the spectrophotometer cells.

Studies on the change in non-sugar contents in the sugar refining process. II. Determination of inorganic constituents in the sugar refining process by atomic absorption spectrometry. T. Amano, K. Hanada and Y. Horiki. *Proc. Research Soc. Japan Sugar Refineries' Tech.,* 1982, **31,** 1-7 *(Japanese).* – The major metals in raw sugar and refinery intermediate and final products were determined quantitatively by flameless atomic adsorption spectrophotometry after dissolving samples in deionized water (or diluting them with the water, where appropriate). The method used was very rapid and gave reproducible results. The metal contents in raw sugar were, in decreasing order: K > Ca > Mg > Si > Na. A large proportion of the K, Na and Mg was removed by affination, but not of the Ca and Si. Granular active carbon treatment did not remove any metals, although bone char treatment removed Ca and Mg, while more than 90% of each metal was eliminated by ion exchange.

A mould causing decrease in the colour of raw sugar. T. Ebashi. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **31,** 15-18 *(Japanese).* – A mould isolated from a stored raw sugar sample bearing many white spots was identified, from morphological and physiological observations, as *Eurotium chevalieri.* When a petri dish filled with normal raw sugar was inoculated with the mould and incubated in a highly humid atmosphere for 14 days at 30°C, a white spot formed in the centre. During 8 months' storage at room temperature under the same conditions, the average colour content of the raw sugar fell by about 20%. Similarly, mould grew on the surface of diluted affination syrups of 20, 40 and 60°Bx after they had been inoculated and incubated under static conditions for 14 days at 30°C, but no mould grew on an inoculated syrup of 76°Bx.

On the air classifier for powder and granules. T. Ikeda. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **31,** 36-39 *(Japanese).* – By installing wire meshes in the air duct of an air classifier for powdered and granular material, the differences in the falling position of the particles as a result of differences in their grain sizes were noticeably increased; the effect would seem to be the result of physical interference by the wire meshes with the particles and air flow. Consequently, slight differences in grain size can be determined at a very high accuracy, which can be controlled by changing the open area of the meshes. Because of a low air duct height, the amount of energy required for a given air flow is small; on the other hand, the capacity of the classifier is much greater than that of a conventional classifier, while the maintenance costs were very low.

Waste water treatment by yeasts. K. Maekawa, Y. Saito and S. Oikawa. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **31,** 64-70 *Japanese).* – Laboratory experiments were conducted on treatment of ion exchange regenerant effluent by ultra-aeration (a type of activated sludge process) in two stages, each of which comprised aeration, clarification and centrifuging; pH was maintained at 4-5 in the first stage, in which the predominant microflorae were yeasts (at pH 3-6) and zoogloeae (at pH 6-9), while zoogloeae predominated in the second stage. BOD_5 removal of more than 90% was attained in the first stage, at a load of 20 kg BOD/m^3 per day and an initial BOD_5 of 13-15,000 ppm. The removal efficiency fell to 80% if the pH was not controlled. The water content of the sludge from the centrifuges was little affected by the type of microflora, but was greatly influenced by the crude ash concentration in the broth and seemed to be affected by the action of osmotic pressure. At a crude ash concentration of 1% and 6%, the respective water contents of the sludge from the centrifuges were 90% and 83%.

Production of liquid sugar from enzyme-inverted refinery molasses by cation exchange resin. Y. Takahashi. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **31,** 76-84 *(Japanese).* – Investigations were made of methods for inversion of refinery molasses and for chromatographic fractionation using Amberlite IR-120B cation exchange resin in Na^+ form to recover invert sugar from the treated molasses. Results showed that enzymic inversion of the molasses was more suitable than acid inversion. Under optimum conditions (a molasses concentration of 50°Bx, 0.4% enzyme concentration on solids, a reaction temperature of 60°C and a reaction time of 5 hours) about 98% inversion was achieved. The resin, of 65-100 mesh, was suitable for fractionation, and gave about 90% sugar recovery. Two different types of liquid sugar were obtained by fractionation: a glucose-rich fraction of 2.4:1 glucose:fructose ratio, and a fructose-rich fraction of 2.5:1 fructose:glucose ratio. Both were of almost 100% invert sugar purity, had a colour content similar to that of raw sugar but contained hardly any ash.

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BY-PRODUCTS

Low-energy motor fuel-grade alcohol distillation systems. R. Katzen, B. Frank and V. T. Gionnoni. *Proc. 4th Int. Symposium on Alcohol Fuels Technol.* (Brazil), 1980, 1043-1045. — Two distillation schemes, one for manufacture of anhydrous alcohol and the other for hydrous alcohol production, are described; they have been developed by Nordon Indústrias Metalúrgicas S/A for highly efficient recovery of alcohol from synthetic and fermentation feedstocks at low energy consumption. Since cane transport costs have to be charged against the 70 litres of alcohol produced per tonne of cane, and each tonne will include 250 kg of bagasse, the bagasse should not be burnt as fuel but should be used for production of fibrous materials, or saccharified and then used as an additional feedstock for alcohol manufacture. On the other hand, bagasse can be effectively used as fuel for the additional steam required to evaporate the vinasse. Data on consumption of steam, cooling water and electricity are given for both systems.

Micro-plants for ethyl alcohol production. R. A. Villen. *Proc. 4th Int. Symposium on Alcohol Fuels Technol.* (Brazil), 1980, 1061-1066. — Details are given of a mini-plant installed on the campus of the Luiz de Queiroz School of Agriculture in Piracicaba, Brazil, designed to produce 50,000 litres of alcohol per year and intended for operation by unskilled labour in villages or on large farms. Results obtained showed that the alcohol yield (50 litres/tonne of cane) was lower than with normal industrial-scale plants because of the less sophisticated equipment used, but the figures are considered reasonable. It is assumed that the cane would be one of the farm products, although the costs of cane obtained from elsewhere are also considered.

Pressed sugar beet pulp — the value-for-money feed. J. Harland. *British Sugar Beet Rev.*, 1982, **50**, (2), 23-25. The economic value of pressed beet pulp is discussed and results from feeding trials are reported; these showed that daily intakes of up to 40 kg of pulp were achieved when the pulp was fed *ad libitum* to Friesian steers, without any digestive disturbances, while carcass quality was satisfactory.

Tops silage assures winter feedstock. W. Hollowell. *British Sugar Beet Rev.*, 1982, **50**, (2), 27-28. — The advantages of feeding beet tops silage over *in situ* grazing by cattle and sheep are discussed.

Engine fuels from biomass. H. W. Parker. *Mechanical Engineering*, 1982, **104**, (5), 54-59. — The manufacture of fuel alcohol from various plant materials, including bagasse, is discussed, covering both ethanol production by fermentation and methanol production by thermochemical treatment. The economics of alcohol manufacture are examined, and practical aspects of the use of ethanol and methanol or their derivatives as automative fuels considered.

The effect of molasses non-sugars on the yield of alcohol and bakers' yeast. V. N. Shvets, P. A. Kulish and E. I. Knogotkova. *Izv. Vuzov, Pishch. Tekh.*, 1982, (1), 72-75 *(Russian)*. — The effect of non-sugars in a molasses wort of 22% concentration on yeast and alcohol was investigated and regression equations derived for calculation of yield with two different yeast strains. Results showed that calcium had the greatest adverse effect of the various non-sugars on yeast yield, while ethanol yield fell with increase in the concentration of caramelan and volatile fatty acids.

Bagasse compaction with retention. C. N. Anderson. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 227-235. The studies on the pelleting behaviour of bagasse[1] have been continued to include an investigation of the possibility of increasing final pellet density by increasing the time under compression with a view to reducing the fibre relaxation after peak pressure application. Results showed that 4 minutes' subjection of bagasse to a pressure of 520 kPa increased the pellet density by 50% at a temperature in the range 100-120°C and a compression moisture content (CMC) of 8%. On the other hand, a satisfactory density of 600 $kg.m^{-3}$ was not obtainable if the time under pressure was only two minutes, the CMC greater than 14% and temperature 80°C, while only acceptable density was achieved by compression at 20°C for 4 minutes. The implications of these results for compression machine design are discussed.

Biological treatment of distillery waste. K. E. McNeil, P. J. Anderson, H. Bartholomew and R. T. Hutchinson. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 301-310. Laboratory and pilot-scale experiments on aerobic and anaerobic treatment of waste from cane juice and syrup fermentation (to simulate distillery waste, of which there is no industrial source in Australia) are reported. Combined treatment reduced the COD from up to 40,000 $mg.l^{-1}$ to below 800 $mg.l^{-1}$. The BOD of this effluent, of the order of 20 $mg.l^{-1}$, indicates that much of the residual COD was not biodegradable. The anaerobic process alone removed more than 90% of the organic matter at daily loadings of up to 9 kg COD per m^3. About 0.35 m^3 per kg COD of methane was generated by the mesophilic processes; for a sugar factory crushing cane and converting all the juice to ethanol, this would have a fuel value equivalent to that of 25% of the bagasse produced. Treatment did not remove colouring matter or inorganic salts.

Zimbabwe fuel ethanol industry — conception to production. R. N. Johnson. *Proc. Australian Soc. Sugar Cane Tech.*, 1982, 311-315. — Details are given of the plant attached to Triangle sugar factory for manufacture of 120,000 litres of absolute alcohol per day from a mash made up of cane juice and molasses. The ethanol from the distillery, which started operations in 1980, is denatured with benzene, which also acts as an additional fuel extender, and it is then blended with gasoline to cover 15% of the petrol requirements of the country.

A method of improved monitoring of pulp dryers. J. Gorski. *Zuckerind.*, 1982, **107**, 438-439 *(German)*. During 1970-79, almost 80% of accidents in the West German sugar industry concerned pulp drying, pelleting and storage, particularly outbreaks of fire in drum dryers as a result of interruption in the wet pulp feed. An automatic system for monitoring feed is described. In-

[1] MacArthur: *I.S.J.*, 1982, **84**, 218.

stalled at Appeldorn factory by Endress & Hauser, the Granuflow DTR 131 is a microwave system operating on the Doppler principle. The sensor transmits the microwaves at a constant frequency and receives the reflected waves from the pulp. Because of the Doppler effect, there is a frequency shift between the two signals which is proportional to the speed of flow of the pulp. This shift is measured by the detector. If there is no change in frequency because of the absence of movement of the pulp, the wall opposite that carrying the detector does not cause any distortion; as a result, the signal received by the sensor is amplified and used to actuate a replay which in turn operates an audible and visual alarm.

Contamination caused by the pulp and paper industry in Cuba. E. Barquinero, R. Cruz, H. Domínguez, M. Reyes and O. Porto. *Revista ICIDCA,* 1981, **15,** (1), 3-11 *(Spanish).* – The major effluent streams in Cuban pulp and paper factories are identified and the pollution load they carry is assessed, as a first step towards its reduction.

Study of the clarification of molasses for production of biomass. M. Klibansky, A. Saez and R. Reádigos. *Revista ICIDCA,* 1981, **15,** (1), 29-39 *(Spanish).* – Five samples of molasses were clarified by two methods, the first involving dilution 1:1 with water, heating to 80°C for 90 min, adjustment to pH 3.2 with sulphuric acid and settling for 24 hr before centrifuging at 25,000 rpm, while the second method eliminated the acid treatment and settling. The latter gave 70% of the benefits of the former with no loss of biotin in either case. Yield and protein content were not affected by the clarification method but were dependent on the source of the molasses.

Application of process simulation techniques in the production of hydrolytic syrups. E. M. Rivas B. and R. Suárez R. *Revista ICIDCA,* 1981, **15,** (1), 40-51 *(Spanish).* – Digital simulation techniques have been applied for material and energy balance calculations in the production of a syrup by hydrolysis of bagasse to be used as a yeast manufacturing substrate. The simulation results were used in the design of a plant having a production capacity of 12,000 tonnes of yeast per year. Energy equivalent to 3.91 tonnes of oil per tonne of yeast is required to convert the bagasse to yeast, but this may be reduced to 3.78 tonnes by installation of a back-pressure turbine which generates 1200 kW of electricity.

Bacteriostatic effect of betaine and its utilization. Food preservation and water activity. S. Oikawa, K. Sato, K. Sayama, K. Kakiya, T. Kawamoto and M. Osawa. *Proc. Research Soc. Japan Sugar Refineries' Technol.,* 1982, **30,** 88-96 *(Japanese).* – Application of betaine as a humectant in food preservation was studied. Results showed that betaine recovered from beet molasses had the same effect as glycine in reducing water activity, but was far less effective than NaCl at the same concentration. Betaine had a bacteriostatic effect only at a concentration greater than 10%; however, at such high concentrations, its taste could not be disguised, so that it should not be used alone but combined with other humectants.

The black liquor evaporation system of a new bleached bagasse pulp factory with the sulphate process. H. Y. Tao. *Taiwan Sugar,* 1982, **29,** 51-60. – Black liquor evaporation, as a means of recovering sodium and sulphur compounds used in bagasse pulp manufacture, is described and problems created by heavy scaling of the tubes in a quadruple-effect evaporator are discussed. Details are then given of a quintuple-effect evaporation system and its performance over two short trial periods; the data are compared with designed and expected performance data and with results for the quadruple-effect evaporator, and indicate that the tested system could be of advantage, although a sextuple-effect system would be optimum.

Developments in pulp drying control. J. S. Hogg, J. D. F. Wilkie, R. D. Morgan and S. C. H. McCarey. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 47 pp. After a historical review of automatic beet pulp drying control in the UK and elsewhere, details are given of two systems installed for the 1981/82 campaign: a Siemens Teleperm M AS220 system installed to control two out of four dryers at Peterborough, and a Holec system (based on a Texas PM 550 programmable controller) installed on a dryer at King's Lynn. The former scheme depends on the mid-point temperature in the dryer, while the Holec scheme manipulates the fuel valve directly to control the outfall temperature on the basis of the dried pulp moisture content (predicted 20 minutes ahead by a simple model). Preliminary results are reported, and showed that both systems have justified themselves, although the performance of the system at King's Lynn was consistently better than that at Peterborough, where there was greater variation in moisture content (although deviation from a target value did fall over a given number of days). The cost benefits of moisture control are briefly assessed.

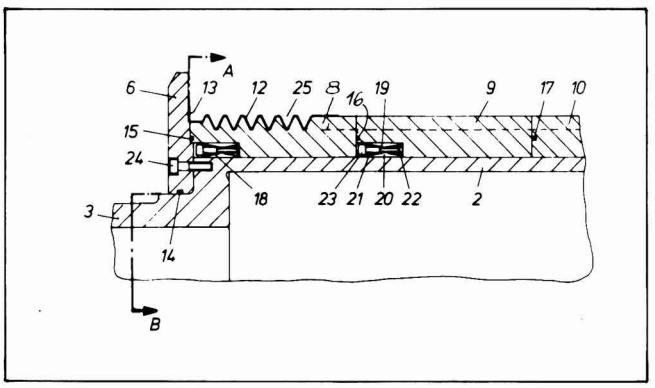
Pressed pulp silage as an alternative to pulp drying. C. Heller. *Paper presented at 26th Tech. Conf. British Sugar plc,* 1982, 29 pp. – Because of rising energy costs, the author's company (Pfeifer & Langen) has been examining the possibility of ensiling pressed beet pulp on a factory scale and selling the silage as animal fodder rather than drying and pelleting the pulp. Trials conducted in 1979-81 are reported. Differences in pressed pulp dry matter had no effect on silage quality. The temperature of the pulp when first ensiled should be at least 40°C and should fall to ambient after four weeks; high temperatures maintained over a longer period than this lead to a loss of structure by decomposing pectin. Since it is not possible to obtain the required fall in temperature in large silos and piles, cooling of the pressed pulp is necessary; undesirable fermentation can be avoided by treating the pulp with chemicals, particularly sodium nitrite or a phosphoric acid-sorbic acid mixture. Good fermentation during ensilage was achieved by adding beet fragment to the cooled fresh pulp in a 15:85 mixture. Ensiled pulp should be compressed to force air out of the heap and physically stabilize the material.

Batch and multi-stage continuous ethanol fermentation of cellulose hydrolysate and optimum design of fermenter by graphical analysis. R. D. Tyagi and T. K. Ghose. *Biotechnol. Bioeng.,* 1980, **22,** (9), 1907-1928; through *S.I.A.,* 1982, **44,** Abs. 82-819. – Bagasse was delignified with NaOH and hydrolysed with cellulase; the filtered hydrolysate, containing 6-7% reducing sugars (70% glucose, 30% other sugars) was concentrated under vacuum. Media based on this hydrolysate, and containing 10, 14, 18 or 22 g glucose/litre, were fermented to ethanol by *Saccharomyces cerevisiae* in batch tests and in a 4-stage continuous fermenter at various dilution rates. Ethanol and biomass concentrations obtained are shown and compared with data predicted from kinetic models.

PATENTS

UNITED KINGDOM

Cane mill roller. Buckau-Walther AG, of Grevenbroich, Germany. **2,025,260.** July 16, 1979; January 23, 1980; October 13, 1982.



The mill roller is provided with a shell in the form of a number of wear-resisting rings 8, 9, 10, etc. These are locked to the shaft 2 by suitable means such as a tongue-and-groove connexion. In the illustration, clamps 18 are provided for each ring in the form of two triangular rings 19, 20 and trapezoidal rings 21, 22. Ring 21 has a plain bore and 22 a threaded bore so that, when bolt 23 is tightened it draws ring 21 closer to ring 22, thrusting rings 19 and 20 apart and clamping the wear-resisting ring (8, 9, etc.) to the shaft 2. When the last ring 8 is in place on the shaft, the end flange 6 is fitted and held in place by means of bolts 24.

The rings 8, 9, etc. and the inner surface of flange 6 are provided with a coating of granular material 12, 13 of high resistance to wear, provided by industrial diamond, or 87% tungsten carbide and 13% cobalt. Juice grooves at the bottom of grooves 25 are not in contact with cane and so do not need to have this coating. Packing rings 14, 15, 16 and 17, etc. are provided between the flange 16 and shaft 2, flange 6 and ring 8, and adjacent rings 8, 9, 10, etc. to prevent access of cane juice to the shaft 2 where corrosion and premature failure might occur.

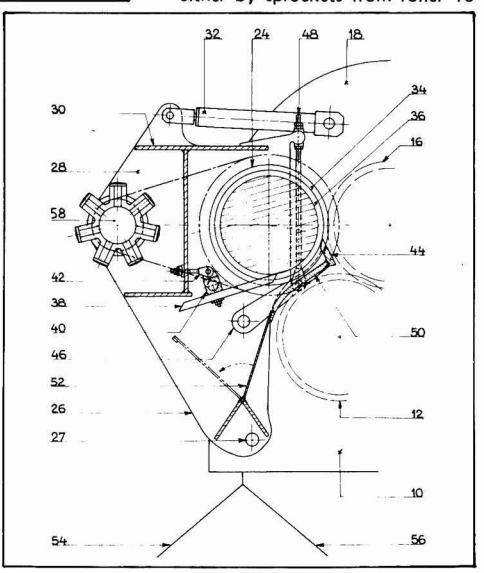
Sugar centrifugal. J. Halder L., of Alajuela, Costa Rica. **2,026,333.** July 25, 1978; February 6, 1980. – See US Patent 4,118,248[1].

Sieve centrifuge. Krauss-Maffei AG, of München, Germany. **2,026,888.** July 31, 1979; February 13, 1980; September 29, 1982. – See US Patent 4,254,904[2].

Cane Mills. Fives-Cail Babcock, of Paris, France. **2,026,896.** July 20, 1979; February 13, 1980.

The cane mill is of the type whereby the inlet roller 12, top roller 16 and discharge roller are in a housing with a cap 18 on each side pivoting about an axis on the discharge side, and with pressure maintained by a hydraulic piston on the feed side. A fourth roller 24 is placed in front of top roller 16 and above inlet roller 12. It is mounted on a support 26 on each side; these pivot about a shaft 27 and the roller 24 is held against roller 16 by a hydraulic cylinder 32 linking the top of support 26 with cap 18. Adjustable limit stops provide a minimum clearance between these rollers.

The roller 24 is provided with grooves 34 and a trash plate 44, supported at each end by arms 46, fits into these and ensures passage of cane from between rollers 24 and 16 to the gap between rollers 16 and 12. The position of the arms 46 and so trash plate 44 is governed by the adjustable tie rods 48. Juice expressed between rollers 24 and 16 enters the juice grooves 36 in the former and pass onto screen 50. A gate 52 on the end of the screen delivers this juice either into the receiver 54 or, if moved to the position indicated by the broken line, into the receiver 56 where it mixes with the rest of the juice extracted in the mill. The grooves 34 are cleaned by knives 38 which are carried by a shaft 40, journalled in the side plates 28 and 26 and located by the adjustable linkage 42 in the cross-piece 30. The roller 24 is driven either by sprockets from roller 16



or, as shown, by a separate hydraulic motor 58 through chains and sprockets.

[1] *I.S.J.*, 1981, **83**, 155.
[2] *ibid.*, 1983, **85**, 154.

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, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

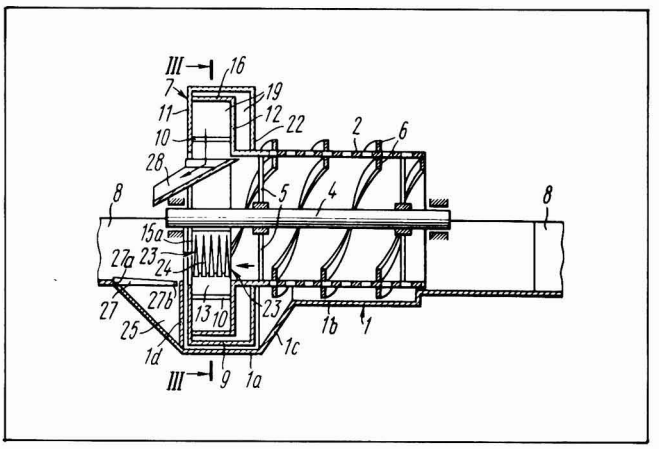
Cane mill stand. Buckau-Walther AG, of Grevenbroich, Germany. **2,026,898.** August 9, 1979; February 13, 1980; October 6, 1982.

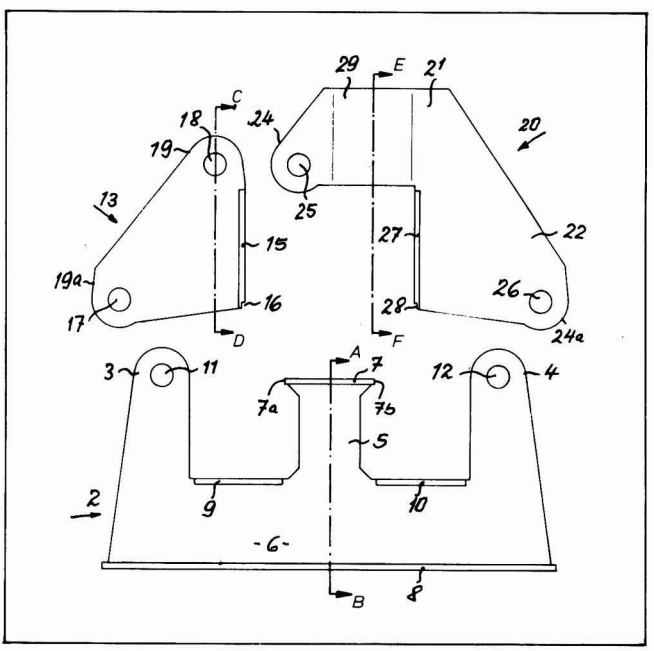
The mill housing comprises three parts on each side, of welded construction. The lower part 2 is mounted on a base plate 8 and is in the form of an E on its back, with bearing surfaces 9, 10 and 7 and with the top of the side pieces 3 and 4 of fork-like construction and provided with bores 11 and 12, respectively.

The upper portion 13 has similar fork-like construction at its ends 19a and 19 as well as bores 17 and 18 so that it fits into the end of the side piece 3 and, with a bolt through bores 11 and 17, can pivot around the bolt. The portion 13 is also provided with a bearing surface 15, with a recess 16 at its lower end which corresponds to the end 7a of surface 7. The other upper portion 20 has a fork-like construction and the ends 24 and 24a, bores 25 and 26 and a bearing surface with recess 28 corresponding to the end 7b of surface 7. It also carries a vertical bore through the body 29, having a smaller diameter nearer the bottom.

When the mill is to be assembled, the corresponding parts 2 are located either independently or joined by means of base plates 8. The roller and journal housing are located in each side, the housings being supported on surfaces 9 and 10. Parts 13 are then fitted and secured by bolts through bores 11 and 17 and parts 20 connected to parts 2 by bolts through bores 12 and 26. Before connecting parts 13 and 22, the top roller and journal housings are fitted, supported by surfaces 7 and 15, and parts 20 then pivoted over so that they may be connected to parts 13 by bolts through bores 18 and 25. Hydraulic pressure is exerted on the top roller by a cylinder located in the bores in the bodies 29; the roller does not make contact with the other rollers when the mill is empty and full pressure may be maintained on it under these circumstances.

Separation of beet trash. Vsesoyuzny Nauchno Issledovatelsky Institut Sakharnoi Promyshlennosti, and Kievsky Tekhnologichesky Institut Pishchevoi Promyshlennosti, of Kiev, USSR. **2,029,272.** September 12, 1978; March 19, 1980; August 25, 1982.





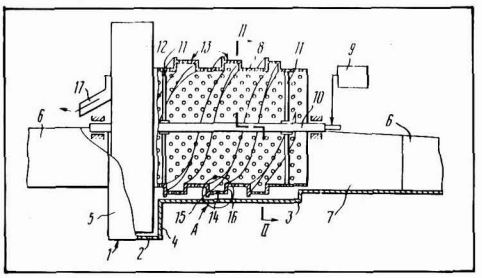
A cylindrical screen 2, supported by radial struts 5, is carried by a shaft 4 which is driven by suitable means. The screen carries internal and external helical ribbons 6 and is mounted within a trough 1 which comprises semi-cylindrical sections 1a and 1b, linked by a tapering section 1c and closed at the feed end by an end plate 1d. The flow rate of beets entering the washer/separator along flume 8 is greatly reduced by the greater diameter, permitting separation of heavier trash through a grating 27 into a chute 25. Openings in plate 1d permit passage of trash and water into the sump formed by plates 1a and 1c, and into passages 19 through ports at intervals around the separation device 7. This comprises an inner cylinder 10 and an outer cylinder 9, with annular plates 11 and 12 and an internal system of passages and ducts formed by plates 12 and 16.

The diameter of cylinder 10 is such as to provide pockets 13 into which lighter trash collects. As the screen and attached separator 7 rotate, trash is returned by ribbons 6 in countercurrent to the flow of roots and is then carried by the system of passages from pockets

13 and passages 19 and is discharged into chute 28. Beet roots are prevented from entering the system at port 15a by means of a grid 23 formed from bars 24.

Beet washer. Kievsky Tekhnologichesky Institut Pishchevoi Promyshlennosti and Vsesoyuzny Nauchno Issledovatelsky Institut Sakharnoi Promyshlennosti, of Kiev, USSR. **2,029,730.** September 12, 1978; March 26, 1980; August 25, 1982.

The washer is located in the flume 6 and comprises a drum 8 mounted by struts 11 on a shaft 10 which is driven by suitable means 9. The drum is mounted within



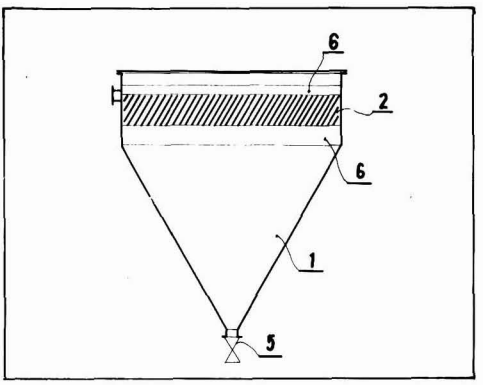
a trough 1 having a larger diameter section 2 containing a trash separation and discharge device 5, and a smaller diameter section 3 connected by a semi-annular plate 4. The drum is provided with helical channels 13 mounted on the outside and formed by plates 14, 15 and 16. The plates 14 are perforated like the drum, while plates 15 are extended towards the inner surface of cylinder 3.

Dirty beets flow past the trash separator section and into the drum where heavy particles are separated. The larger ones are trapped within the channels 13 while the smaller ones pass through the perforations of the drum 8 and plates 14, into the trough section 3. Rotation of the drum causes the larger particles to be moved within the channels in countercurrent to the beet flow so that they are delivered to the separation section. The plates 14 are of increasing length as they near the separation section and this prevents them becoming jammed with particles. The smaller particles are transported by the extended plates 15 so that they too are carried to separator section 5. The axis of the drum is mounted with a slight eccentricity from that of the trough so that the clearance between the tip of plates 15 and the trough varies, and this prevents jamming. The particles are discharged through chute 17 while the cleaned beets pass into the section 7 connecting the washer to the flume 6.

Removal of potassium ions from vinasse. ENI Ente Nazionale Idrocarburi, of Rome, Italy. **2,030,127.** September 10, 1979; April 2, 1980. – Vinasse from distillation of fermented beet molasses is treated with an acid having a poorly-soluble K salt (H_2SO_4, HNO_3, HCl, or tartaric acid) and an organic solvent (an aliphatic alcohol, ketone or volatile ester) in such quantities as to cause the K salt to precipitate; this is then separated and the solvent recovered from the vinasse by distillation.

Clarifier. Vupcht Vyzkumny ustav potravinarske a chladici techniky, of Hradec Kralove, Czechoslovakia. **2,030,884.** October 6, 1978; April 16, 1980.

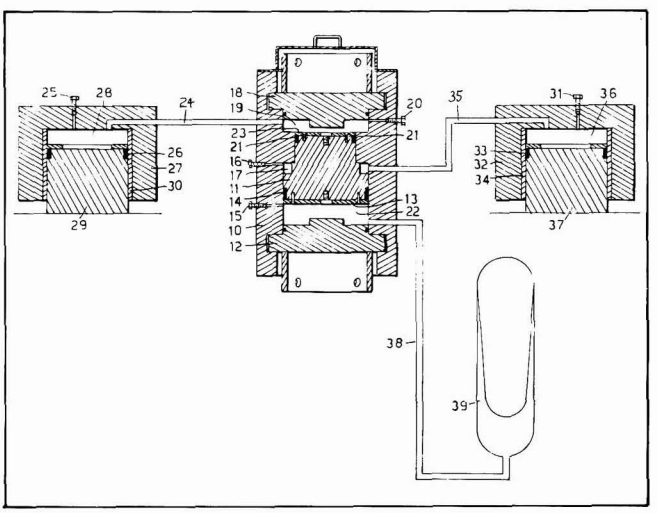
The clarifier is in the form of a conical or pyramidal tank 1 having a system of plane parallel oblique plates 2 acrosse the top and, above and below, inclined transverse plates 6.



Sugar-containing liquid is delivered through a port which is at the same level as plates 2 and the entrained solids separate on the latter, with the clarified liquid rising and passing to an overflow while the solids drain into tank 1 from which they are removed through discharge 5.

Cane mill roller control. The Bundaberg Foundry Co. Ltd., of North Bundaberg, Queensland, Australia. **2,034,602.** November 22, 1978; June 11, 1980.

The auxiliary hydraulic ram assembly comprises a piston 11 within a cylinder 10 closed by head 18 and base 12. The bore of cylinder 10 is stepped so providing a chamber 22 below the piston, another 19 above, and an intermediate chamber 17. The piston is provided with end plates 13 and 23 and seals 14 and 21, while air bleeds 15, 16 and 20 are provided for each chamber. Chamber 22 is connected to the hydraulic accumulator



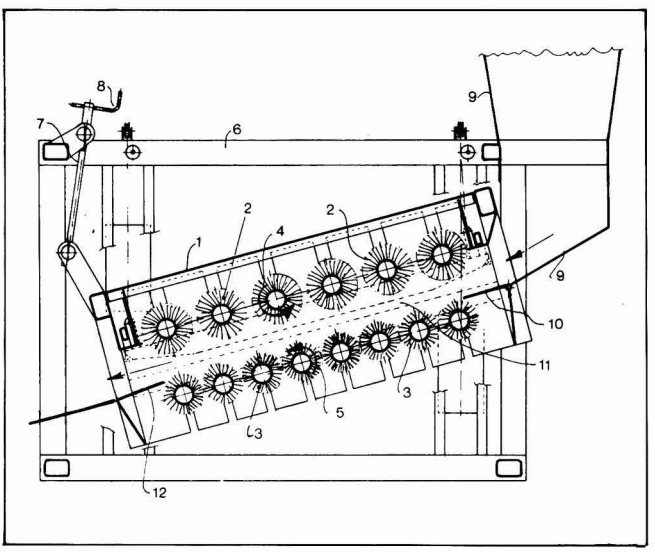
39 through conduit 38 while chambers 19 and 17 are connected by flexible hose conduits 24 and 35 to chambers 28 and 36 of the support rams 27 and 32.

These have pistons 29 and 37 moving inside the liners 30 and 34 and provided with seals 26 and 33. The chambers 28 and 36 are also provided with air bleeds 25 and 31. The hydraulic pressure in accumulator 39 is transferred through the auxiliary ram to the two support rams on either side of the mill roller. If a foreign body or thicker blanket at one side of the roller causes that side to lift, the chamber on that side – say 28 – becomes smaller and hydraulic fluid is transferred through conduit 24 to chamber 19. This causes the piston 10 to move downwards. Chamber 17 is thus enlarged and this causes contraction of chamber 36, so that the other side of the roller rises and it remains horizontal.

Beet peeler. A/S De Danske Sukkerfabrikker, of Copenhagen, Denmark. **2,036,791.** December 12, 1979; July 2, 1980.

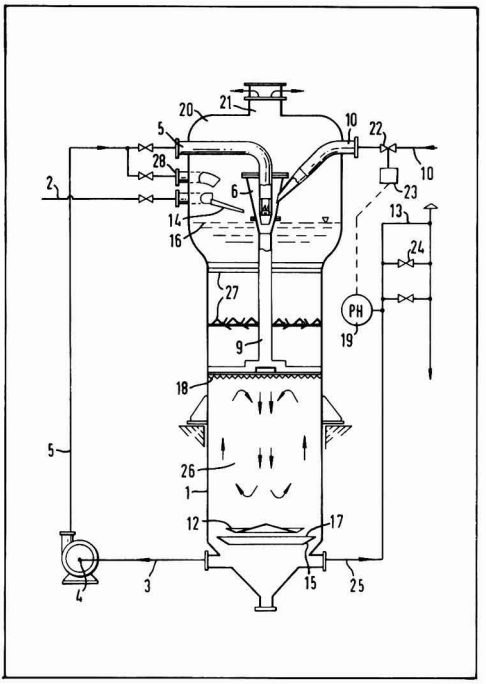
The inclined housing 1 contains an upper row of rotatable cylindrical brushes 2 and a lower row of brushes 3. The rows rotate in the direction of the arrows and brushes 3 are mounted so that the tips of adjacent brushes are in contact. The housing is mounted on a support 6 and its angle of inclination can be varied by turning the handwheel 8 which operates the linkage 7. Washed sugar beets are delivered into the housing from hopper 9, over guide plate 10 and enter the housing.

After passage between the brushes they pass over guide plate 12 and so out through the open end of the housing whence they pass to the slicers. The action of the brushes is to remove the peel from the washed roots, which contains low purity juice in small quantity and contains a large proportion of the colour-forming constituents in the beet. This peel is separated by brushes 3 and is deposited on the floor.



Extracting juice from cane. Intercane Systems Inc., of Windsor, Ont., Canada. **2,038,654.** December 19, 1979; July 30, 1980. – See US Patent 4,230,733[1].

Carbonatation tank. Institut für Forschung und Rationalisierung der Zuckerindustrie, of Halle, East Germany. **2,039,295.** November 26, 1979; August 6, 1980.



Limed juice enters the upper section of the vessel 1 by feed 2 and is distributed at the top of the liquid level 16 by a tray 14. Carbonatated juice is withdrawn through delivery conduit 25 and goes to process, while its pH is measured by meter 19 and used to govern the flow of CO_2 through pipe 10 by means of controller 23 and valve 22. Juice is also withdrawn from tank 1 through pipe 3 and delivered by pump 4 to a feed pipe 5 having a by-pass 28 which also delivers onto distributor tray 14. The juice is sent at high speed through pipe 5 into the conical chamber 6 where it mixes with gas delivered through pipe 10, aided by swirl vanes at the bottom of the vertical section of pipe 5.

The mixture of gas and juice passes down through pipe 9 into the main mixing section 26 where it circulates. The baffle plate 12 and gas separator 17 prevent gas being entrained with the juice flowing out through pipes 3 or 25. Efficiency of gas utilization is enhanced by the gas absorber 18 and the gas distribution grids 27, residual gas leaving the tank through outlet 21 in the top 20.

[1] *I.S.J.*, 1982, **84**, 317.

Argentina sugar exports, 1982[1]

	1982	1981	1980
		tonnes, tel quel	
Raw sugar			
Algeria	0	10,000	10,500
Chile	0	7,830	67,442
China	3,589	0	0
Finland	10,284	0	0
Mexico	6,446	0	0
Morocco	14,000	10,482	0
Portugal	14,698	0	0
Uruguay	0	9,046	6,188
US	114,470	381,483	247,476
USSR	34,276	200,553	67,939
	197,763	661,094	399,545
White sugar			
Chile	57,533	37,770	64,780
Egypt	0	7,600	0
Sudan	0	0	5,000
Tunisia	0	0	10,000
Uruguay	200	0	170
US	2,036	4,709	0
USSR	0	10,000	0
Venezuela	0	0	10,000
	59,769	60,079	89,950
Total	257,532	721,173	489,495

Alcohol utilization bibliography. — The Centro de Pesquisas e Desenvolvimento is a research and development foundation linked with the State government of Bahia in Brazil. One of its projects is the preparation of a bibliographic survey on the use of ethyl alcohol as a raw material and as a substitute for petrochemical-based feedstocks. Data have been collected from as many Brazilian and international sources as possible and the first of a proposed series of reviews has been published under the name *Alcoolquímica Informações.* The reviews will appear monthly and will be available free of charge from CEPED, Setor de Documentação e Informação, Caixa Postal 9, Camaçari, Bahia, Brazil 42800, which requests workers in the field to contribute summaries of their studies for inclusion.

Rumania beet crop, 1982[2]. — The 1982 sugar beet harvest in Rumania amounted to 6,647,000 tonnes, up 1,240,000 tonnes from the year before but considerably under the target of 8,860,000 tonnes. The average beet yield amounted to 24.74 tonnes per hectare, compared with 22.08 tonnes in 1981. The extraction rate must have been very low, however, because sugar production amounted to only some 600,000 tonnes, white value (652,000 tonnes, raw value), against 609,000 tonnes (663,000 tonnes, raw value) in the previous campaign.

Fiji sugar crop, 1982[3]. — The four sugar factories of the Fiji Sugar Corporation crushed a record total of 4,074,727 tonnes of cane to produce 486,679 tonnes of raw sugar, again a record. Molasses production amounted to 150,049 tonnes. The crushing rate of the factories was 940 t.c.h., also a record, which compares with the previous highest rate of 880 t.c.h. achieved in 1981.

Thailand cane crop reduction[4]. — A revised estimate of sugar cane production for the 1982/83 season indicates a crop of 20 million tonnes compared with 31 million tonnes in the 1981/82 season. In 1983/84 the crop is expected to fall to some 12-15 million tonnes, owing to a long-lasting drought. If sufficient rain were to fall, a recovery to 18-19 million tonnes might be possible.

Australian sugar companies merger talks[5]. — The Boards of Directors of the companies operating the Marian and Cattle Creek sugar factories in Queensland have, on the basis of a feasibility study, recommended that the two companies be merged, a proposal that would need a 75% approval from each set of shareholders. Local press reports suggest that Cattle Creek growers would not vote for something that might result in the closure of their mill; however, it is understood that it would be some years before Marian mill would be in a position to process all cane from both areas.

Japan beet crop, 1982[6]. — The 1982 beet crop in Japan reached a record 4,108,000 tonnes, an increase of 753,000 tonnes or 22% above the 1981 crop. This was in spite of a reduction to 697,000 hectares (4300 ha or 6% less than the 1981 area); the increased crop was caused by favourable weather conditions which raised beet yield by 30%.

Switzerland sugar imports, 1982[7]

	1982	1981
	tonnes, tel quel	
Austria	168	1,168
Belgium	430	431
Cuba	2,701	2,180
France	61,942	49,868
Germany, West	96,235	86,828
UK	284	13,289
Other countries	126	16
	161,886	153,780

Sri Lanka expansion program[8]. — Imports of sugar by Sri Lanka normally total some 225,000 tonnes, white value, but by the mid-1980's this will be drastically reduced when three new sugar projects come into operation, with a total capacity of 118,000 tonnes/year. The 27,000 tonnes/year Sevengala project is government-owned and financed by the Asian Development Bank, while the 47,000 tonnes/year Palewatta and 44,000 tonnes/year Moneragala projects are in the private sector. Palewatta, a £35,000,000 project, is planned to have an ultimate capacity of 70,000 tonnes a year from 30,000 acres of rain-fed cane. By the mid-1980's, the country's sugar consumption is expected to have risen to around 300,000 tonnes/year, and to a level of some 350,000 tonnes/year at the end of the decade. Currently, the two plants at Hingurana and Kantalai produce about 27,500 tonnes of sugar; theoretically they could produce 50,000 tonnes but they suffer from inadequate equipment and less than ideal cane growing conditions.

Coca-Cola increases HFCS usage[9]. — The Coca-Cola Company, which claims to be the world's largest buyer of sugar, has raised the proportion of high fructose corn syrup in its soda fountain soft drinks from 50% to 75% of total sweeteners. Canned and bottled Coca-Cola will continue to use 50% sugar as the sweetening agent. The move is intended to reduce costs, since HFCS costs 17 cents/lb for the second generation 55% product, against 30 cents/lb for sugar. High sugar prices in the US result from the government's protection program.

New Indonesian sugar factory[10]. — A new factory, with a capacity of 4000 t.c.d., is to be built at Baturaja, South Sumatra, by C. Itoh & Co. and Kawasaki Heavy Industries Ltd. of Japan.

Hong Kong sugar imports, 1982[11]. — Imports of sugar by Hong Kong in 1982 reached 118,602 tonnes, tel quel, against 108,826 tonnes in 1981. Two origins — China (25,725 tonnes) and South Korea (75,994 tonnes) — accounted for the vast majority of the total, as was also the case in the previous year when they supplied 25,067 and 55,358 tonnes, respectively.

UK beet research finance. — The rate of contribution by UK growers and British Sugar plc in 1983/84 for research and education has been set by the Ministry of Agriculture at 9.0 pence per tonne of beet purchased, an increase of 0.5 pence on 1982/83. Beet research in the UK has been financed by the industry since 1936 and the current program includes studies on plant breeding, variety trials, plant physiology, agronomy, crop husbandry, nutrition, pest and disease control, prevention of virus infection, machinery and weed beet, while the levy also pays for the provision of advice and education to growers through publications, film and demonstrations.

Poland campaign results, 1982/83[12]. — The 1982 beet harvest in Poland amounted to 15.1 million tonnes, down 5.0% from the 1981 harvest, according to official Polish figures. The beet yield was reported to be 30.6 tonnes/ha, down 9.5% from the year before, but the sugar content was substantially higher, since sugar production amounted to 1,840,000 tonnes, white value, up 6.8% from the year before.

1 "El Azúcar Argentino en Cifras"; *Supp. to La Industria Azuc.*, 1983, (1017).
2 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 128.
3 *Fiji Sugar*, 1983, **8**, (1), 16.
4 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 99, 231.
5 *Australian Sugar J.*, 1983, **74**, 564.
6 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 131-132.
7 C. Czarnikow Ltd., *Sugar Review*, 1983, (1636), 33.
8 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 130.
9 *Public Ledger's Commodity Week*, March 5, 1983.
10 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 132.
11 C. Czarnikow Ltd., *Sugar Review*, 1983, (1639), 47.
12 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 140.

UK sugar imports, 1982[1]

	1982	1981
	tonnes, tel quel	
Barbados	43,347	28,020
Belize	35,460	49,093
Congo	0	5,291
Cyprus	0	3,347
Denmark	71,195	76,834
Fiji	134,033	194,781
France	17,121	3,495
Guyana	158,147	179,206
Holland	35,537	27,020
Ireland	46,664	33,302
Jamaica	114,792	129,896
Malawi	5,213	10,522
Mauritius	396,866	349,725
St. Kitts	21,468	15,348
Swaziland	61,410	74,878
Trinidad	38,667	66,784
Zimbabwe	6,350	0
Other countries	70,380	4,137
	1,258,655	1,255,221

New Yugoslavia sugar factory[2]. — Construction of a new sugar factory at Sabac in Serbia Province is nearly complete; the plant will slice 400,000 tonnes of beet per campaign grown on an area of 5000 hectares. Part of the equipment has been supplied by Czechoslovakia and the remainder manufactured locally.

UK sugar exports, 1982[3]. — Official statistics of United Kingdom exports of sugar during 1982 show a total of 149,988 tonnes, tel quel, the largest quantity going to Israel (61,821 tonnes). Other major destinations included Norway (24,866 tonnes), Nigeria (16,279 tonnes) and the Sudan (12,597 tonnes).

Ivory Coast white sugar manufacture[4]. — Sugar production in the six factories of the Ivory Coast reached a level of 182,000 tonnes in the 1982/83 crop, against 172,000 tonnes produced in 1981/82. Domestic consumption is some 80,000 tonnes, about half as white sugar, while the surplus has in the past been exported as raw sugar to Europe, Egypt and Mali. Prospects for exports to other African countries are promising, however, although the sugar will have to be refined and shipped as cube sugar. As a consequence, Sodesucre has decided to add refining sections to its complexes at Borotou and Zuénoula for production of 80,000 tonnes/year of granulated white and cube sugar for export. Construction is planned for the 1984/85 season.

Belize sugar exports, 1982[5]. — Exports of sugar from Belize in 1982 totalled 103,849 tonnes, raw value, against 95,292 tonnes in 1981 and 103,149 tonnes in 1980. The EEC and the US were the major destinations, taking 43,395 and 40,485 tonnes, respectively: in the two previous years they had shared all the exports, but in 1982 19,969 tonnes were delivered to Canada.

Puerto Rico cane harvest delay[6]. — The sugar cane harvest in Puerto Rico, which should have started at the end of January, has been delayed by the refusal of the state-owned Sugar Corporation to sign the collective labour contract, according to *Latin America Commodities Report.* Only one of the country's five factories is reported to be working.

Yugoslavia campaign results, 1982/83[7]. — In the 1982/83 campaign, the 21 sugar factories sliced a total of 5,598,000 tonnes of beet, harvested from 138,800 hectares, and produced 651,313 tonnes of sugar, white value. This was a reduction from the 801,000 tonnes, white value, (871,000 tonnes, raw value) of sugar produced in the 1981/82 campaign.

El Salvador sugar imports and exports[8]. — Exports from El Salvador in 1982 totalled 56,169 tonnes, raw value, against 48,635 tonnes in 1981 and 35,273 tonnes in 1980. In all three years the only destination was the US. In contrast to the two previous years, however, El Salvador imported 10,674 tonnes of sugar from Guatemala in 1982.

Fiji cane crop reduction by bad weather[9]. — Drought, followed by hurricane damage, has caused widespread loss with flooding of the entire cane growing area of the main island Viti Levu. Advanced cane was the most affected and, as a consequence, 1983/84 sugar production is expected to be reduced to about 430,000 tonnes against 486,700 tonnes in the previous season.

US sugar imports, 1982[10]

	1982	1981
	short tons, raw value	
Domestic off-shore		
Hawaii	863,609	1,095,977
Puerto Rico	80,393	48,361
Foreign		
Argentina	178,848	443,950
Australia	310,315	715,125
Belize	48,644	56,290
Bolivia	16,344	8,091
Brazil	328,413	1,099,351
Cameroun	0	5,775
Canada	33,473	2,597
Colombia	38,002	177,900
Costa Rica	61,707	81,513
Dominican Republic	383,214	761,007
Ecuador	3,075	54,673
Fiji	39,896	23,822
Guatemala	59,999	224,213
Haiti	6,604	0
Honduras	70,121	94,528
Madagascar	0	12,274
Malawi	54,822	87,627
Mauritius	20,572	0
Mexico	16,333	107
Mozambique	31,800	40,066
Nicaragua	62,858	80,089
Panama	102,956	103,958
Paraguay	16,949	16,160
Peru	59,343	0
Philippines	243,741	239,043
El Salvador	58,030	46,497
South Africa	51,997	0
Swaziland	84,340	191,869
Taiwan	61,820	0
Thailand	336,776	262,059
West Indies	94,259	104,292
Zimbabwe	88,839	92,119
Other countries	268	288
	3,908,360	6,169,621

Peru sugar imports. — Peru has allowed private companies to import up to 50,000 tonnes of refined sugar[11] (subsequently raised to 150,000 tonnes[12]) to end an acute shortage caused by torrential rains, according to government sources. Flooding in the north of the country hampered production and disrupted distribution to Lima. It was hoped that production would recover in April. Last year Peru produced 740,000 tonnes of sugar, tel quel, and exported 100,000 tonnes. Official forecasts published before the rains estimated 1983 production at 804,000 tonnes, but no revised forecast has so far been published.

PERSONAL NOTES

Prof. Dr. Ferdinand Schneider has resigned from the Presidency of the Scientific Committee of the C.I.T.S. owing to ill-health, and has been replaced by **Prof. Giorgio Mantovani** of Italy.

We regret to report the death last year of **Emmanuel Rochecouste** at his home in Brisbane, Queensland. Apart from studies in England, he spent most of his life in his birthplace of Mauritius where he was engaged in research in the sugar industry from 1948 to 1966, becoming eventually head of the Botany Division of M.S.I.R.I. He contributed greatly to the study of weed control in sugar cane and was the author of a monograph on the subject published in 1967, the year after he left Mauritius to work for the DuPont company in Australia as Senior Research Biologist. He retired in 1977 and had been intending to publish a revised and amplified edition of his monograph.

We regret also to report the death, early this year, of **V. E. Baikow.** Of Russian origin, Baikow had lived and worked in the USA for many years although travelling widely as a consultant. He is perhaps best known for his book, "Manufacture and refining of raw cane sugar", the second edition of which was published last year.

1 C. Czarnikow Ltd., *Sugar Review,* 1983, (1638), 40.
2 F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 140.
3 C. Czarnikow Ltd., *Sugar Review,* 1983, (1640), 51.
4 F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 163, 214.
5 *I.S.O. Stat. Bull.,* 1983, **42**, (2), 4.
6 F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 163.
7 C. Czarnikow Ltd., *Sugar Review,* 1983, (1642), 60.
8 *I.S.O. Stat. Bull.,* 1983, **42**, (2), 12-13.
9 F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 166.
10 C. Czarnikow Ltd., *Sugar Review,* 1983, (1639), 45.
11 F. O. Licht, *International Sugar Rpt.,* 1983, **115**, 179-180.
12 *Public Ledger's Commodity Week,* April 2, 1983.

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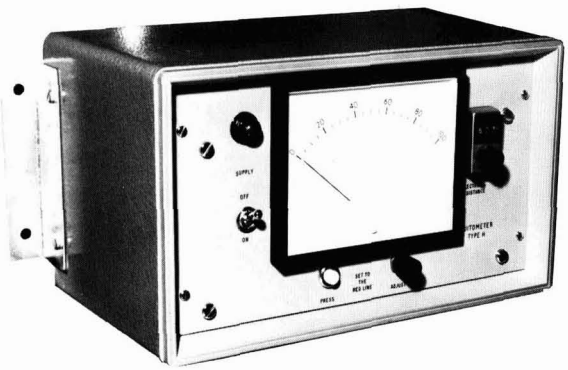

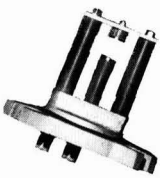

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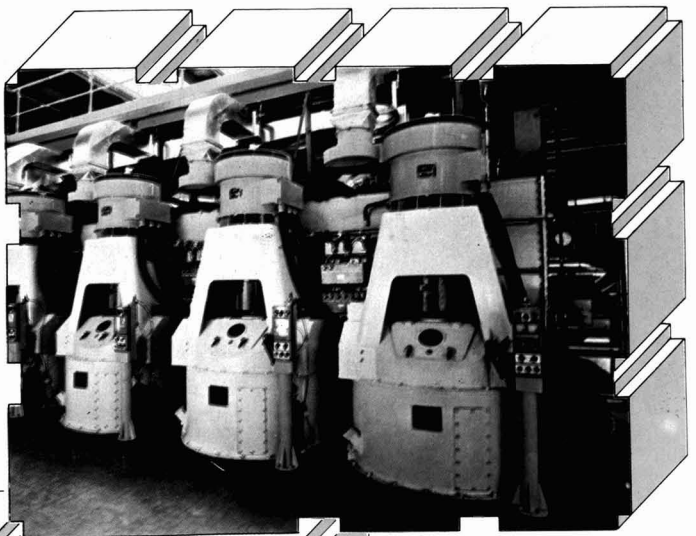

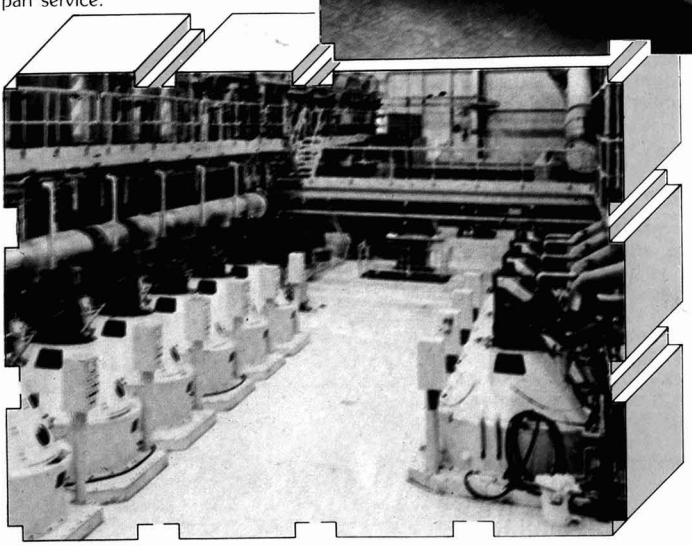

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