

# INTERNATIONAL SUGAR JOURNAL



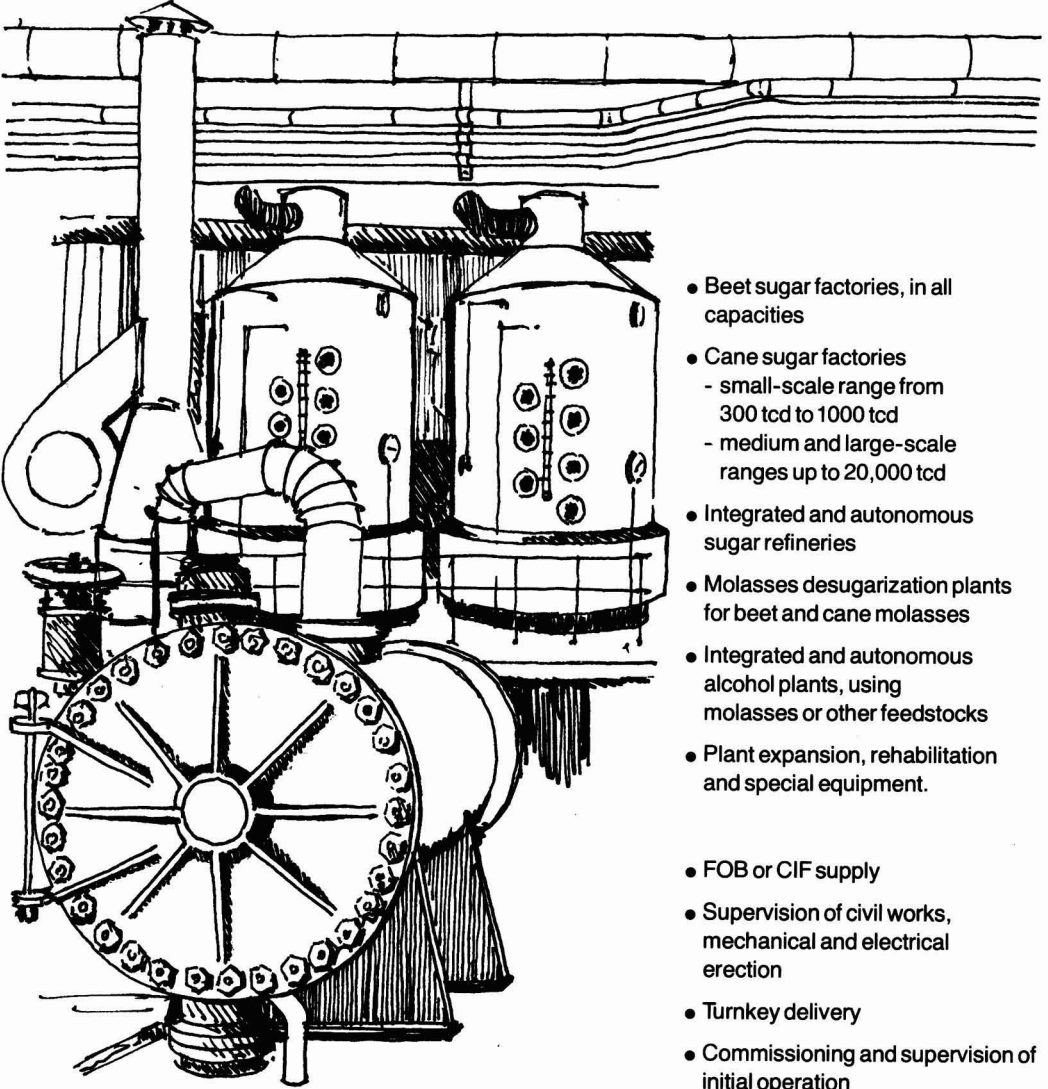
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MARCH 1983

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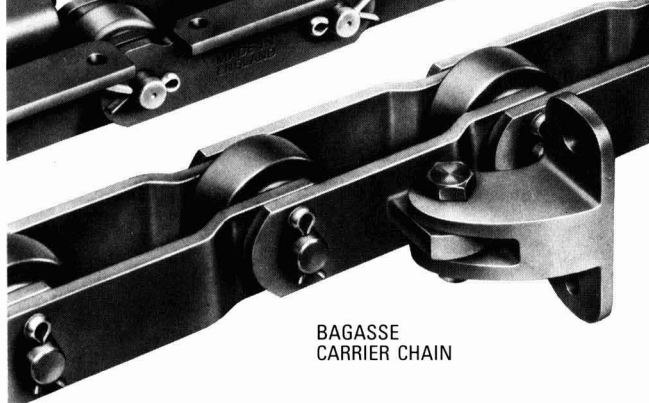
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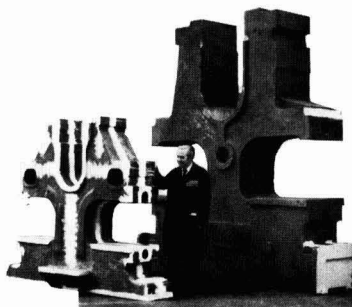


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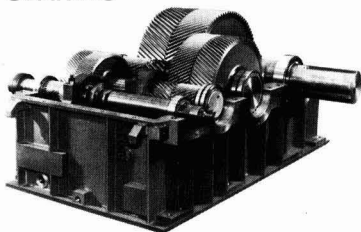
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# INTERNATIONAL SUGAR JOURNAL


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# NOTES AND COMMENTS

## World sugar prices

The London Daily Price for raw sugar started in January at £100 per tonne but fell to £96 on January 5 and stayed at about this level until January 17. Thereafter weakening of the pound sterling against other currencies encouraged a rise and the LDP reached £99 on the 18th and continued upwards, aided by reports of fresh purchases of Thailand raws by the USSR, to reach £110 on January 27. The price then faltered and fell, to end the month at £106.

White sugar values were weaker at the beginning of the month than in December, perhaps owing to greater awareness of the large quantities to be disposed of from the European beet crops. From an LDP(W) of £134 on January 4, the price fell to £131 the next day but then strengthened with reports of purchases by Mexico and Ecuador, and reached £144 on January 11, a premium of no less than £45. Thereafter white sugar values declined to £136 and stayed at about this level to the end of the month, closing at £134, a premium of only £28.

## The EEC and the ISA

The EEC Commission has released details of its proposals put forward to the Preparatory Group which is seeking a basis for a new International Sugar Agreement. The plan involves different procedures and obligations for three categories of exporting members. The ten larger exporters (Argentina, Australia, Brazil, Cuba, Dominican Republic, EEC, India, Philippines, South Africa and Thailand) would undertake most of the responsibility for defending the market. They would do this by means of extended stockholdings and without being subject to export quotas. The suggested stocks figure is between 5 and 6 million tonnes, about double the present ISA holdings; the EEC would hold about 2 million tonnes or approximately what it already withholds from the market.

A second group of exporters, with shipments normally below 500,000 tonnes a year, would be subject to export quotas and a special stocks arrangement. For these countries the quotas would be established as a proportion of basic export tonnages as at present, but would be set at a level which more closely reflects their actual share of the market than is the case at the moment. Further, if necessary, it would have to be possible to reduce quotas to a smaller proportion than the present limit of 85% of b.e.t.'s, perhaps to 75-80%.

The smallest exporters, at present permitted to export up to 70,000 tonnes a year, would continue to be permitted to dispose of that or a similar tonnage free of any restriction. Stocks held by the medium and larger exporters would be released when the price reached trigger points, enabling the shipment of larger quantities when the price rises above these previously agreed levels. If the concerted stocking and destocking system proved insufficient to achieve acceptable prices, the larger exporters would also consider additional measures such

as area reductions, supplementary reserve stocks and schemes to promote consumption and diversification.

The EEC envisages that importing members would also play a part in financing the stockpiles in the exporting countries, although this suggestion was not well received by them at the January meeting of the Preparatory Group. However, the EEC's point about inclusion of alternative sweeteners in a new ISO was considered valuable. EEC countries have been critical of the working of the special arrangements for shipment of Cuban sugar to the East European bloc and the Commission called for greater clarity about the amounts involved and the arrangements by which they escaped regulations applying to world market exports.

The Preparatory Committee is to meet in mid-March and it is hoped that the ISO Secretariat will have produced a Draft Agreement for consideration by heads of delegations attending that meeting.

## World sugar production estimates

The latest forecasts of world sugar production by *World Sugar Journal* and by F. O. Licht GmbH were published recently. They are produced on a slightly different basis and so are not exactly alike but both show increased figures for 1982/83 nearing those of 1981/82 in spite of the crop area reductions which have taken place.

*World Sugar Journal*<sup>1</sup> note improved results from a number of European countries, particularly Poland, since their previous estimate and expect production to reach 97,256,000 tonnes, raw value, against 98,916,000 tonnes in 1981/82. Licht set production at 98,866,000 tonnes in 1982/83 against 99,872,000 tonnes in the previous season<sup>2</sup>, with Brazil regaining its position as the world's largest producer of centrifugal sugar. If the estimate is borne out, the sugar surplus "will be substantially higher than anticipated and, unless major decisions to cut back production are taken urgently, there seems to be little prospect of better prices, and many sugar-dependent economies will be set on course for disaster".

C. Czarnikow Ltd. comment<sup>3</sup>: "The present supply/demand imbalance stems from the individual actions of many of the world's major producers, and it is interesting to note that the current level of prices in the international market often has very little effect on the returns received by individual producers. A glance at the six major producers clearly illustrates this situation.

"Brazil exports large tonnages of sugar to the world market, but it also has a substantial domestic outlet upon which the incomes of producers can be sustained. India is in a very similar situation, but with even larger domestic requirements.

"Although the level of domestic consumption in Cuba is not large, there is a whole chain of long-term trade agreements with individual communist countries under which prices well in excess of those prevailing in the world market are paid. The Soviet Union produces almost entirely for domestic consumption and, in any case, has a strictly state-controlled industry whose returns are not influenced by those ruling in the world market.

"Producers in the USA were suffering recently from the effect of world market prices and to safeguard their interests the US government has introduced quotas, thereby isolating the sugar and to some extent the corn sweetener industries almost entirely from the effect of prices ruling outside the country. Finally, of course, there is the EEC which, taken as a group, is by far the

<sup>1</sup> 1983, 5, (7), 9-17.

<sup>2</sup> *International Sugar Rpt.*, 1983, 115, 19-26.

<sup>3</sup> *Sugar Review*, 1983, (1631), 5-6.



*Notes and comments*

largest producer, with very nearly 15% of the world's output. A substantial proportion of this is produced under guarantee so the full rigours of the world market are only felt on around two to three million tonnes of sugar. With so large an amount of protection safeguarding producers all around the world, the sort of tonnages which we have seen this season and last must be expected to continue if there is no external control imposed."

**South African sugar industry inquiry<sup>1</sup>**

A Committee of Inquiry into the Sugar Industry was appointed in March 1981, under the Chairmanship of Dr. A. J. V. Röhrich, and completed its report on September 30, 1982. The Committee met formally on 28 days during its inquiry and received written evidence from 47 organizations and individuals. Members travelled extensively in the cane areas of South Africa and received the cordial cooperation of organizations and individuals in the industry.

The report is now in the hands of the South African Sugar Association for study but it has already been commented that some of the Committee's recommendations could be difficult to implement. For example, the Committee concludes that the industry could be expanded over the next ten years by a total of about 141,000 tonnes of sugar per annum. However, no possibilities were seen for expanding cane cultivation to use in alcohol manufacture. The Committee considered that a strong case has been made for establishment of a new sugar factory in the Onderberg area of the Eastern Transvaal, while effect should be given to the proposals of the Van Biljon Commission in regard to small, uneconomical mills.

A new cane transport system is recommended whereby growers would accept full responsibility for cane transport costs and appropriate compensation be paid to the losers. The longer the existing system continues, the more difficult it will become to change it to a sound economic foundation. The Committee recommends that the Sugar Association be given the responsibility of determining the industrial selling prices of sugar within parameters to be approved by the Minister from time to time, which would give the industry sufficient flexibility to decide on the timing and frequency of price adjustments. No changes are recommended to the present system for export sugar production, transport and marketing.

**World sugar balance 1982/83**

F. O. Licht recently published their second estimate for the balance between world sugar supply and demand for the period September 1982 to August 1983<sup>2</sup>. The figures are reproduced below and show that, with amended production data from the previous crop, now set at more than 100 million tonnes, raw value, initial stocks are higher than earlier estimated<sup>3</sup>, while production is now expected to be 940,000 tonnes higher in Europe and some 500,000 tonnes higher in the rest of the world, by comparison with the earlier balance figures.

Against this, forecast consumption has been revised upwards by 636,000 tonnes, but this still provides an end-period stock figure of 37 million tonnes or almost 40% of annual consumption, against the generally accepted normal level of 24%. While ISO exporting members and especially India, as well as the EEC, will be accumulating and withholding large amounts from the market, the surplus remains large and oppressive.

"Although planned output cuts by Brazil and the EEC could put the world sugar demand/supply situation in better balance in 1983/84, another surplus is not outside the realm of possibility. Production must decline to approximately 95 million tonnes to prevent another surplus next year."

It is thus not surprising that the EEC Joint Working Party on sugar has called on other world exporters to follow the Community's lead and reduce planted area and stockpile sugar<sup>4</sup>.

	1982/83	1981/82	1980/81
	tonnes, raw value		
Initial stocks	32,414,000	24,502,000	25,236,000
Production	98,628,000	100,196,000	88,080,000
Imports	28,830,000	31,231,000	28,674,000
	159,872,000	155,929,000	141,990,000
Exports	29,416,000	32,097,000	28,120,000
Consumption	93,453,000	91,418,000	89,368,000
Final stocks	37,003,000	32,414,000	24,502,000
" " % consumption	39.60	35.46	27.42

**Terminal markets dollar quotations possibility<sup>5</sup>**

The French Terminal Market Association proposed last year to the French government that it permit a switch to dollar pricing on the Paris white sugar market, according to the President of the Association. He said that a decision in this respect was urgent, with the proposed switch to dollars on the London sugar market; any hesitation by the government in converting the market to international pricing in dollars would be interpreted as a sign of weakness abroad and could have "serious" consequences.

However, London is reported to have no immediate plans to launch a dollar-based futures contract. The Chairman of the London Terminal Market Association confirmed that a white sugar contract with dollar pricing had been drawn up but it had been put "on ice" to see if the existing white sugar market in Paris would attract more turnover and additionally to see how the London raw sugar contract fared. Turnover of the Paris market improved in 1982, with volume rising by 17.9% to 12.9 million tonnes.

**EEC sugar stockpile**

Member countries of the EEC withheld 992,000 tonnes, white value, of C- or non-quota sugar of their 1981/82 production from the market and this was carried forward to the 1982/83 marketing year. There had been general indications that the Commission intended to limit exports in 1982/83 to the same level as in 1981/82 but it was feared that insufficient C-sugar would be stockpiled and that the Commission would have to limit exports of A- and B-quota sugar. There was little sign of this during January and weekly releases ran at higher levels than forecast.

However, in early February it was announced that Community sugar producers had given commitments to stockpile 1,089,000 tonnes, white value (1.2 million tonnes, raw value), for carrying over to the 1983/84 marketing year. This included 649,000 tonnes for France (including 14,000 tonnes of B-quota sugar), 200,000 tonnes for West Germany, 80,000 tonnes for the UK, 70,000 tonnes for Belgium, 48,000 tonnes for Holland, 23,000 tonnes for Ireland, 14,000 tonnes for Denmark and 5000 tonnes for Italy (this last all being B-quota sugar).

<sup>1</sup> *S. African Sugar J.*, 1982, 66, 407, 415, 417, 419-423.

<sup>2</sup> *International Sugar Rpt.*, 1983, 115, 61-65.

<sup>3</sup> *I.S.J.*, 1983, 85, 2.

<sup>4</sup> *Public Ledger*, January 22, 1983.

<sup>5</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 70.

# The role of thermographic surveying in energy conservation\*

By J. S. HOGG, J. S. UNWIN, A. L. JENKINS  
and A. J. RANDALL

## Introduction

Among the many advances in semiconductor technology one such technique has been the detection of infra-red radiation and the processing of the electrical signals produced into T.V. type visual displays. Early applications were mostly military but now the techniques are widely available and much used in industry for non-contact temperature measurement. Over the last year we have looked at the equipment available and its method of use and concluded that it could be of use in British Sugar. Following some brief demonstrations on site by an equipment maker in the 1980/81 campaign a further more extensive programme of investigations was carried out at three factories in the 1981/82 campaign.

These surveys showed how thermography could be used in a factory as an investigation tool and a fault finding device. The survey results can also be interpreted quantitatively and a direct assessment of heat loss calculated.

## INFRA-RED THERMAL IMAGING

### Elementary theory

All objects having a temperature above absolute zero naturally emit electromagnetic energy. The actual amount of energy emitted depends on the object's temperature and its surface condition (or emissivity). The higher the temperature the more energy is emitted.

The energy emitted by an object is distributed throughout the electromagnetic spectrum (Fig. 1). While the shape of the distribution stays fairly constant, it may be seen that the actual amount and spectral distribution of the energy vary considerably with temperature. For any given object at a certain temperature there is only one wavelength where the energy is at a maximum. Approximately 75% of the object's total energy occurs on the longer wavelength side and 25% on the shorter wavelength side of this maximum energy point.

Energy emitted from an object must travel through the atmosphere and, since the atmosphere itself absorbs and emits energy, there are physical limitations which determine where in the spectrum measurement can be made.

The different constituent parts of air attenuate the different wavelengths of the infra-red spectrum to differing degrees. Figure 2 shows the transmission/attenuation of infra-red energy in the atmosphere, and also indicates which of the constituents is responsible for the attenuation. It may be seen that there is a band between 5 and 8 microns where virtually all the energy is attenuated by water vapour. The bands (or windows) immediately above and below this are the ones normally used for thermographic purposes, the 3-5 micron band being generally used for higher temperatures detection, and the 8-14 micron band being used for lower temperatures.

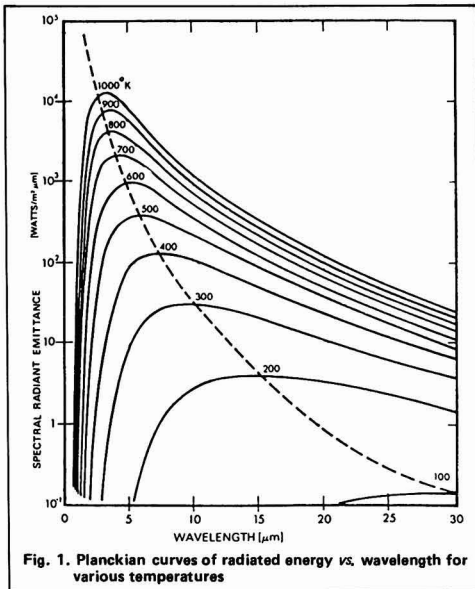


Fig. 1. Planckian curves of radiated energy vs. wavelength for various temperatures

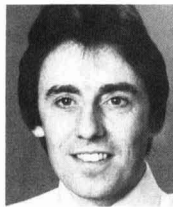
\* Paper presented to the 26th Technical Conference, British Sugar plc, 1982.



J. S. Hogg



J. S. Unwin

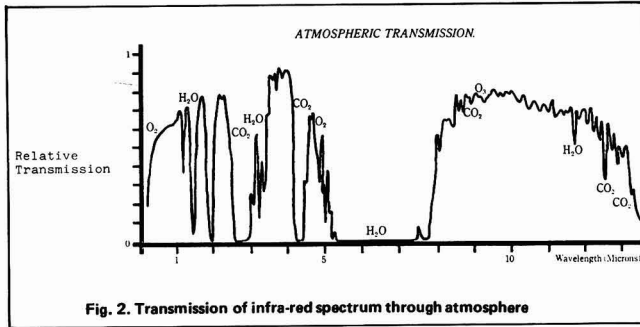


A. L. Jenkins



A. J. Randall

*The role of thermographic surveying in energy conservation*



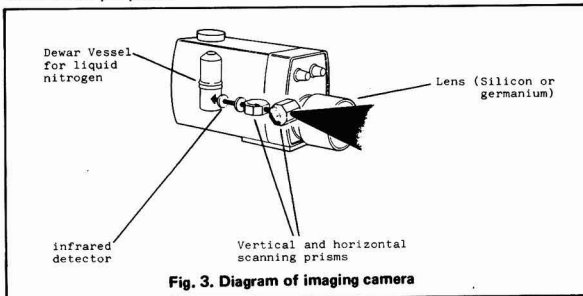
**Fig. 2. Transmission of infra-red spectrum through atmosphere**

It is the detection of this radiated energy (or a representative portion of it), and the process of converting it into a visible image, that is termed "Thermography".

*Imaging detection equipment*

The various cameras which are now available for infra-red imaging operate on a number of differing principles. The following description of the operation of the "AGA" camera, which was the first one developed commercially, may be taken as being broadly representative.

Referring to Figure 3, the incident infra-red energy is focused by a special silicon or germanium lens (selected to pass the particular range of wavelengths required) through an optical-mechanical scanning system and onto a highly sensitive detector of indium antimonide or mercury cadmium telluride. In the AGA system the detector is mounted in the base of a Dewar flask which is filled with liquid nitrogen (at -196°C). This reduces the normal electronic activity in the detector to a very low level and also provides a reference for temperature calibration purposes.



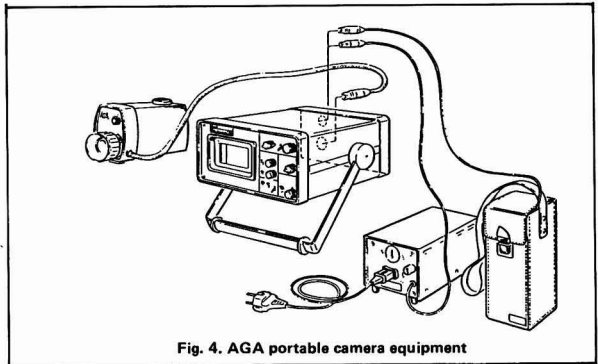
**Fig. 3. Diagram of imaging camera**

Once the invisible infra-red energy has been converted into an electrical signal, the image may be displayed on a cathode ray tube in such a way that variations in the temperature of the object viewed are seen in varying shades of grey.

It is a particular advantage of the liquid nitrogen-cooled system (and some other systems using other means of cooling) that the image may be temperature calibrated. There is also available an "isothermal" mode of operation in which all those parts of the image at the same temperature are highlighted. By use of this latter technique, together with multiple exposure photography, it is possible to produce a thermogram

in which the different temperature bands are highlighted in different colours.

It is clearly not necessary to use expensive equipment to detect where no lagging exists, the answer to that problem being in the hands of factory management. What thermal imaging systems do, however, is to display the heat radiated by plant very quickly and in a format that is very easy to interpret. Plant which is out of reach can be checked in an instant, as can the efficacy of lagging which may have only just been installed, or may have been in place for 20 years.



**Fig. 4. AGA portable camera equipment**

Whilst, with the ever rising cost of energy, the principal use of this technique is, and is likely to remain, the investigation of energy loss, there are already many other uses established such as the location of over-heated bearings, examination of live electrical equipment for hot or cold spots, and the highlighting of defects in the refractory brickwork of furnaces and chimneys. Whilst use for purposes such as these may be marginal to the main task of the equipment, it may be found that the savings achieved in the identification of potential faults are much more than marginal.

A typical set of portable thermal imaging equipment is shown in Figure 4. The cost of such a set of equipment is approximately £14,000. The equipment is very simple to use and an instruction period of only a few hours is needed for a new operator.

**THERMOGRAPHIC SURVEYS DURING THE 1981/82 CAMPAIGN**

British Sugar at first contemplated the purchase of a set of thermographic equipment. However, while investigating the market for suitable portable equipment, we discovered a number of companies providing specialist survey services. We therefore decided that our first entry into the field of heat loss surveying should be through one of these specialist companies.

British Sugar instructed B.L. Thermographic Surveys Ltd. (B.L.) to conduct thermographic surveys at Newark, Bury St. Edmunds and Brigg factories in order to determine heat losses from process lines and major items of plant. The survey team comprised one representative from each of B.L., Central Offices and the



relevant factory. The B.L. representative was responsible for the operation of the AGA 750 thermal imaging camera, the 35 mm camera and the video recorder. The Central Offices and factory representatives were responsible for temperature measurements using a digital contact thermometer, wind measurements using a digital anemometer and the recording of all information. The length of time needed to conduct the survey was dependent on both the size of the factory and its layout. The survey reports produced by B.L. comprised of: a selection of thermograms (photographs of heat loss), calculations of energy loss for all items of plant in watts per square metre and the cost of heat loss per campaign for selected items of plant. When calculating the radiative heat loss an allowance was made for the emissivity of the surface which can vary from 0 to 1, e.g. polished aluminium has an emissivity of 0.05 and oxidized steel an emissivity of 0.79. As the infra-red camera was sensitive to only the radiative component of heat loss it was necessary to calculate the convection loss separately. When estimating heat loss through convection the windspeed must be taken into account because even low windspeeds can significantly alter values of convection loss.

*Newark factory survey*

Newark factory was selected for a survey to assist the Newark Energy Task Force in making the newly reconstructed factory as efficient as possible. The survey was carried out during the week of November 23-27, 1981. The factory was divided into the following areas: Diffusion, Carbonatation and Filtration, Decalcification and Sulphitation, Evaporators and Condensate receivers, Sugar End, Pulp Pressing, Boiler House, Oil Tanks, Lime Kilns, Pulp Dryers, Tarehouse and Miscellaneous plant items and a time allocated to each area according to its energy consumption.

The areas were surveyed using the principle that every item of plant with a temperature above 50°C should have been lagged when it was originally installed, but it soon became apparent that certain items of plant had been traditionally not lagged because of their shape and requirement for ease of access. All manual valves and pipeline flanges were not lagged during the reconstruction on the basis that the pay-back period was considered too long. The pay-back period has been re-checked by the Energy Task Force using today's fuel prices and found to be comparable to the Company's current lagging pay-back period. The thermal camera showed that the majority of lagging around the tanks and pipelines was to a satisfactory thermal standard. The thickness of lagging on the 1st and 2nd evaporator bodies was considered insufficient as their surface temperatures were 50°C. The thermal camera detected steam leaking past two of the five evaporator exhaust steam safety valves. Whilst scanning both main boilers several hot spots were detected and marked for further investigation. The survey found that the juice process had been adequately lagged but no consideration has been given to reducing the heat losses within the wet pulp and pressed pulp processes. Consequently, the temperatures of pressed pulp to dryers and press water are lower, resulting in higher pulp dryer fuel consumption. Further investigations are necessary to study the relationship of pulp dry substance against temperature to see if it is feasible to lag the wet pulp process without loss of pressing efficiency.

*Brigg factory survey*

Brigg factory was selected for a survey because it had

*The role of thermographic surveying in energy conservation*

the Company's first outside R.T. diffuser and the majority of the remainder of the factory was insulated by old lagging. The survey was to have been conducted over a five-day period but the campaign finished earlier than expected and only one day (January 12, 1982) of the survey was conducted. The remainder will be conducted during the early part of the 1982/83 campaign. The whole of the one-day survey was used to assess the thermal efficiency of the lagging on the outside R.T. diffuser and ancillary equipment. The survey found that the standard of lagging on the whole R.T. diffuser installation was very high. During the campaign outside temperatures of -20°C had been experienced giving a temperature differential of 95°C across the lagging of R.T. diffuser. The circulation juice heaters had been efficiently lagged in a way which took into account both their shape and process maintenance access requirements.

*Bury St. Edmunds factory survey*

Bury St. Edmunds factory was selected for a survey because of high ambient temperatures present within the factory's Beet End and Sugar End building. The survey required the eight days of January 4-11, 1982 and was conducted in a similar way to the Newark survey. The report showed that a significant number of pipelines in both the Beet End and Sugar End had not been lagged during the reconstruction. Consequently, the ambient

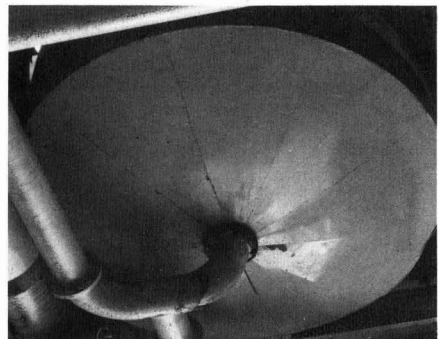


Fig. 5A. Normal photograph of decalcification plant at Bury St. Edmunds showing apparently well-finished lagging installation

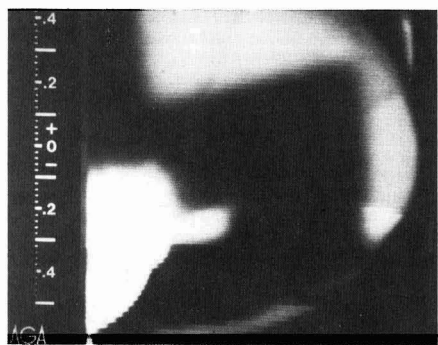


Fig. 5B. Thermogram of same plant showing lagging missing from under the cladding

temperatures in these areas were higher than in Newark factory. The lagging of the decalcification columns and tanks was found to have been installed haphazardly underneath the aluminium, leaving areas completely unlagged. It was concluded that Bury St. Edmunds Management should consider lagging all tank manholes and heater tops and bottom similarly to those in Newark Factory.

Figures 5 and 6 show typical thermograms and, for comparison, normal photographs of the same plant items.

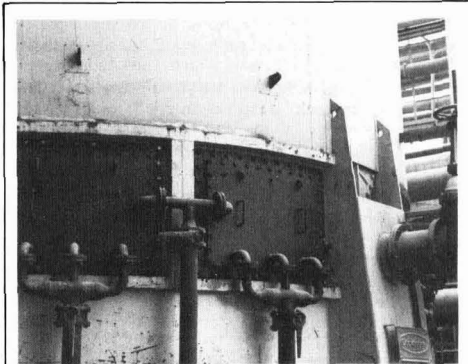


Fig. 6A. Normal photograph of base of tower diffuser showing pipes and manholes not lagged

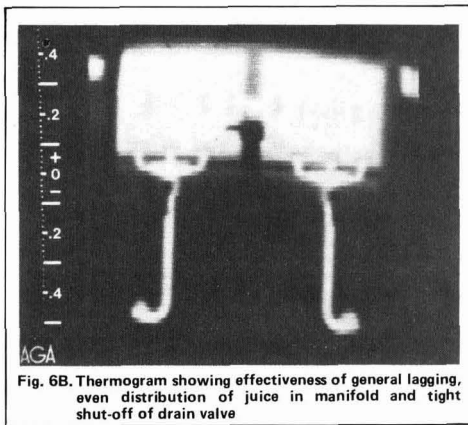


Fig. 6B. Thermogram showing effectiveness of general lagging, even distribution of juice in manifold and tight shut-off of drain valve

#### INTERPRETATION OF THERMOGRAPHIC SURVEYS

The results of the thermographic survey of plant can be used in many ways, e.g. newly installed lagging can be checked once plant is in operation, indicating areas of poor installation, while existing lagging can be checked for its current effectiveness. Thermographic imaging can also be considered for finding areas which are in need of lagging, assessing the rate of energy loss from such areas and determining the likely payback if these areas were to be lagged.

Following the survey work recently carried out, an actual rate of heat loss was determined for the complete evaporator, heater and condensate system at Bury St. Edmunds factory and this can be used to check the assumptions made in the heat balance computer programs

currently used by Central Office and factory personnel in British Sugar.

#### Factory survey for lagging assessment

B.L. Thermographic Surveys produced, on interpretation of their results, values for the heat loss from sections of the plant in watts per square metre. From these results, taking a standard campaign length, the cost of such a heat loss can be calculated and compared with the likely cost of lagging. However, unless the heat loss is so large that there is no question of whether or not to lag, this is not immediately a useful decision-making tool.

Lagging is a means of saving energy and therefore the rate at which fuel prices rise is a factor in the payback time for the installation of the lagging. The cost to the Company of borrowing money must equally be considered as this reduces the value of the benefits received. These two factors can, within the accuracy of the overall calculations, and the time span under consideration, be taken to cancel each other out and a straight-line relationship taken.

#### The cost of heat losses

The details of the calculation of value of lost heat is given as follows:

For a loss of  $1 \text{ kW.m}^{-2}$  the cost can be quantified as follows:

Length of campaign = 110 days  
= 2640 hours

Total heat loss in a campaign at this rate of loss = 2640 kWh  
1 kWh = 3600 kJ

Heavy fuel oil price = £120/tonne  
Energy content of oil = 42,500 kJ/kg  
Energy cost = £2.82/GJ  
Cost of 2640 kWh =  $2.82 \times 3,600 \times 2640$   
= 1,000,000  
= £26.80

Assuming a combined boilerhouse and turbine efficiency of 84% the cost per campaign is £31.90 – therefore, a heat loss of  $1 \text{ kW.m}^{-2}$  costs £32 per campaign.

Using this information about current prices and taking the assumption regarding the relationship of fuel prices and the cost to the Company of borrowing money a nomograph (Fig. 7) is produced of rate of heat loss and payback in relation to the cost per square metre of lagging.

In the case of Fig. 7 a reduction of 80% in the heat loss due to lagging is taken. This can be varied to suit conditions and lagging types. Allowance may also be made for coal or gas firing and factories which operate with a thick juice refining run.

The current costs of lagging, depending on the surfaces to be lagged, are in the range of £25 to £60 per  $\text{m}^2$ .

The use of the nomograph is illustrated by the example: Assume it is Company policy that lagging installations should have a maximum payback of two years and it costs £50 per  $\text{m}^2$  to instal. From the nomograph it can be seen that heat losses of greater than  $1 \text{ kW.m}^2$  would be necessary to justify any investment. This calculation can be carried out for any part of the factory plant, whether unlagged or lagged by old and now inefficient lagging.

#### Energy losses in evaporators

Following the survey at Bury St. Edmunds an overall

rate of heat loss for the evaporators, heater and condensate tank system was determined as 405 kW. This station is typical in lagging standard of the more recently installed evaporator and heater equipment in British Sugar and so can be taken to have losses typical of such an installation.

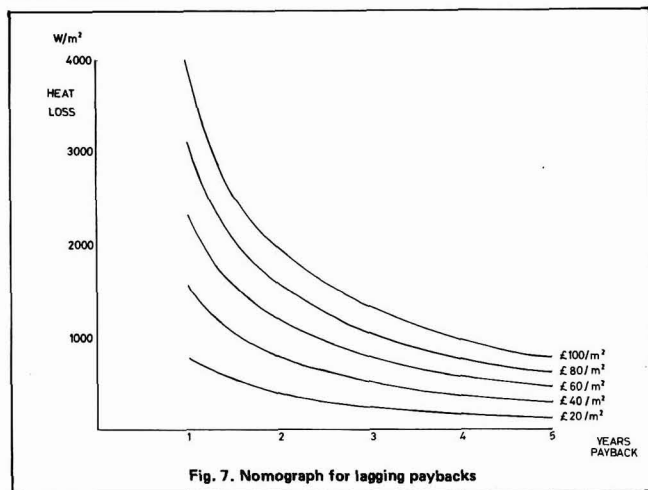


Fig. 7. Nomograph for lagging paybacks

In the Technical Paper produced for the Third Technical Conference in 1950 by O. H. Phipps, 'The Calculation of Heat Balance and Heating Surfaces of a Complete Evaporator Station', heat losses from the steam entering evaporators were taken as:

Steam temperature, °C	Radiation loss, %
over 130	6
120 - 130	5
105 - 120	4
85 - 105	3
less than 85	2

These losses are very large by today's standards and could not be tolerated under present energy prices.

When the total flow of energy in the vapour streams to evaporators at Bury St. Edmunds was calculated and compared with the losses suggested by the survey an overall loss of 0.11% was indicated.

In addition, heat is lost from vapour, condensate and juice pipelines, flanges and valves which were not included in the survey. This loss is difficult to assess and it seems reasonable to consider the overall heat loss as 0.25% of energy in vapour flows in the evaporators. This is the case if the factory installation is modern and well-lagged.

The current computer heat balance program used by Central Office and factory personnel uses a figure of 1%. This may be reasonable for an older factory with poorer lagging but thermographic surveys have not yet taken place at any such factory.

The problem with taking a general figure for the loss from all vapour streams is that it does not take into account differences in vapour temperatures through the system. This may well be compensated for, however, by different lagging techniques in different areas of the factory plant.

The effect of changing the heat loss from 1% to 0.25% of all vapour flows in the evaporator system is to reduce the requirement on a typical evaporator balance of

#### The role of thermographic surveying in energy conservation

exhaust steam by 2% of its total while maintaining a similar thick juice Brix.

#### Conclusions

Thermal imaging is a well established technique that can simply demonstrate in an easily interpretable way the heat losses from process plant and provide a permanent record of the temperatures. The work carried out to date has demonstrated the use of the equipment in detecting faulty insulation. The temperature recorded can be easily turned into heat losses and the cost-effectiveness of lagging determined.

#### Acknowledgements

The authors would like to express their thanks to the management and staff at Newark, Brigg and Bury St. Edmunds factories for their co-operation and interest in the surveys. We would also record our appreciation of the help we have received from AGA Infra-red Systems Ltd.

#### Summary

An account is given of the theory of thermal image formation and its application at three factories in England for examination of surfaces to determine the efficiency of their insulation and their temperatures in order to correct deficiencies and to assess the economic value of heat loss against the cost of insulation.

#### Le rôle de la surveillance thermographique dans la conservation d'énergie

On détaille la théorie de la formation d'une image thermique et de son application dans trois usines Anglaises pour examiner les surfaces afin de déterminer l'efficacité de leur isolation et leurs températures. Cela permet de corriger des déficiences et d'évaluer la valeur économique des pertes calorifiques comparées au coût du calorifugeage.

#### Die Rolle der thermographischen Untersuchungen bei der Energieeinsparung

Berichtet wird über die Theorie der Bildung von thermischen Bildern und deren Anwendung in drei Fabriken in England für die Untersuchung von Oberflächen, um die Effektivität der Isolierung und deren Temperatur zu bestimmen, um Mängel zu korrigieren, und um den ökonomischen Wert der Wärmeverluste gegenüber den Isolierungskosten zu bestimmen.

#### El papel de medición termográfica en la conservación de energía

Se presenta un examen de la teoría de formación de imágenes térmicas y su aplicación en tres azucareras en Inglaterra para examinación de sobreficies para medir la eficiencia de su aislamiento y sus temperaturas con el fin de corregir deficiencias y de asesar el valor económico de pérdida de calor contra el costo de aislamiento.



# The Canesorb carbon/bone char system at Atlantic Sugar

By WILLIAM F. BARTON and WILLIAM J. KNEBEL

## PART III

### Steady-state characteristics of the plant Canesorb carbon/bone char system

The Canesorb carbon/bone char system was maintained at near steady-state conditions during the operating period January – December 1981. During this time, the performance characteristics of the dual adsorbent system were generally near those projected by Calgon from their early work.

Using an average adsorption cycle 70% longer than with bone char, the system achieved average colour and turbidity removals of approximately 75% from clarified white sugar liquors and of approximately 82% from soft sugar liquors, giving effluent liquors comparable to those obtained by straight char operation. Tables II and III summarize the operation and performance of the system during the period. Again, the aforementioned performance was attained in spite of the unusually higher than anticipated colour and turbidity loadings placed on the adsorbent. This phenomenon is illustrated in Figure 16 which indicates that colour and turbidity loadings approximately three times those previously placed on straight service char occurred during most

cycles. With these high adsorbate loadings, the Canesorb carbon activity was still maintained at current operating levels with iodine numbers of  $480 \pm 20$  units and molasses numbers of  $210 \pm 10$  units. From Table III, a substantial improvement in adsorbate removal in the processing of clarified remelt liquors is also shown for the dual adsorbent system during 1981.

The overall de-ashing performance by the Canesorb carbon/bone char system was less than that afforded by straight service char. Table IV indicates that the average ash removal from clarified white sugar liquors by the adsorbent mixture was approximately 10%. This reduction in ash removal, as compared with operations with straight char, had virtually no impact on the downstream processes.

The adsorbent make-up requirements for the individual components averaged 2.2% w/w for Canesorb carbon and 1.4% w/w for virgin char (equivalent). Table V also indicates a slight decrease in Canesorb carbon content for the subject operating period. At steady-state, the dual adsorbent system would appear to maintain its composition and inventory volume at component make-

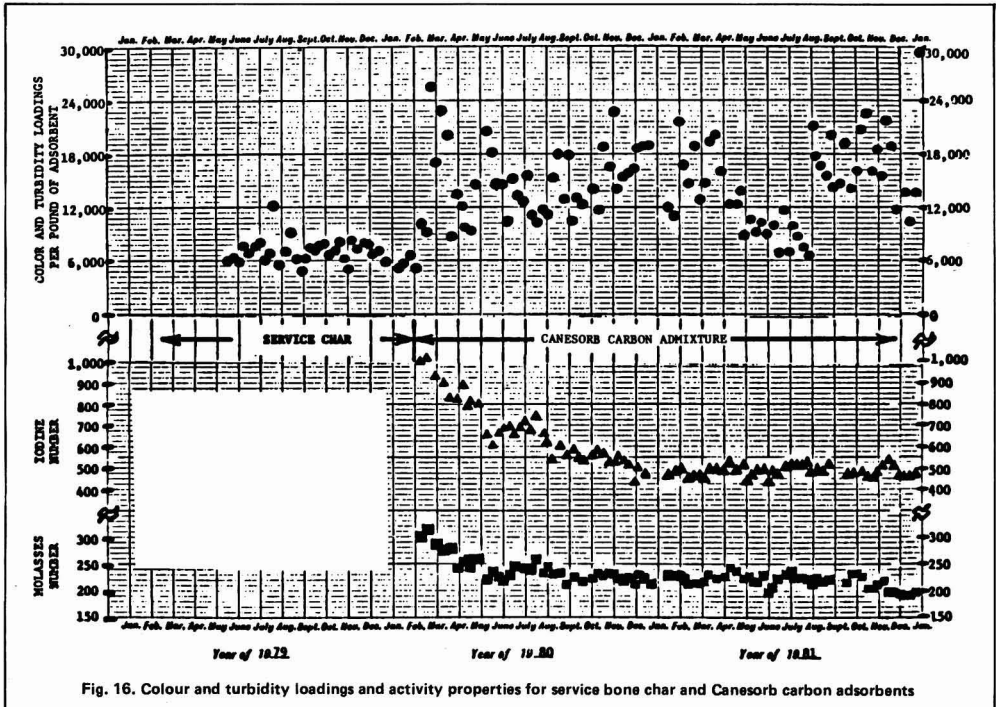
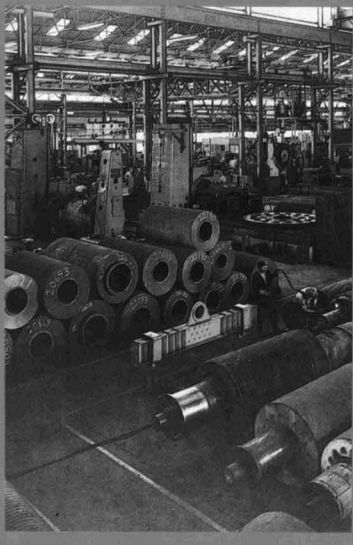
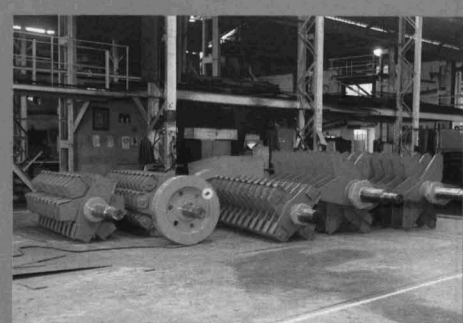
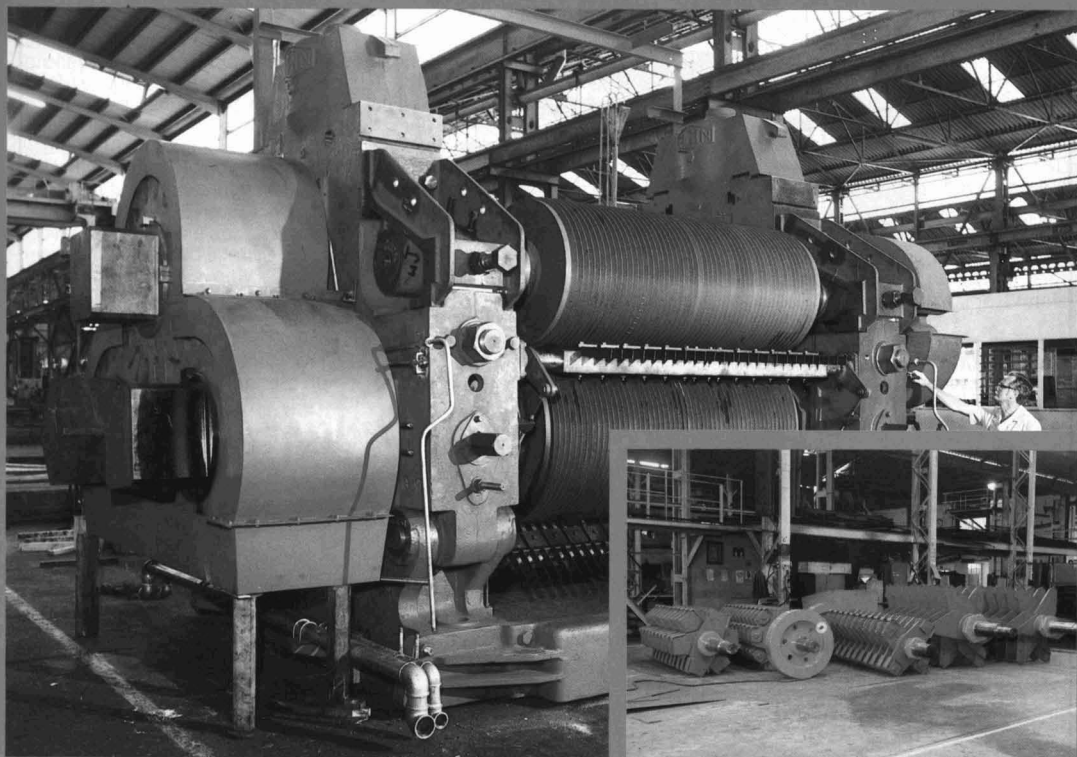


Fig. 16. Colour and turbidity loadings and activity properties for service bone char and Canesorb carbon adsorbents

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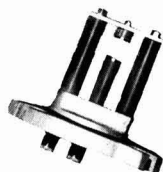
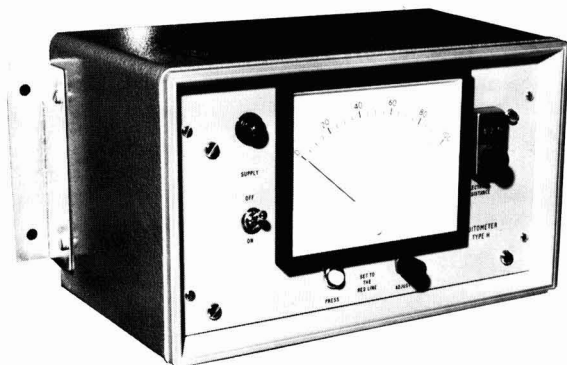
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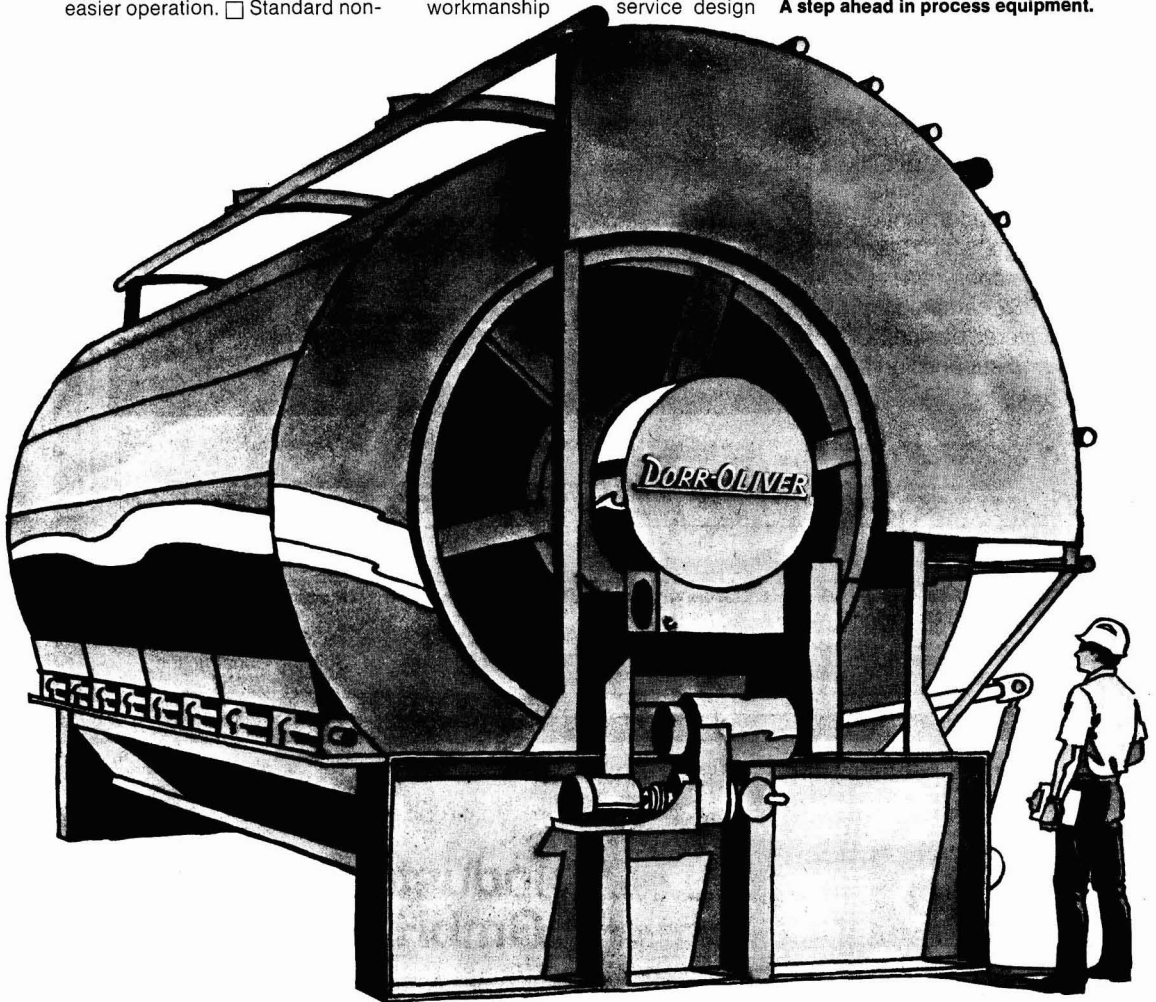
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up rates of approximately 2.6% w/w Canesorb carbon and 1.3% w/w virgin char.

The fuel usage for the CS/BC system was comparable to that for the previous operating periods (Table VI) and averaged 1.45 lb No. 2 fuel oil per ft<sup>3</sup> of adsorbent mixture. Again, the higher value for the dual adsorbent system is attributed to the greater number of start-ups and shut-downs of the kiln, which averaged 2.5 per week. Extended sweetening-off times, coupled with insufficient adsorbent volumes in the system, were the major causes of interruptions in mid-week kilning operations.

*The Canesorb carbon/bone char system at Atlantic Sugar*

Sweetening-off times for the Canesorb carbon cisterns were generally 1.2-to-1.3 times those for char. Table VII indicates that the sweetwater volumes per cistern and/or per operating week were substantially reduced from those generated during straight char operations.

The CS/BC system also afforded substantial reductions in (a) sucrose losses, (b) hot water usage and related steam requirements for production of hot water, and (c) energy usage within the char house. Table IX indicates that the average energy usage per operating week was reduced by approximately 30% within the char house.

**Table IV. Physical properties of clarified white sugar liquors<sup>1</sup> for service bone char and Canesorb carbon systems**

Operating period	Sulphated total ash, % w/w dry basis			Invert sugar, % w/w dry basis		Average pH	
	Influent	Effluent	Removal, %	Influent	Effluent	Influent	Effluent <sup>2</sup>
May – December 1979	0.06 ± 0.02	0.04 ± 0.01	25 ± 7	0.11 ± 0.03	0.10 ± 0.02	7.0 ± 0.1	7.8 ± 0.3
February – June 1980	0.07 ± 0.01	0.06 ± 0.01	14 ± 3	0.14 ± 0.03	0.13 ± 0.03	6.9 ± 0.1	7.8 ± 0.2
July – December 1980	0.07 ± 0.01	0.06 ± 0.01	13 ± 2	0.12 ± 0.03	0.12 ± 0.03	7.0 ± 0.1	7.9 ± 0.3
January – June 1981	0.07 ± 0.02	0.06 ± 0.02	13 ± 4	0.13 ± 0.03	0.14 ± 0.03	7.0 ± 0.1	7.8 ± 0.2
July – December 1981	0.09 ± 0.03	0.08 ± 0.02	10 ± 3	0.14 ± 0.01	0.15 ± 0.01	7.0 ± 0.1	8.0 ± 0.2

<sup>1</sup> The clarified white sugar liquors refer to the actual materials (i.e. melt liquors blended with 3-8 % remelt liquors w/w) entering and discharged from the char cisterns.  
<sup>2</sup> The pH of the effluent liquor is maintained near 7.8-8.1 by the addition of magnesite.

**Table V. Summary of adsorbent composition and make-up requirements for service bone char and Canesorb carbon systems**

Operating period	Adsorbent burned, <sup>1</sup> ft <sup>3</sup> /week	Adsorbent composition, % Canesorb/Service char	Canesorb carbon		Adsorbent make-up		Service char	
			lb/week	% <sup>2</sup>	Virgin char lb/week	% <sup>2</sup>	lb/week	% <sup>2</sup>
May – December 1979	24,200 ± 6,200	0.0/100	—	—	22,000 ± 5,600	1.4 ± 0.2	—	—
February – June 1980	15,500 ± 4,100	18-19/81-82	8,000 ± 1,300	4.6 ± 0.9	2,000 ± 1,800	0.24 ± 0.24	14,000 ± 5,800	1.8 ± 0.7
July – December 1980	16,100 ± 2,900	19-22/78-81	5,200 ± 200	2.8 ± 0.4	3,000 ± 500	0.40 ± 0.02	9,000 ± 2,400	1.2 ± 0.3
January – December 1981	18,200 ± 4,200	20-24/76-80	5,500 ± 1,300	2.2 ± 0.6	8,000 ± 2,200	0.92 ± 0.02	6,000 ± 1,800	0.70 ± 0.0

<sup>1</sup> This quantity includes the total amount of adsorbent (i.e. service and run-back materials) which passed through the kiln during the operating week.  
<sup>2</sup> This entry relates the amount of each constituent which has been added as make-up to the existing adsorbent mixture during the kilning operation relative to the amount of that respective service constituent already within the adsorbent mixture.

**Table VI. Summary of the reactivation conditions for the adsorbents of service bone char and Canesorb mixtures**

Operating period	Average melt rate, tonnes/week	Average melt days per week	Adsorbent burned <sup>1</sup> , ft <sup>3</sup> /week	Kilning time <sup>2</sup> , hr/week	Average fuel usage <sup>3</sup> Imp.gal/week lb fuel oil/ft <sup>3</sup> adsorbent
May – December 1979	4,590 ± 610	4.2 ± 0.6	24,200 ± 6,200	95 ± 12	3,860 ± 350 1.31 ± 0.05
February – June 1980	4,200 ± 670	3.9 ± 0.6	15,500 ± 4,100	65 ± 20	2,740 ± 620 1.45 ± 0.10
July – December 1980	4,130 ± 830	3.8 ± 0.8	16,100 ± 2,900	69 ± 15	3,030 ± 560 1.54 ± 0.13
January – June 1981	4,540 ± 710	4.2 ± 0.7	18,300 ± 3,410	91 ± 18	3,230 ± 610 1.46 ± 0.09
July – December 1981	5,520 ± 960	5.1 ± 0.9	18,200 ± 4,960	88 ± 19	3,220 ± 920 1.44 ± 0.21

<sup>1</sup> This quantity includes the total amount of materials (i.e. service and run-back materials) which passed through the kiln during the operating week.  
<sup>2</sup> This entry encompasses ONLY the kilning times for the actual service adsorbents.  
<sup>3</sup> These entries include those requirements for the actual kilning times and for start-up and shutdowns during the operating week.

**Table VII. Summary of sweetwater generated and sucrose losses for service bone char and Canesorb carbon mixture systems**

Operating period	Sweetwater generated			Steam requirements to concentrate sweetwater <sup>1</sup> , lb/week	Sucrose losses to the sewer	
	hr/filter	ft <sup>3</sup> /filter	ft <sup>3</sup> /week		lb/filter	lb/week
May – December 1979	9.5 ± 1.5 <sup>2</sup>	740 ± 110	15,000 ± 4,000	330,000 ± 90,000	400 ± 100	8,000 ± 2,000
February – June 1980	10 ± 3 <sup>2</sup> 13 ± 3 <sup>3</sup>	790 ± 220 670 ± 130	9,000 ± 3,000 8,000 ± 2,000	210,000 ± 70,000 170,000 ± 40,000	450 ± 160	5,200 ± 1,600
July – December 1980	14 ± 3 <sup>3</sup>	660 ± 210	8,000 ± 2,000	180,000 ± 50,000	470 ± 150	5,600 ± 1,000
January – December 1981	12 ± 4 <sup>3</sup>	600 ± 200	8,000 ± 2,000	180,000 ± 50,000	400 ± 100	5,400 ± 1,300

<sup>1</sup> All of the sweetwater volume, which is generated from the cisterns, is concentrated from approximately 9.5°Brix to approximately 70°Brix with a triple-effect evaporator requiring 1 lb of steam to evaporate 2.5 lb of water.  
<sup>2</sup> The process hot water flow rates were maintained at 80 ft<sup>3</sup>/hr<sup>1</sup> for the complete sweetening-off process.  
<sup>3</sup> The process hot water flow rates were set at 80 ft<sup>3</sup>/hr<sup>1</sup> during the initial phases (i.e. from 60° to 10°Brix) of this process and then were maintained at 40 ft<sup>3</sup>/hr<sup>1</sup> over the remaining phases.

**Table VIII. Summary of hot water usage for sweetening-off and water-wash processes**

Operating Period	Hot water usage <sup>1</sup>				Steam requirements for generation of process hot water <sup>2</sup>	
	Sweetening-off process		Water-wash process		lb/filter	lb/week
	ft <sup>3</sup> /filter	ft <sup>3</sup> /week	ft <sup>3</sup> /filter	ft <sup>3</sup> /week		
May – December 1979	1,500 ± 200 <sup>3</sup>	30,000 ± 8,000	3,000 ± 300	60,000 ± 20,000	27,000 ± 3,000	540,000 ± 60,000
February – June 1980	1,400 ± 300 <sup>3</sup> 1,400 ± 200 <sup>4</sup>	16,000 ± 4,000 16,000 ± 4,000	4,000 ± 1,200 4,000 ± 1,200	46,000 ± 12,000 46,000 ± 12,000	32,000 ± 9,000 32,000 ± 9,000	370,000 ± 100,000 370,000 ± 100,000
July – December 1980	1,500 ± 300 <sup>4</sup>	18,000 ± 4,000	3,000 ± 1,000	40,000 ± 7,000	27,000 ± 7,000	320,000 ± 80,000
January – December 1981	1,400 ± 400 <sup>4</sup>	19,000 ± 5,000	4,000 ± 1,000	54,000 ± 13,000	32,000 ± 8,000	440,000 ± 110,000

<sup>1</sup> The average temperature for process hot water was 190 ± 5°F.  
<sup>2</sup> The low-pressure (i.e. 15 psig) steam used to raise the temperature of process water by 100°F is estimated to contain approximately 1,000,000 B.Th.U. per 1000 lb steam.  
<sup>3</sup> The process hot water flow rates during the complete sweetening-off process were maintained at 80 ft<sup>3</sup>/hr<sup>1</sup>.  
<sup>4</sup> The process hot water flow rates during the sweetening-off process were set at 80 ft<sup>3</sup>/hr<sup>1</sup> during the initial phases (i.e. from 60° to 10°Brix) of this process and then were maintained at 40 ft<sup>3</sup>/hr<sup>1</sup> over the remaining phases.

**Table IX. Estimated energy consumption for service bone char and Canesorb carbon systems**

Operating period	Average melt rate, tonnes/week	Average energy usages <sup>1</sup> , Million B.Th.U./week
May – December 1979	4,590 ± 610	1,560 ± 190
February – June 1980	4,200 ± 670	1,060 ± 240
July – December 1980	4,130 ± 830	1,040 ± 210
January – December 1981	5,060 ± 980	1,200 ± 280

<sup>1</sup> This entry encompasses the combined energy usages for kiln fuel (45 ± 4%), steam for hot water production (34 ± 3%), steam for sweet-water concentration (18 ± 3%), and electricity (3 ± 1%) to operate the char house.

*Further considerations*

The most effective regenerative practices for the Canesorb carbon/bone char system is a compromise of operating variables. Enhanced oxygen levels (e.g. 5-7% v/v in the entering combustion gases), which may be required in handling the increased adsorbate (i.e. colour and turbidity) loadings on the Canesorb carbon, must be limited in order to preserve the integrity of the bone char component. Kilning operations with 3% v/v free oxygen in the combustion gases appear to yield a steady-state condition with an effective carbon overlay of 6-7% w/w. Elevated kilning temperatures (e.g. considerably

above 1000°F), which accelerate the regenerative process for the Canesorb carbon component, must be limited in order to preserve the hydroxyapatite structure of the char component and also in order to be compatible with the materials of construction within the conventional char kiln. An average kilning temperature of 1100°F appears as a "norm" in Canesorb carbon mixture reactivations.

Excessive turbidity or particulate levels in lower-purity sugar liquors were found to have a negative effect on the decolorization of those influent streams; hence, a pretreatment (e.g. clarification) step may be required to minimize them before liquor contact with the adsorbent. The effect of eliminating particulate matter, which formerly contributed to the adsorbent loadings, manifested itself in improved levels of decolorization performance of all sugar liquors.

With the aforementioned limitations placed on kilning conditions for the Canesorb carbon/bone char system, it was recognized that operating limits should be placed on adsorbate loadings of the adsorption system such that consistent decolorization performances could be sustained for the various sugar liquors. To establish guidelines on adsorbate loadings for the purpose of process control, Atlantic Sugar created the index of "colour and turbidity loading per pound of adsorbent". This unit is simply the total colour plus turbidity loading placed on each pound of the adsorbent mixture during an active cycle. From previous operating data, an adsorbate loading limit of 12,000 colour and turbidity units per pound of adsorbent mixture per active cycle has been established in effecting the regeneration of the mixture

on single-pass through the kiln as related to the liquor treatment sequence at the refinery.

As a consequence of these measures, a significant improvement in decolorization performance has been obtained recently from the Canesorb carbon/bone char system. Revisions to the mechanical settling device and in the adsorbent-liquor ratio-fill program have afforded cistern fills with higher working capacities than those which were attained in past operations. Use of special chemical regenerative measures during the initial phases of the water-wash cycle, particularly when the spent adsorbent mixture has been exposed to excessive adsorbate loadings (from high-coloured raws and high volumes or greatly extended on-stream times of yellow sugar liquors), has also contributed to the significant enhancement of decolorization performance in the processing of clarified white sugar liquors. With these mechanical settling techniques and control of colour and turbidity loadings, it would appear that adsorbate removal capabilities in the range of 84-90% could be consistently attained over an adsorptive cycle service time of 80 hours.

#### *Acknowledgements*

The authors wish to acknowledge the magnificent efforts of the many individuals in the Calgon and Atlantic Sugar organizations in the development of the CS/BC adsorption system and its first successful implementation in the sugar refining industry.

#### *Summary and conclusions*

The Canesorb carbon/bone char process at Atlantic Sugar has been operated continuously over two years and at near steady-state conditions for about one year from the time of its plant implementation. An adsorbent composition of  $21 \pm 3\%$  w/w Canesorb carbon and  $79 \pm 3\%$  w/w bone char has consistently afforded 70% longer service life than straight char and has yielded comparable, if not slightly improved, decolorization. This level of performance by the CS/BC system has been achieved at average colour and turbidity loadings per unit adsorbent volume of 2-3 times that previously applied to straight char. Recent efforts at Atlantic Sugar in optimizing the regeneration process and in conducting more effectively the cistern-fill operations have resulted in significant improvements in the decolorization performance of the mixed-adsorbent system.

There has been a significant reduction in ash removal from the treated liquors; however, this appears to have had minimal impact on subsequent processing.

The carbon/bone char mixture appears to have adapted to conventional char house equipment and materials handling practices. The present inventory has acquired an average particle diameter of approximately  $0.84 \pm 0.02$  mm, each constituent appearing to have acquired similar particle sizes. At steady-state, the dual adsorbent system appears to maintain its composition level and its inventory volume at make-up rates of approximately 2.6% w/w Canesorb carbon and 1.3% w/w virgin char.

Atlantic Sugar has observed reductions in the following materials and utilities: kiln fuel (21%), process hot water (28%), sweetwater generated and concentrated (46%), sucrose losses to the sewer (32%), and make-up materials for each of the adsorbent components. In total, a reduction of approximately 30% in energy usage within the char house has resulted from implementation of the Canesorb carbon/bone char process.

After the resolution of some initial operational difficulties the new system is now functioning satisfactorily and in general compliance with the findings from early pilot studies.

#### **Le système charbon Canesorb/noir animal à l'Atlantic Sugar**

Le procédé charbon Canesorb/noir animal a opéré chez Atlantic Sugar en continu pour plus de deux ans et — depuis l'installation de l'unité — pour environ un an dans des conditions près de l'équilibre. Un adsorbant composé pour  $21 \pm 3\%$  p/p de charbon Canesorb et pour  $79 \pm 3\%$  p/p de noir animal a efficacement permis d'allonger le temps de service de 70% par rapport au noir animal seul et a permis d'obtenir une décoloration comparable, si non légèrement meilleure. Ce niveau de performance du système a été réalisé avec des charges moyennes de couleur et de turbidité par unité de volume d'adsorbant qui étaient 2 à 3 fois celles appliquées précédemment au noir animal seul. Des efforts récents entrepris à Atlantic Sugar pour optimiser le procédé de régénération et pour conduire plus efficacement les opérations de remplissage des fours de régénération ont conduit à des améliorations significatives de la performance de décoloration du système d'adsorbant mixte. On a noté une réduction significative de l'enlèvement des cendres des sirops traités. Il est apparu que cela avait un impact minimal dans la suite du processus. Le mélange charbon/noir animal s'est apparemment adapté à l'équipement conventionnel de la station à noir et aux pratiques de manutention du matériel. Un récent inventaire a donné un diamètre moyen des particules d'environ  $0,84 \pm 0,02$  mm, chaque constituant ayant pris des dimensions similaires des particules. A l'état d'équilibre, le système d'adsorbant double a maintenu son niveau de composition et les volumes de réajoute ont été d'environ 2,6 % p/p de charbon Canesorb et 1,3 % p/p de noir frais. Atlantic Sugar a observé des réductions dans les matières et besoins suivants: le combustible de régénération (21%), l'eau chaude pour le procédé (28%); la quantité d'eau sucrée générée et concentrée (46%), les pertes de sucre vers l'égout (32%) et les besoins de réajoute pour chacun des composants de l'adsorbant. Au total l'installation du procédé charbon Canesorb/noir animal a fait réaliser une économie de 30% dans les besoins énergétiques de la station de noir. Après avoir résolu quelques difficultés opérationnelles de démarrage, le nouveau système fonctionne maintenant de manière satisfaisante et les résultats confirment de manière générale les données obtenues précédemment dans l'étude pilote.

#### **Das Canesorb-Kohle/Knochenkohle-System bei der Atlantic Sugar**

Der Canesorb-Kohle/Knochenkohle-Prozess der Atlantic Sugar arbeitet seit über zwei Jahren kontinuierlich und im Dauerzustand fast ein Jahr nach der Inbetriebnahme. Das Adsorbens setzt sich aus  $21 \pm 3\%$  Canesorb-Kohle und  $79 \pm 3\%$  Knochenkohle zusammen, hat eine 70% längere Haltbarkeit als reine Knochenkohle und ermöglicht eine vergleichbare, wenn nicht etwas verbesserte Entfärbung. Diese Standardleistung des Systems wurde mit 2-3facher durchschnittlicher Farbe- und Trübungsbelastung pro Adsorbentienvolumen im Vergleich zu der vorher angewendeten reinen Knochenkohle erzielt. Neuere Arbeiten bei der Atlantic Sugar zur Optimierung des Regenerationsprozesses und zur effektiveren Beschickung der Behälter resultierten in signifikanten Verbesserungen der Entfärbungsleistung des



Mischadsorbentensystems. Es wurde eine signifikant geringere Asche-Adsorption aus den behandelten Säften festgestellt; dies scheint jedoch nur minimalen Einfluß auf die Weiterverarbeitung zu haben. Die Kohle/Knochenkohlemischung scheint der konventionellen Ausrüstung und Arbeit der Knochenkohlestation zu entsprechen. Gegenwärtig wird mit einer Teilchengröße von  $0,84 \pm 0,02$  mm gearbeitet. Beide Bestandteile scheinen die gleiche Teilchengröße angenommen zu haben. Im Dauerzustand scheint das Zwei-Adsorbentensystem seine Zusammensetzung zu halten und die Bettfüllung muß jeweils um 2,6 Gew.-% Canesorb-Kohle und 1,3 Gew.-% frische Knochenkohle ergänzt werden. Die Atlantic Sugar hat folgende Abnahmen des Material- und Energieverbrauchs beobachtet: Ofenbrennstoff (21%), Prozeßheißwasser (28%), erzeugtes und konzentriertes Süßwasser (46%), Saccharoseverluste im Abwasser (32%) und des Ersatzes der verbrauchten Adsorbentien. Insgesamt resultierte eine Abnahme des Energieverbrauchs um 30% innerhalb der Knochenkohlestation durch die Installation des Canesorb-Kohle/Kochenkohle-Prozesses. Nach der Lösung einiger Anfangsprobleme arbeitet das neue System zufriedenstellend und ist in allgemeiner Übereinstimmung mit den Ergebnissen früherer Pilotversuche.

**El sistema carbón Canesorb/carbón animal en Atlantic Sugar**

El proceso carbón Canesorb/carbón animal en Atlantic Sugar ha sido en operación continua durante dos años y en condiciones casi estado-estable para cerca de un año desde la fecha de implementación en la refinería. El adsorbente, de una composición de  $21 \pm 3\%$  por peso de carbón Canesorb y  $79 \pm 3\%$  de carbón animal, ha dado

continuamente un tiempo en servicio 70% más que él de carbón animal sólo y ha dado también una descolorización igual si no mejorada. Este nivel de funcionamiento se ha obtenido con cargas promedias de color y turbidez 2-3 veces la carga aplicada previamente a carbón animal. Recientes esfuerzos para optimizar el proceso de regeneración en Atlantic Sugar y para cargar más efectivamente los tanques de carbón ha resultado en mejoramientos significativos en el funcionamiento del sistema con adsorbentes mixtos en descoloración. Había una disminución significativa de la separación de ceniza de los licores tratados: sin embargo, ésta parece de impacto minimal sobre el proceso que sucede. Parece que la mezcla de carbón Canesorb y carbón animal se ha adaptado al equipo y prácticas convencionales de manejo de materiales en la estación de descolorización. El inventario actual ha adquirido un diámetro promedio de partícula de unos  $0.84 \pm 0.02$ mm; cada constituyente parece de tamaño similar de partícula. En estado estable, la sistema con dos adsorbentes parece mantener su composición y volumen de inventario con niveles de adición de 2.6% por peso de carbón Canesorb y 1.3% de carbón animal nuevo. Atlantic Sugar ha observado disminuciones en los materiales y servicios siguientes: combustible para regeneración (21%), agua caliente en el proceso (28%), soluciones de azúcar diluidas obtenido por lavado que deben concentrarse (46%), pérdidas de azúcar al acantarilla (32%), y cantidades de los adsorbentes para cumplir los inventarios. En total, una disminución de unos 30% en uso de energía en la estación de descolorización ha resultado del implementación del proceso carbón Canesorb/carbón animal. Después de la resolución de algunas dificultades iniciales en operación, el sistema funciona con éxito y en conforme general con los resultados de estudios de escala pilota.

## Gypsum and other pulp pressing aids

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### PART III

*Distribution of ions for calcium chloride addition*

The studies of the distribution of the added ions reported above were continued in experiments with calcium chloride solution. It was expected that the behaviour of the cations would parallel that for gypsum, the added element being calcium in each case; moreover, it was judged likely that the distribution of chloride would be similar to that of sulphate, as evidence suggests that the anion does not take part in any absorption/desorption reactions<sup>7, 8, 17</sup>.

Tables XIX and XX give ionic distributions derived from the mean analytical data obtained from steady-state composites on January 18 and 19, 1982 for periods with and without calcium chloride addition to supply water at 14 kg calcium/100 tonnes beet sliced, using diffuser mean balance data in Table XVIII which were obtained from the parameters in Table XVII.

It can be seen from Tables XIX and XX that acceptable balances of the cations in and out of the diffuser were obtained, although those for magnesium and potassium in Table XX are rather low.

**Table XVII. Analytical parameters for mass balance**

Parameter	With CaCl <sub>2</sub>	Without CaCl <sub>2</sub>
Cosettes: Pol (%S)	15.88	15.78
Raw juice: Pol (%S)	14.17	13.86
Pulp press water: Pol (%S)	2.78	2.37
Diffusion supply water: Pol (%S)	1.62	1.31
Pressed pulp: Pol (%S)	2.22	2.32
Dry substance (%)	24.39	20.76

The measured increase in calcium content of supply water was 0.59 keq/100 tonnes beet sliced, which is 84%

Table XVIII. Mass balances across King's Lynn diffuser

Parameter	With CaCl <sub>2</sub>	Without CaCl <sub>2</sub>
Yield of pressed pulp (% on beet sliced)	21.75	26.64
Diffusion Loss (%S on beet sliced)	0.48	0.62
Draft (% on beet sliced)	108.68	109.38
Make-up water (% on beet sliced)	30.43	36.02
Supply water (% on beet sliced)	72.93	80.54
Press water (% on beet sliced)	42.50	44.52
Yield of wet pulp (% on beet sliced)	64.25	71.16

recovery of the added quantity, 0.70 keq/100 tonnes beet sliced.

As the data in Tables XIX and XX show, the chloride content of raw juice increased by 0.48 keq/100 tonnes beet sliced and that of pressed pulp by 0.19 keq/100 tonnes beet sliced when calcium chloride was added at 0.70 keq/100 tonnes beet sliced. These correspond to recoveries, in juice and pulp respectively, of 69 and 27% of the added chloride, in good agreement with the corresponding values of 76 and 40% recoveries of added sulphate that were reported above.

Table XIX. Ionic balances with CaCl<sub>2</sub> at 39 kg/100 tonnes beet sliced (January 19, 1982)

Sample	Ionic content (meq/100g)					Ionic content (keq/100 tonnes beet sliced) (using Table XVIII)				
	Ca	Mg	K	Na	Cl	Ca	Mg	K	Na	Cl
Fresh cossettes	3.14	1.69	3.68	1.18	0.43	3.14	1.69	3.68	1.18	0.43
Supply water	1.79	0.27	0.97	0.28	N.D.	1.31	0.21	0.71	0.20	N.D.
IN						4.45	1.90	4.39	1.38	
Pressed Pulp	15.10	3.17	2.96	1.03	1.06	3.28	0.69	0.64	0.22	0.23
Press water	1.00	0.48	1.77	0.40	2.09	0.43	0.20	0.75	0.17	0.89
Raw Juice	0.41	1.16	3.36	0.85	0.86	0.45	1.26	3.65	0.92	0.94
OUT						4.16	2.15	5.04	1.31	2.06
OUT/IN (%)						93	113	115	95	

N.D. = Not determined.

Table XX. Ionic balances without added CaCl<sub>2</sub> (January 18, 1982)

Sample	Ionic content (meq/100g)					Ionic content (keq/100 tonnes beet sliced) (using Table XVIII)				
	Ca	Mg	K	Na	Cl	Ca	Mg	K	Na	Cl
Fresh Cossettes	3.50	2.34	5.00	0.95	0.50	3.50	2.34	5.00	0.95	0.50
Supply water	0.89	0.15	0.74	0.18	N.D.	0.72	0.12	0.60	0.15	N.D.
IN						4.22	2.46	5.60	1.10	
Pressed Pulp	10.61	2.68	3.88	1.05	0.14	2.83	0.71	1.03	0.28	0.04
Press water	0.44	0.24	1.21	0.27	0.14	0.20	0.11	0.54	0.12	0.06
Raw Juice	0.72	1.09	2.72	0.60	0.42	0.79	1.19	2.98	0.66	0.46
OUT						3.82	2.01	4.55	1.06	0.56
OUT/IN (%)						91	82	81	96	

N.D. = Not determined.

Table XXI below has been derived in the same way as Tables XIII and XV, in order to show the changes in cations in pressed pulp.

116% of the added quantity of pressing aid was recovered in the juice and pressed pulp, based on the increase in the amounts of the added anion in the juice and pulp.

Between 27 and 40% of the added anion was present in the pressed pulp. The lower of these values may be

Table XXI. Changes in ionic concentrations in pressed pulp with use of calcium chloride (January 18/19, 1982)

Cation	Cation content (keq/100 tonnes beet sliced)						Change in content in pressed pulp	Change in content in pressed pulp solids
	Without CaCl <sub>2</sub>			With CaCl <sub>2</sub>				
	Pressed pulp (C <sub>p</sub> )	Press water (C <sub>w</sub> )	Pressed pulp (C <sub>f</sub> )	Pressed pulp (C <sub>p</sub> )	Press water (C <sub>w</sub> )	Pressed pulp (C <sub>f</sub> )		
Ca	2.83	0.20	2.74	3.28	0.43	3.11	+0.45	+0.37
Mg	0.71	0.11	0.66	0.69	0.20	0.61	-0.02	-0.05
K	1.03	0.54	0.77	0.64	0.75	0.35	-0.39	-0.42
Na	0.28	0.12	0.22	0.22	0.17	0.15	-0.06	-0.07

These results show that very similar amounts of potassium, magnesium and sodium were desorbed from pulp by the addition of calcium chloride at 0.70 keq calcium/100 tonnes beet sliced as were found to be desorbed by the addition of gypsum at 0.85 keq calcium/100 tonnes beet sliced. This is in accordance with the observations reported above, which showed very little change in uptake of calcium or desorption of potassium over a much wider range of added calcium than considered here.

82% of the additional calcium in pressed pulp appeared to be associated with the pulp fraction rather than with the water in the pressed pulp.

Once again, about 75% of both the potassium and the sodium in pressed pulp was calculated to be associated with the pulp component of pressed pulp prior to calcium addition, and the proportion was reduced to about 55% on addition of calcium.

#### *Distribution of ions for aluminium sulphate addition*

The addition of aluminium sulphate provided an opportunity to investigate the distribution of the trivalent aluminium ion between pulp and juice. Pressed pulp composites were collected several hours after commencing addition of aluminium sulphate solution to exhausted cassettes after draining at 0.56 keq (5.0 kg) aluminium/100 tonnes beet sliced. It was apparent from their analysis that virtually all the added aluminium was present in the pressed pulp, but data are not yet available to deduce which ions were desorbed into juice as a result. As the uptake of aluminium was similar to that of calcium from gypsum, it may well be that stoichiometrically equivalent additions of aluminium sulphate and gypsum have similar effects on raw juice composition.

#### *Discussion of observed distribution of added ions*

In the experiments reported above between 96 and

the more reliable, being based on 96% recovery of the added anion. The balance of the anion would be expected to leave the diffuser in the juice, and indeed, the measured increase in the corresponding raw juice was between 69 and 76% of the added amount. In each of the two quoted ranges, the first value refers to chloride, the second to sulphate, but it is unlikely that there is any real difference between the distributions for each anion.

These proportions are quite different from those found in some earlier work. Detailed Dutch laboratory studies<sup>17</sup> concluded that only 24% of added chloride was present in raw juice, and, in previous factory investigations<sup>9</sup> by these laboratories, no increase in thin juice chloride above the base concentration of about 0.9 keq/100 tonnes beet sliced was detected for an addition rate of about 1.25 keq chloride/100 tonnes beet sliced. The close agreement between the results of the present experiments with added chloride and sulphate leaves little doubt, however, that about 70% of the added anion was present in the juice at King's Lynn factory.

The increase in the anion content of juice must be exactly balanced by the increase in cation content, and the same must hold for pressed pulp. In this work, the addition of 0.85 keq calcium was accompanied by desorption from pulp into juice of about 0.4 keq potassium, 0.1 keq sodium and 0.05 keq magnesium, findings which are in reasonable accord with the observed increase in anion content of juice. Even in detailed laboratory studies<sup>17</sup>, however, an exact balance between increases in anion and cation contents of raw juice was not achieved; it is considered more reliable to base conclusions on the measured changes in anion concentration as these are proportionally greater than those for the cations.

#### *Elimination of ions from juice during processing*

**Sulphate:** About 55% of the sulphate in raw juice has

been found in previous studies by these laboratories<sup>18-20</sup> to be eliminated in carbonatation. The extent of this elimination was checked by measurements on some King's Lynn composite juice samples for steady-state periods with and without gypsum addition. The results for sulphate in raw juice are those reported in Tables XI and XII and these are complemented in Table XXII by concentrations measured on matching composite samples of second carbonatation juice.

Table XXII. Elimination of sulphate in carbonatation

Experiment	SO <sub>4</sub> content (keq/100 tonnes beet sliced)		Elimination (%)
	Raw juice	Second carb. juice	
With gypsum	1.36	0.59	56.6
Without gypsum	0.71	0.28	60.6

These results confirmed that rather more than half the sulphate in raw juice was eliminated in carbonatation, even when the concentration was virtually doubled by adding 74 kg gypsum/100 tonnes beet sliced.

In the earlier work<sup>18-20</sup>, a wide range of sulphate concentrations in second carbonatation juice had been observed — from 4 to 99 mg/100 g apparent sucrose. It would appear that solubility product does not determine the elimination at this stage in the process, or the residual concentration in second carbonatation juice would be constant.

The solubility of calcium sulphate decreases as the sugar concentration is increased: it is 0.13% w/v in 20% sucrose solution but only 0.03% w/v in 55% sucrose solution<sup>21</sup>. Indeed, calcium sulphate has been found to comprise 0.5% w/w of third-effect evaporator scale<sup>2,22</sup>, and would also be expected to be present in thick juice filter-cake. It is thus likely that some sulphate is removed as juice is concentrated later in the process.

If all the sulphate in second carbonatation juice recorded in Table XXII were to pass to molasses, the concentrations would be about 10 meq sulphate/100g molasses dry substance for no gypsum addition and 20 meq sulphate/100 g molasses dry substance for addition of 74 kg gypsum/100 tonnes beet sliced, assuming 3.8% molasses on beet and 80% molasses dry substance. To compare these deductions with practice, the sulphate contents of several weekly composites of King's Lynn molasses before and during gypsum addition were measured, as recorded in Table XXIII.

No significant increase was observed in the molasses sulphate concentrations as a result of adding 74-89 kg gypsum/100 tonnes beet sliced. However, the sulphate content of the molasses was considerably more than was to be expected from the results for second carbonatation juice in Table XXII. This additional sulphate had undoubtedly been formed by oxidation of sulphur dioxide added in sulphitation; previous work has shown that between about 20 and 50% of added SO<sub>2</sub> is oxidized to sulphate<sup>23,24</sup>.

The broad similarity of all the sulphate concentrations reported in Table XXIII may indicate that the sulphate concentration in molasses is determined by solubility product relationships. Use of gypsum would thus not increase the sulphate content of molasses if the solubility product limit had already been exceeded, for example, because of oxidation of added SO<sub>2</sub>.

Table XXIII. Gypsum usage and sulphate in molasses

Week Ending	Gypsum addition (kg/100 tonnes beet)	Sulphate (meq/100g molasses refractometric solids)
Nov. 2, 1981	0	26.7
Nov. 9, 1981	0	31.0
Nov. 16, 1981	0	29.6
Dec. 7, 1981	74	30.2
Dec. 14, 1981	76	28.1
Dec. 21, 1981	89	34.8

**Other ions:** As reported above, significant changes in potassium, sodium and chloride contents of raw juice, as well as in sulphate content, can accompany use of pressing aids. These three ions all pass through carbonatation without elimination<sup>18-20</sup> and will accumulate in molasses. The concentration of magnesium in raw juice is also slightly increased by using pressing aids; this ion is virtually eliminated in carbonatation<sup>18,20</sup>.

#### Influence on molasses non-sugars

For addition of calcium chloride at King's Lynn factory at the rate of 0.85 keq/100 tonnes beet sliced, this paper shows that about 70% of the chloride would pass to molasses, say 0.6 keq/100 tonnes beet sliced. In raw juice, the extra chloride is balanced by potassium, sodium and magnesium, but sodium added as soda-ash would later replace this small quantity of magnesium. The net effect is thus that the extra chloride in molasses is balanced by about 0.4 keq potassium and 0.2 keq sodium/100 tonnes beet sliced.

Calcium chloride addition at 0.85 keq (47 kg CaCl<sub>2</sub>)/100 tonnes beet sliced thus increases non-sugars in molasses by about 0.4 keq (30 kg) potassium chloride and 0.2 keq (12 kg) sodium chloride/100 tonnes beet sliced.

From the work on addition of gypsum at King's Lynn at the same rate, not more than about 0.25 keq sulphate/100 tonnes beet sliced accumulates in molasses because of elimination during carbonatation and later processing. However, about 0.4 keq potassium and 0.1 keq sodium/100 tonnes beet sliced pass to molasses from the increases in raw juice. It is probably appropriate to consider that the excess of these two cations over the sulphate would be balanced by acid anions formed from invert sugar degradation in carbonatation<sup>19,20,25-27</sup>. This excess can therefore be considered as replacing sodium from soda-ash which would otherwise usually have been added to neutralize the invert degradation products, and so, assuming that this excess is 0.25 keq potassium/100 tonnes beet sliced, the net effect is to increase the weight of non-sugars in molasses by 0.25 x (39.1 - 23.0) = 4 kg/100 tonnes beet sliced.

<sup>19</sup> Idem: Paper presented to the 7th Tech. Conf. British Sugar Corp., 1954.

<sup>20</sup> Idem: Paper presented to the 12th Tech. Conf. British Sugar Corp., 1959.

<sup>21</sup> Silin: "Technology of Beet Sugar Production and Refining", (Moscow), 1958, p. 256.

<sup>22</sup> Carolan: Irish Sugar Co. Ltd. Research Rpt., 1954, (33).

<sup>23</sup> Carruthers et al.: Paper presented to the 8th Tech. Conf. British Sugar Corp., 1955.

<sup>24</sup> Idem: Paper presented to the 10th Tech. Conf. British Sugar Corp., 1957.

## Gypsum and other pulp pressing aids

Use of gypsum at 0.85 keq (74 kg gypsum)/100 tonnes beet sliced thus increases the non-sugars in molasses by 0.15 keq (13 kg) potassium sulphate, 0.1 keq (7 kg) sodium sulphate and 4 kg excess of potassium over the more usual sodium/100 tonnes beet sliced.

It is considered likely that addition of 0.85 keq aluminium sulphate /100 tonnes beet sliced would have the same effect on molasses non-sugars as a similar quantity of gypsum.

### ECONOMICS OF USING PRESSING AIDS

#### Price of pressing aids

Table XXIV shows the current prices of the three pressing aids discussed in this paper for minimum 10-tonne lots delivered to King's Lynn factory, and the cost of using these compounds at 0.85 keq cation/100 tonnes beet sliced.

Compound	Price (£/tonne)	Typical cation content (% w/w)	Price of cation		Cost of 0.85 keq cation/100 tonnes beet (£)
			(£/tonne)	(£/keq)	
Gypsum	49.54	23.1	214	4.29	3.65
Flake CaCl <sub>2</sub>	133.70	28.0	478	9.55	8.12
CaCl <sub>2</sub> solution	64.48	12.9	500	10.00	8.50
Aluminium sulphate	132.20	9.1	1453	13.07	11.11

#### Increase in molasses production

In British Sugar, molasses is not usually exhausted, and it is considered that the best estimate of the effect of an increase in molasses non-sugars on molasses production and extra sugar taken to molasses is obtained by simple ratios using the typical purity<sup>2,8</sup>. Thus, for 63% apparent purity and 75% dry substance of molasses at King's Lynn, an increase of 1 kg molasses non-sugars/100 tonnes beet sliced would be associated with increases of 1.7 kg sugar and 3.6 kg molasses/100 tonnes beet sliced. At present-day net realized values for sugar and molasses for sale, the net cost of such an increase would be £0.32/100 tonnes beet sliced.

As calculated above, use of 0.85 keq calcium chloride/100 tonnes beet sliced would increase molasses non-sugars by 42 kg/100 tonnes beet sliced, giving a net cost of £42 x 0.32 = £13.44/100 tonnes beet sliced. For similar usage of gypsum, the increase would be 24 kg molasses non-sugars/100 tonnes beet sliced, giving a net cost of £7.68/100 tonnes beet sliced.

If the costs of the additives, from Table XXIV, are included, the debits from using these quantities of calcium chloride, as solution, and gypsum become £21.94 and £11.33/100 tonnes beet sliced respectively. Gypsum is thus about £10/100 tonnes beet sliced cheaper to use than calcium chloride solution for the same effect on pressed pulp dry substance.

Indeed, even if all the chloride added as calcium chloride were to pass to molasses as potassium chloride and all the sulphate added as gypsum were to pass to molasses as potassium sulphate, the effects on molasses production would be such that, although the price advantage in favour of gypsum would be partly eroded, it would still be cheaper to use by about £1/100 tonnes beet sliced.

It is improbable that there could be so great a difference in the relative effects on molasses non-sugars of using aluminium sulphate or gypsum as to eliminate the substantial price advantage of the latter. Behaviour of the sulphate ion would be the same for each compound, and, even if sulphate from aluminium sulphate were associated only with extra sodium in molasses and sulphate from gypsum only with extra potassium in molasses, which is about the most favourable plausible bias to aluminium sulphate, there would still be a worthwhile cost advantage in using gypsum. Moreover, as discussed above, there may be substantial hidden extra cost factors in using aluminium sulphate.

#### Benefits from use of pressing aids

As demonstrated earlier in the paper, use of pressing aids at about 0.85 keq/100 tonnes beet sliced had the effect of increasing pressed pulp dry substance from about 20.5 to about 24.0% dry substance. This corresponded at King's Lynn factory to a saving of about £40/100 tonnes beet sliced in the cost of heavy fuel oil for the pulp dryers.

An increase in efficiency of water removal from pressed pulp also reduces the diffusion loss. Table XXV gives mean data for pressed pulp dry substance and pol for periods with and without gypsum use. Results for pol and dry substance for the two periods of several days in the upper half of the table are each based on between 40 and 90 individual measurements at regular intervals over each period; those in the lower half are each based on 8 to 12 individual measurements over each period.

Table XXV. Effect of gypsum on pressed pulp dry substance and diffusion loss

Date	Gypsum addition, kg/100 tonnes beet sliced	Pressed pulp		Yield of pressed pulp (Y) % on beet	Diffusion loss (L) % on beet
		Mean dry substances, %	Mean pol, %S		
Nov. 10-16, 1981	N11	20.6	1.61	25.2	0.41
Dec. 1-3, 5-7, 1981	73.7	24.0	1.73	21.3	0.37
Dec. 8, 1981	N11	20.4	1.97	26.3	0.52
Dec. 7, 1981	74.0	23.8	1.87	21.8	0.41

Increases of 3.4 units of pressed pulp dry substance were accompanied by a reduction in diffusion loss, and an other example of this effect is given in Table XVIII.

It should be noted that pressed pulp pol may increase although the dry substance has also increased. Table XXV includes an example of this, and such a deduction can be reached by extension of theoretical considerations previously published<sup>2,9</sup>.

The extra yield of white sugar which follows from a reduction in diffusion loss as a result of using a pressing aid can be financially significant. For example, reduction of the diffusion loss by 0.05% sugar on beet sliced would produce white sugar worth about £15/100 tonnes beet sliced.

<sup>25</sup> Shore: *Compt. Rend. 10e. Comm. Int. Tech. Sucr.*, 1957, 196-202.

<sup>26</sup> Oldfield: *ibid.*, 56-66.

<sup>27</sup> Oldfield & Shore: *Paper presented to British Sugar 32nd Works Managers Conf.*, 1969.

<sup>28</sup> Oldfield et al.: *I.S.J.*, 1981, 83, 106-109, 131-136.

<sup>29</sup> Rodgers: *Paper presented to the 2nd Tech. Conf. British Sugar Corp.*, 1949.



## Conclusions

(1) Gypsum, which is a commercial grade of  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , was used successfully as a pulp pressing aid at King's Lynn factory. Added as an approximately 15% w/v slurry to supply water at about 17 kg (0.85 keq) calcium/100 tonnes beet sliced, it increased pressed pulp dry substance by about 3.5 units to about 24% dry substance.

(2) Calcium chloride, added as an approximately 22% w/v solution to supply water at about 14 kg (0.70 keq) calcium/100 tonnes beet sliced, also resulted in pressed pulp of about 24% dry substance.

(3) Aluminium sulphate, added as an approximately 24% w/v solution to supply water at about 10.1 kg (1.12 keq) aluminium/100 tonnes beet sliced, also gave about 24% pressed pulp dry substance.

(4) Halving the addition rates of gypsum and aluminium sulphate had virtually no effect on the increase in pressed pulp dry substance. This finding would appear to be associated with the capacity of the pulp to absorb the cation of the pressing agent.

(5) Gypsum costs about £3.50/keq (20 kg) calcium; this is less than half the price of a kilo-equivalent of calcium as calcium chloride and about one-third the price of a kilo-equivalent (9 kg) of aluminium as aluminium sulphate.

(6) Added sulphate from gypsum and added chloride from calcium chloride were found to be distributed between raw juice and pressed pulp in the ratio 70 : 30.

(7) Most of the added cation from the pressing aid was absorbed by the pulp. Potassium, and, to a lesser extent, sodium and magnesium were desorbed into juice, the total quantity desorbed being similar to the quantity of cation absorbed, and to the increase in amount of the pressing aid anion in raw juice.

(8) In view of subsequent chemical reactions in the process, it is considered that use of 0.85 keq calcium/100 tonnes beet sliced is associated with an increase of 24 kg molasses non-sugars/100 tonnes beet sliced if the calcium source is gypsum, but 42 kg/100 tonnes beet sliced if the source is calcium chloride. These effects increase the cost advantage of gypsum over calcium chloride. Aluminium sulphate probably has a similar effect to gypsum on molasses non-sugars.

(9) Using a pressing aid reduced both dryer fuel usage and diffusion loss. The financial benefits from these two effects far outweigh the costs incurred by using such pressing aids as are discussed in this paper. For example, at King's Lynn factory, use of about 72 kg gypsum/100 tonnes beet sliced resulted in a net saving from reduced dryer fuel usage alone of about £30/100 tonnes beet sliced. The saving would have been reduced by about £10/100 tonnes beet sliced by use of the stoichiometrically equivalent quantity of calcium chloride, i.e. 46 kg  $\text{CaCl}_2$ /100 tonnes beet sliced. Aluminium sulphate solution, if used in stoichiometrically equivalent amounts, i.e. 47 kg  $\text{Al}_2(\text{SO}_4)_3$ /100 tonnes beet sliced, would probably give a similar saving to calcium chloride, but it would increase corrosion through a lowering of pH at the water end of the diffuser. Moreover, the use of calcium chloride or aluminium sulphate was found to reduce the capacity of the press station because of an apparent increase in volume of wet pulp.

## Acknowledgments

The authors wish to thank management and staff at King's Lynn for their willing help in carrying out the experiments with pressing aids reported in this paper. The analytical work carried out by personnel at Research Laboratories and Central Laboratory is also gratefully acknowledged.

## Summary

An account is given of trials in which gypsum (commercial-grade calcium sulphate) was used as an aid to pulp pressing, with comparative trials using calcium chloride, aluminium sulphate and no aid. Both forms of calcium addition improved pressed pulp dry substance but the gypsum was cheaper and also resulted in less melassigenic non-sugar entering the process. Aluminium sulphate also raised the pressed pulp dry substance to the same extent but was more expensive and, because it lowered the pH of the diffusion supply water, was likely to lead to corrosion.

## Le gypse et d'autres adjuvants de pressage de pulpes

On rapporte des essais dans lesquels du gypse (sulfate de calcium commercial) fut utilisé comme adjuvant au pressage de pulpes. On compare les résultats à ceux obtenus avec d'autres adjuvants, tels que le chlorure de calcium ou le sulfate d'alumine ou sans adjuvant. L'addition des deux formes de calcium améliorerait la teneur en matières sèches après pressage. Le gypse était cependant meilleur marché et conduisait aussi à l'introduction dans le processus d'une quantité plus faible de non-sucre mélassigènes. Le sulfate d'alumine augmentait aussi la teneur en matières sèches dans la même proportion, mais il est coûteux et favorisait la corrosion parce qu'il abaissait le pH de l'eau d'alimentation de la diffusion.

## Gips und andere Schnitzelpreßhilfsmittel

Berichtet wird über Versuche mit Gips (technisches Calciumsulfat) als ein Hilfsmittel für die Schnitzelpressung sowie über Vergleichsuntersuchungen mit Calciumchlorid, Aluminiumsulfat und ohne Hilfsmittel. Beide Calciumsalze erhöhten die Trockensubstanz der Preßschnitzel, aber Gips war billiger und produzierte weniger melassebildende Nicht-Zuckerstoffe, die in den Prozeß gelangen. Aluminiumsulfat erhöhten die Trockensubstanz der Preßschnitzel im gleichen Maße aber war teurer und erniedrigte den pH-Wert des Extraktions-Wassers, was evt. zu Korrosion führen kann.

## Yeso y otras ayudas para prensamiento de pulpa de remolacha

Se presenta un examen de ensayos en que yeso (sulfato de calcio de grado comercial) se ha empleado como ayuda para prensamiento de pulpa, con ensayos comparativos empleando cloruro de calcio, sulfato de aluminio y sin ayuda. Ambas formas de adición de calcio mejoraron el contenido de sustancia seca en pulpa prensada pero el yeso estuvo más barato y también causó entrada de menos no-azúcar en el proceso. Sulfato de aluminio elevó también el contenido de sustancias secas en pulpa prensada al mismo nivel, pero costó más y, por su reducción del pH de la agua que entra la difusión, es probable que causaría corrosión.

# SUGAR CANE AGRONOMY

**Sugar cane agronomy.** Anon. *Mem. Anual Est. Exp. Agro-Ind. Obispo Colombres* (Tucumán, Argentina), 1980, 39-46 (Spanish). — Experiments are briefly reported on growth and ripening of cane, planting distance effects on yield, decline of yield in successive ratoon crops, control of weeds, use of glyphosate to eliminate stools, soils, fertilization and irrigation studies, harvesting and cane quality, topping height, post-harvest deterioration, and time of harvesting.

**Studies on intercropping of spices and tobacco with autumn sugar cane.** R. S. Verma, M. P. Motiwale, R. S. Chauhan and R. K. Tewari. *Indian Sugar*, 1981, 31, 451-456. — Trials are reported in which tobacco and three different spices were intercropped, individually, with autumn-planted cane. Only garlic caused the cane yield to be greater than when the cane was grown alone, while the other intercrops reduced it. The net income from garlic + cane was almost double that of cane alone, although all the intercrop + cane combinations gave higher net returns than cane alone. Intercropping caused a sharp fall in top borer incidence and did not significantly affect juice quality.

**The Australian sugar cane planter is dedicated to his work.** R. Coruña. *Sugarland* (Philippines), 1981, 18, (3), 6-7. — An outline is presented of Australian cane growing and the attitude of the Australian cane farmer to his work.

**Philippines sugar industry.** D. J. Heinz. *Sugarland* (Philippines), 1981, 18, (3), 10-15. — Details are given of a report prepared by the author after a visit to Negros Occidental and Cebu in the Philippines and which dwells on various aspects of cane growing, particularly varietal development and cultural practices.

**Effect of Agromin on growth, development and quality of sugar cane.** O. Singh and R. S. Kanwar. *Indian Sugar*, 1981, 31, 591-595. — Field trials over two seasons are reported in which the effect of Agromin (containing micro-nutrients in chelated form) on cane sett germination, growth and juice quality was investigated. Results showed that dipping of setts in 1% Agromin was as effective as dipping in 0.5% Agallol (in terms of % germination increase over the control). Foliar application of 0.5% Agromin solution 40, 60 or 80 days after sett treatment significantly increased growth, millable stalk length, stalk population, girth and yield.

**Planting technique and spatial density in relation to late-sown sugar cane under north Indian conditions.** P. P. Singh, S. K. Saini, O. P. Mishra and T. P. Singh. *Indian Sugar*, 1981, 31, 597-602. — A three-year field experiment to compare vertical with horizontal planting of setts (pre-germinated or not) showed that vertical planting gave a higher yield in the case of setts that were not pre-germinated, but otherwise gave a lower yield. Narrower

inter-row spacing (60 vs. 90 cm) gave a higher yield, best results being obtained with horizontal planting of pre-germinated setts.

**Field origins of dextran and other substances which affect sucrose crystallization.** J. E. Irvine. *Bol. Téc. (GEPLACEA)*, 1981, (19), 3 pp (Spanish). — See *I.S.J.*, 1982, 84, 110.

**Aerobic and anaerobic nitrogen-fixing bacteria in sugar cane roots.** A. P. Ruschel, J. Orlando, E. Zambello and Y. Henis. *Bol. Téc. (GEPLACEA)*, 1981, (19), 6 pp (Spanish). — See *I.S.J.*, 1979, 81, 176.

**Cultivation of ratoon cane.** P. Chandra and K. Jalihal. *Bol. Téc. (GEPLACEA)*, 1981, (19), 3 pp (Spanish). A practice, especially suitable for small farmers, is to leave the dry cane leaves as a mulch instead of burning them. Advantages include elimination of the need for organic fertilizer and for weeding and reduction of disease.

**Drip irrigation of sugar cane — the Hawaiian story.** W. Gibson. *Tech. Bull. (GEPLACEA)*, 1981, (20), 6 pp. See *I.S.J.*, 1978, 80, 362-366.

**Evaluation of N fertilizer efficiency for plant and ratoon crops in irrigated sugar cane.** F. Chui and G. Samuels. *Tech. Bull. (GEPLACEA)*, 1981, (20), 4 pp. — See *I.S.J.*, 1979, 81, 144.

**Influence of physical properties of clay soils on their management for sugar production in Guyana.** C. L. Paul. *Trop. Agric.*, 1982, 59, 162-166. — Physical properties of some clay soils in the cane-growing area of Guyana are reviewed with respect to their influence on management practices for sugar production. High silt contents of the soils caused rapid breakdown of structure after land preparation. Infiltration of water within the profile was highly dependent on cracks. Generally, a moisture content of 25-30% was found to be the optimum range at which the soils should be manipulated. Penetration resistance measurements were considered useful for indicating soil water contents at which the soils would permit the passage of vehicles. Differences in clay type were probably the main reason for differences in soil behaviour between the Berbice and Demerara regions of the coastal belt. These differences were observed in shrinkage measurements. Management of the clay soils was thought to be closely linked with understanding and enhancing of processes that caused dehydration, shrinkage and deep cracking within the soil profile.

**Aspects of the management of salinity on swelling clay soils in Jamaica.** M. E. A. Shaw. *Trop. Agric.*, 1982, 59, 167-172. — Management practices currently recommended for salinity control on two major irrigated heavy clay soils, of very low hydraulic conductivity, in the semi-arid southern coastal plains of Jamaica, where sugar cane is almost exclusively grown, are reviewed. The main policies governing recommended practices of salinity management are: leaching of accumulated salts from the soil profile by storm rains, land forming and land shaping, improved soil physical condition, conscious irrigation management and the use of salt-tolerant varieties. The soils in question have become salinized appreciably over the last 15 years, averaging 1.5-2.0‰ per year. Irrigation water quality and quantity have also markedly declined. These conditions, aggravated by a succession of low rainfall years, have been accompanied by depressed yields.

# CANE PESTS AND DISEASES

**Proposals for improving the use of the ISSCT disease resistance ratings.** C. Ricaud. *Sugarcane Pathologists' Newsletter*, 1981, (27), 40-44. — While the disease resistance rating system described by Hutchinson<sup>1</sup> is widely used, it is often applied after only one test, whereas re-testing would impart greater confidence to the results and permit a better appreciation of shades of reaction. It is proposed that the system be modified so that the only ratings to be given after just one test would be 2, 5 and 8 (broadly indicating that a variety is resistant, intermediate or susceptible); only where further tests have been carried out should one of the other six ratings be applied. Hence, in effect, the system would include six groups (in addition to immunity) instead of nine: highly resistant and resistant, moderately resistant and moderately susceptible, and susceptible and highly susceptible, each pair corresponding to the broad group 2, 5 and 8 given above.

**A coryneform bacterium as causal agent of ratoon stunting disease of sugar cane.** R. A. Oellermann, M. Nayiager and D. Pillay. *Sugarcane Pathologists' Newsletter*, 1981, (27), 51-53. — Details are given of the isolation and culture of a bacterium, results of which leave little doubt that it is identical to the coryneform bacterium responsible for RSD.

**Studies on iron chlorosis in sugar cane. I. Survey, soil and plant analysis.** G. R. Naik and G. V. Joshi. *Maharashtra Sugar*, 1981, 7, (1), 71-73, 75-76. — The symptoms of iron chlorosis in cane are briefly described, and details are given of soil characteristics associated with the disorder, which is not attributable to iron deficiency but to iron immobilization by other components in an alkaline soil.

**Sugar cane borers.** Anon. *Ann. Rpt. Inst. Rech. Agron. Trop.* (Réunion), 1980, 19-21 (French). — Studies of cane infestation by *Chilo sacchariphagus* in 31 fields, in which the four varieties of cane grown represented some 60% of the total cane area of Réunion, showed that, when more than 70% of the canes were infested, 10% of the internodes were under attack and sugar losses became appreciable. However, in fields not subject to winds, fewer than 10% of the internodes were infested, whereas the cane in half of the fields that were wind-swept had internode infestations above this level.

**New light on nematocides.** Anon. *S. African Sugar J.*, 1981, 65, 525, 527-529. — See Moberly & Clowes: *I.S.J.*, 1982, 84, 273.

**Studies on the feeding potential of the coccinellid predator, *Pharoscygnus horni* Wesm., on the scale insect of sugar cane.** C. Seshagiri Rao and C. Subba Rao. *Indian Sugar*, 1981, 31, 401-403. — *P. horni* is an effective predator of *Melanaspis glomerata*, and a study was made of the effects of artificial diets on its lifespan. Results

showed that a diet of honey agar gave a lifespan averaging 11 days (by comparison with 30 days feeding on scale insects in the wild), while addition of 5% scale insect (by weight) to the diet increased it to an average of 13 days. However, none of the artificial diets tested induced oviposition, in contrast to feeding in the wild, so that it is concluded that the beetle used the food merely as an energy source.

**Eldana on south coast of Natal.** Anon. *S. African Sugar J.*, 1981, 65, 559. — *Eldana saccharina* occurrence in cane fields in coastal areas south of Durban is reported. Although levels of infestation are low, the spread of the pest is cause for concern. In 1975 the borer was known to be prevalent in natural vegetation in the region, particularly on *Cyperus immensus*, but reasons for its move from this natural host into cane fields remain unknown.

**Rapid diagnostic service for RSD.** R. A. Bailey. *S. African Sugar J.*, 1981, 65, 567-568. — Microscopic diagnosis of ratoon stunting disease has been extensively used at the SASA Experiment Station for survey and research purposes since 1976. Improvements to the techniques used in the test were introduced in 1979 and permit rapid testing of large numbers of stalk samples as a service available to growers. The procedure involves examination of xylem sap from stalks of both seed cane and commercial cane for the causative bacterium. The demand for RSD diagnosis has increased rapidly, the number of samples received per month in 1981 averaging 475. Seed cane samples comprise about 50% of those received; early surveys indicated an average 22% of fields used as seed cane sources were contaminated. However, there is evidence of an improvement in the health of seed cane. The importance of the diagnostic service as a contribution to control of the disease is mentioned; surveys in 1978-79 had shown that about one-third of commercial cane fields in South Africa were infested with RSD, and it is felt that future surveys will enable the effect of control measures adopted by growers to be monitored.

**Discovery of the pupa of *Migdolus fryanus* Westwood (Col. Cerambycidae).** M. A. Sansigolo, F. C. Albuquerque, N. Fontanari and O. Alonso. *Brasil Açuc.*, 1981, 98, 326-327 (Portuguese). — Pupae of the title pest were discovered during searches in the cane area of Cia. Agrícola Predro Ometto following initial reports of its presence at Fazenda São Miguel.

**Numbering sugar cane leaves and shoots.** G. T. A. Benda. *Tech. Bull.* (GEPLACEA), 1981, (18), 4 pp. — The numbering of cane leaves, nodes, internodes and buds is intended to identify each part individually, to determine current relationships and to clarify the pattern of development. Two numbering methods are described: one developed by Kuijper<sup>2</sup> and a modification of a technique devised by Schoute to evaluate the growth of tillers of cereal grasses<sup>3</sup>. Application of the methods to cane pathological studies is indicated. It is stressed that one method is enough where there is little variation with age of cane or where no further change is expected beyond a threshold stage, whereas more than one method is needed when small differences in the stage of development affect the measured values.

<sup>1</sup> *Proc. 13th Congr. ISSCT*, 1968, 1087-1089.

<sup>2</sup> *Archief Suikerind. Ned.-Ind.*, 1915, 23, 528-556.

<sup>3</sup> *Koninkl. Akad. Wetensch. Verhandl.*, 1910, Sec. 2, 15:XIX, 1-492.

# CANE BREEDING AND VARIETIES

**From glasshouse to field: a background to sugar cane breeding.** Anon. *S. African Sugar J.*, 1981, **65**, 519-520. An outline is presented of cane breeding as carried out in South Africa.

**Genetic improvement of sugar cane.** Anon. *Mem. Anual Est. Exp. Agro-Ind. Obispo Colombres* (Tucumán, Argentina), 1980, 1-20 (Spanish). — A record is presented of the cane breeding work carried out at the Experiment Station, including further flowering induction by photoperiod adjustment, obtaining of true seed, production of plantlets, introduction of varieties and the selection of clones in each of the six stages employed.

**Variability and correlation studies in sugar cane.** R. R. Singh, B. K. Tripathi and S. Lal. *Indian Sugar*, 1981, **31**, 457-459. — Genetic variability was determined for cane height, girth, number of internodes, internode length, cane weight and sugar content. Highest genotypic coefficients of variance and genetic advance were observed in cane height followed by cane weight, whereas heritability was highest for sugar content followed by internode length; generally, heritability values were moderate for all the characters studied. Although a positive correlation was found between sugar content and all the investigated characters, it was significant only for internode length and cane weight at genotypic level.

**Breeding new cane varieties.** D. M. Hogarth. *Cane Growers' Quarterly Bull.*, 1982, **45**, 72-94. — Details are given of the cane breeding program of the Bureau of Sugar Experiment Stations in Queensland, which has released about 40 varieties in the Q series since 1965. Information is given on the work carried out in connexion with varieties introduced from other countries, and descriptions are given of the cross-pollination program at Meringa which is basic to the overall breeding program. Seed is sent from Meringa to the experiment stations at Ayr, Mackay and Bundaberg, where hundreds of thousands of seedlings are raised and about 100,000 planted out in the field. Varieties selected from the yield observation trials are planted on farms in each district, so that the most promising can be tested under a range of conditions. The grading system used for varietal assessment is explained, and testing for rust, Fiji disease and leaf scald resistance is described. Profiles and (in some cases) colour photographs are given of leading varieties in each district.

**Parental diversification for improved sugar cane varietal production.** A. S. Ethirajan, B. V. Natarajan and R. Nagarajan. *Maharashtra Sugar*, 1982, **7**, (5), 9-12. — A fall in the average cane yield per ha towards the close of the last decade by comparison with the preceding decade is attributed to a number of factors, including repeated use of selected parental stocks (thus narrowing the gen-

etic base), a multiplicity of selection objectives (causing erosion of the genetic advance for major commercial attributes), the outbreak of major diseases such as red rot, and extension of the Indian cane area to sub-tropical regions liable to drought, cold, waterlogging, etc. The genealogy of popular Coimbatore cane varieties is shown and details given of 31 varieties, with their parentage, year of release and brief notes. Information is given on measures being adopted to broaden the genetic base, including the launching of a massive systematic program of evaluation and exploitation of the world collection of germplasm located at the Cannanore Research Centre through studies at nine major centres, and establishment of a decentralized varietal testing procedure for local adaptability of varieties based on the provision of hybrid seed to 17 cane research centres.

**Variability in the estimation of genotypic parameters in hybrid progeny of sugar cane.** J. A. Mariotti. *Rev. Ind. Agríc. Tucumán*, 1981, **58**, (1), 53-67 (Spanish). — In experiments to detect systematic environmental effects on the genotypic parameters used for selection, 80 genotypes taken at random from hybrid progenies were planted in replicated plots at four sites in Tucumán and data collected on yield components and quality in plant and ratoon crops. The data were subjected to variance analysis to estimate the degree of genetic determination and selection gains. Results are summarized in tables and graphs and indicate (1) selection environments significantly affect the estimation of genotypic parameters; (2) estimates based on a single experimental situation (such as one site and one year) are not reliable, in general; and (3) it was possible to detect certain systematic environmental effects such as age of the crop and quality of phenotypic expression for some characters. One of the sites appeared to be systematically better than the others for selection purposes.

**Biochemical studies on flowering in sugar cane. III. Studies on Co 285 — carbohydrate metabolism at distinct stages of flower development under normal day conditions.** K. C. Rao and M. Vijayasathy. *Maharashtra Sugar*, 1982, **7**, (6), 11, 12-17. — The total sugars, polysaccharides, reducing sugars and sucrose were determined in the leaf, stem and flower tissues in the top 6-leaf portion of Co 285 plants of the same physiological age and at distinct stages of flower development. The significant differences observed are discussed in relation to flowering.

**Sugar cane flowering. Determination of photoperiod requirements.** C. A. Levi. *Rev. Ind. Agríc. Tucumán*, 1981, **58**, (1), 35-48 (Spanish). — Experiments to determine the best photoperiodic conditions for induction of flowering in cane showed that they were the maintenance of the photoperiod after November 16, 1979, at 12 hr 35 min for 30 days, followed successively by 30-day photoperiods of 12 hr 25 min, 12 hr 15 min and 12 hr 10 min. After this time the photoperiod was the natural one and fell to 11 hr 30 min.

**Plant morphology in relation to cane yield and sugar yield in sugar cane.** M. S. Punia, R. S. Hooda and R. S. Paroda. *Indian Sugar*, 1982, **31**, 663-666. — Of 41 genotypes examined for morphological attributes in relation to plant and sugar yield, five were found to be high-yielding, of high sugar content and resistant (or moderately so) to various diseases. Details are tabulated of the growth parameters, Brix, sucrose content and disease resistance of the five.

# BEET PESTS AND DISEASES

**Decay of heart leaves and root dry rot.** M. Kubacka-Szmidtgal. *Gaz. Cukr.*, 1981, 89, 125-126 (Polish). Brief reference is made to the effects of boron deficiency on beet leaves and root as well as on yield (which may fall by 20-30% when the soil B content is below 0.7 ppm) and sugar content (which may fall by 2-4%).

**New means of controlling sugar beet seedling rot in 1977-80.** N. Jarowaja. *Gaz. Cukr.*, 1981, 89, 127-128 (Polish). — Fungicidal trials to control stem rot, black leg and Pythium rot are reported. In both laboratory and field tests, the most effective was Alentisan 30 at 600 ml per 100 kg of seed; it gave much greater emergence than with the untreated control.

**Pest control in the initial phase of beet growth.** M. Kubacka-Szmidtgal. *Gaz. Cukr.*, 1981, 89, 129 (Polish). Some recommendations are given on effective spraying of seedlings against soil-borne and leaf pests.

**Effect of pesticides used in beet cultivation on the biological activity of the soil.** C. Bellinck and J. Mayaudon. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1981, 49, 57-67 (French, Dutch). — The effects of pesticides and of pre-sowing, pre- and post-emergence herbicides on the biological activity of the soil (as measured by radio-respirometer) were investigated at various locations during 1973-75. Tabulated and graphed results show that Nortron at 20 litres.ha<sup>-1</sup> was particularly harmful, residues still being found in the soil long after application, even when the herbicide was applied in the autumn; at half this dosage rate, the adverse effects were very much reduced. Pyramin at 5 kg.ha<sup>-1</sup> was equally harmful, its residual action being directly proportional to the soil organic matter content. Temik, even at 20 kg.ha<sup>-1</sup>, was found to have little effect on the biological activity of the soil while assuring a good crop yield.

**Rhizomania. I. Detection of the beet necrotic yellow vein virus (BNYVV) using indicator plants.** I. Horak and R. Schlösser. *Zuckerind.*, 1982, 107, 23-26 (German). The title virus is transmitted via zoospores of the fungus *Polymyxa betae* and may cause considerable losses. Detection of the virus was found, in experiments, to be possible by inoculation of *Chenopodium quinoa* or *C. amaranticolor* with isolates from the tissue of trap plants grown in the suspect soil, or by direct transmission from diseased plant parts. However, tobacco necrotic virus (TNV) is almost always found in soils infected with BNYVV, and TNV is so virulent that it causes lesions within 2-4 days of inoculation and possible subsequent leaf death, whereas at least 7-10 days must elapse before lesions appear as a result of BNYVV infection. Despite much effort, no plant has been found that is adequately resistant to TNV.

**Control of beet pests.** L. van Steyvoort. *Le Betteravier*, 1982, 16, (161), 17, 20 (French). — Advice is given on

chemical control of beet insect pests, with an indication of efficiency ratings for five insecticides and one mixture against six classes of insect. Only Temik 10 G at 10 kg.ha<sup>-1</sup> is shown to be currently effective in the control of aphids and hence beet yellows.

**Virus yellows incidence and the effects of winter weather.** Anon. *British Sugar Beet Rev.*, 1982, 50, (1), 57-58. — It has been found that there is a good relationship between winter and early spring weather and virus yellows incidence in the following summer; it is based on the fact that the severity of the winter determines the survival of plants infected with the virus and of the greenfly acting as vector, while temperatures in the spring govern the speed at which the greenfly multiply and disperse.

**Growth, pests and diseases of sugar beet in Belgium in 1980.** L. van Steyvoort. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1981, 49, 79-88 (French, Dutch). — Information is given on climatic conditions, beet growth and yield (including the percentage of bolters), pests and diseases in Belgian beet fields in 1980. Only the pygmy mangold beetle (*Atomaria linearis*) posed any real problems, for which application of 0.75 kg.ha<sup>-1</sup> a.i. Carbofuran in the furrow at sowing has proved the best means of control, although Terbufos is almost as effective. Powdery mildew developed late, while there was practically no incidence of virus yellows as a result of pesticide control of aphids in recent years.

**Beet pests and diseases.** L. van Steyvoort. *Le Betteravier*, 1982, 16, (163), 11, 14 (French). — The author discusses damping-off of beet seed and strangulation of roots by fungi even where the seeds have been pretreated with fungicides; since it is the state of the soil and weather conditions that promote the activity of the fungi (*Pythium* spp. and *Aphanomyces* spp.), chemical treatment will not help, and the only remedies are aeration of the soil by hoeing and drying of the seedbed. It is stressed that plantlets that have suffered from root strangulation may recover. Other insect pests briefly discussed are *Atomaria linearis*, slugs and aphids as virus yellows vectors. Means of control are indicated.

**Causes and prevention of virus yellows: 30 years of vector control with systemic insecticides (1952-1982).** W. Kolbe. *Die Zuckerrübe*, 1982, 31, 148-150 (German). A survey is presented of the causes, economic importance and conditions favouring the spread of virus yellows as well as overwintering of both virus and vector, but the bulk of the article is devoted to chemical control of the two major aphid vectors, *Myzus persicae* and *Aphis fabae*.

**Mildew — powdery or downy?** W. Byford. *British Sugar Beet Rev.*, 1982, 50, (2), 15-17. — Descriptions are given of the symptoms and means of control of powdery mildew (*Erysiphe communis*) and downy mildew (*Peronospora schachtii*) with the aim of helping farms to distinguish between the two diseases.

**Deficiency diseases in beet.** R. Vanstallen. *Le Betteravier*, 1982, 16, (164), 11, 14 (French). — The symptoms of deficiencies in Mg, B and Mn and means of remedying them are described. Typical soil contents of Zn, Mg, B and Cu and the amounts taken up by the beet are indicated, and it is emphasized that the question is not strictly of deficiency but of imbalance between the various soil nutrients or of an excessively acid or lime soil.



# BEET SUGAR MANUFACTURE

**A suggested standard design for (juice) purification.** E. Havlova and J. Cepelak. *Listy Cukr.*, 1982, 98, 49-55 (Czech). — A carbonation system is described which incorporates conventional pre- and main liming as well as 1a and 1b carbonation and 2nd carbonation but allows for variation in beet juice quality by e.g. introducing a reserve second-stage vessel for 2nd carbonation where more thorough treatment is required.

**Optimization of the flume and wash water circuit in a sugar factory.** W. Strube. *Lebensmittelind.*, 1982, 29, 69-72, 127-129 (German). — With adoption of early beet harvesting (in order to allow the fields to be prepared for the next crop in the rotation), the beets must be stored for a longer period unless the factory capacity is increased. However, this may result in increased losses, particularly where the dirt tare is excessive. At Zeitz sugar factory, in East Germany, the problem has been solved by washing the beet before storage and transferring the muddy water to a circular settling tank. Investigations over three campaigns showed that the scheme, which incorporates the existing flume system in a circuit with the settling tank and recycling of clear water for the washing, was successful in preventing increase in beet deterioration and gave better processing results, with lower juice colour and higher sugar yield than at neighbouring factories. Liming of the flume water reduced bacterial activity, and forced ventilation of the piled beet proved unnecessary.

**Trials on electro dialysis of sugar factory by-products.** J. C. Giorgi and R. Gontier. *Sucr. Franç.*, 1982, 123, 133-143 (French). — A 30-cell electro dialyser was used in molasses demineralization tests. At a current density falling from  $15.2 \text{ mA.cm}^{-2}$  at the start of the cycle to  $4.3 \text{ mA.cm}^{-2}$  at the end and a voltage of 1 V per cell, up to 40% of the K in the  $50^\circ \text{Bx}$  molasses was recovered after 180 minutes; addition of  $\text{MgCl}_2$  to the molasses equivalent to 40% of the K content increased K recovery to more than 50% of the initial content, while there was no transfer of  $\text{Mg}^{++}$  to the concentrate stream during the first 120 min, and it did not exceed 10% of that initially present. Sugar recovery tests were less reproducible than the demineralization tests, but an average 20% of the sugar was recovered, a result comparable to that obtained with the Quentin process. A possible industrial process is suggested which would be based on electro dialysis of molasses from low-grade massecuite, followed by concentration, mingling with some of the low-grade sugar, affination and electro dialysis of the run-off. Costs of such an operation are briefly examined.

**Is there a limit to pulp pressing?** J. C. Giorgi, R. Gontier and R. Ascher. *Sucr. Franç.*, 1982, 123, 145-152 (French). — Tests on beet pulp pressing showed that application of a pressure of 75 bar for 1 hour raised the dry solids content from 32.6 to 60% at a temperature of  $20^\circ \text{C}$ , pH 6.4 and 1:1 dilution of the pulp with press

water. Poorer results were obtained when the temperature was raised to  $60^\circ \text{C}$ , when  $\text{MgCl}_2$  or  $\text{CaCl}_2$  was added, when the pH was reduced to 2 by addition of sulphuric acid, when the pulp had undergone slight fermentation, or when the pulp:water ratio was increased.

**The contribution of an "autonomous terminal" in the field of beet reception.** G. Windal and F. Boom. *Sucr. Franç.*, 1982, 123, 159-162 (French). — Preliminary trials of a system designed for automatic recording of beet delivery information are reported. The core of the system is an autonomous terminal which receives a plastic card bearing a magnetic strip. The card carries the number of the vehicle and is inserted in the terminal at the weighbridge; information is then transferred to the card, which is presented to an automatic reader at the beet reception point. Thus, the information is transmitted to the central computer, while the truck driver receives a print-out of the data. Only the vehicle number remains permanently on the card — all the other information is automatically erased when a new set of data is transferred to the card. After slight teething troubles, the system functioned perfectly satisfactorily.

**Low-grade work with vertical crystallizers at Zuckerfabrik Süderdithmarschen AG, St. Michaelisdonn.** H. J. Dunker. *Zuckerind.*, 1982, 107, 296-301 (German). — Details are given of a Selwig & Lange S & L 78 experimental vertical crystallizer used in tests in 1978/79 at the title sugar factory, and descriptions are given of a pilot-plant model of a crystallizer and of its subsequent full-scale development based on the preliminary test results and incorporating a modified cooling/mixing element aimed at improving both heat transfer and the residence time pattern. Results for 1980 and 1981 with this new model, the S & L 80, showed an average heat transfer coefficient of  $35 \text{ W.m}^{-2}.\text{C}^{-1}$ , while the residence time pattern, given as a Gaussian distribution curve, was optimum for application of the real plug flow principle. The massecuite temperature was reduced from  $70.4^\circ$  and  $75.0^\circ \text{C}$  on average to  $41.1^\circ$  and  $47.0^\circ \text{C}$  in 1980 and 1981, respectively, while the vertical crystallizer contributed to a 5.81 units fall out of a total of 6.96 units fall in purity in 1980, and 6.30 units out of a total of 9.30 in 1981.

**Test on sugar washing by different means and using different devices.** V. A. Shestakovskii, T. P. Matvienko, A. N. Savich and G. G. Mikhal'chuk. *Sakhar. Prom.*, 1982, (3), 9-12 (Russian). — Tests are reported in which A-sugar was washed in the centrifugal with diluted 2nd run-off from A-massecuite followed by hot water by comparison with washing only with hot water; for the combined washing method, a perforated pipe was used whereas a multi-jetspray system was used for the other method. Results showed that the use of the combined method increased white sugar yield and reduced water consumption by comparison with the other method, provided the colour of the massecuite did not exceed  $40^\circ \text{St}$ . Application of the perforated pipe to washing of other products also gave improved performances.

**Investigation of the corrosive properties of recycled and waste water at a sugar factory.** A. I. Sorokin and A. P. Parkhomets. *Sakhar. Prom.*, 1982, (3), 25-28 (Russian). Investigations of the corrosive action of Class I, II and III waste water and of water recycled from the  $\text{CO}_2$  gas washing plant showed that only the recycled water caused sufficient corrosion of carbon steel to warrant special means of protection, while none of the waste water posed any threat.

# NEW BOOKS

**Sugar year book 1981.** 335 pp; 10 x 13.8 cm. (International Sugar Organization, 28 Haymarket, London SW1Y 4SP, England.) 1982. Price: £10.00.

This is the 35th issue of the pocket book of sugar statistics published by the ISO, and the 5th under the 1977 International Sugar Agreement. The statistics relate to centrifugal sugar only and have been supplied either under the rules of the ISA, submitted by the governments concerned, extracted from statistical publications or estimated; unless otherwise stated, they are on a calendar year basis, and are expressed in terms of raw sugar of 96°S as far as possible. Of the more than 120 countries represented, 44 are exporting members of the ISA and 15 are importing members. The EEC is given as one block. The tables cover sugar production, consumption, imports, exports and stocks in the years from 1974 to 1981, with imports also broken down into countries of origin and covering the period 1975-81. Also included are tables of world statistics and information on prices. As with past editions, the figures are easily readable on matt paper, and the book makes a very compact, neatly arranged volume.

**Exergie (Exergy).** T. Baloh. 239 pp; 14.8 x 21 cm. (Technische Universität Berlin, Universitätsbibliothek, Budapester Str. 40, D-1000 Berlin 30, Germany.) 1982. Price: DM 11.00.

The term "exergy" was suggested by Rant in 1953 to indicate extractable energy, and it is generally used nowadays in reference to convertible energy, although opinions differ as to whether it is a parameter of state or not; however, the tendency seems to be to use Fratzscher's definition of it as a thermodynamic parameter that is equally dependent on properties of state of the energy carrier and on ambient conditions, and so is an expression for the reciprocal effect of two systems.

The present monograph is the 4th edition of a series of lecture notes for planning engineers who took part in seminars in 1970-73, the only difference between this and the 3rd edition lying in the use of the International System of Units and expansion of the contents to include a chapter on optimization. The other ten chapters cover various aspects of heat exergy, including an explanation of the exergy concept, ambient conditions and equilibrium with these, exergy calculations, entropy, the value of exergy in optimization of evaporator operation, and a number of exergy and other diagrams. The work is a major contribution to the literature on heat utilization and will be of value to those heat engineers who can read German.

**Zuckerwirtschaftliches Taschenbuch** (Sugar economic pocket book) 1982/83. Ed. K. Dankowski, R. Barth and G. Bruhns. 254 pp; 10 x 14.7 cm. (Verlag Dr. Albert Bartens, D-1000 Berlin 38, Postf. 380 250, Germany.) 1982. Price: DM 30.00.

The latest edition of this very interesting collection of statistics on beet, cane, sugar and molasses in West

Germany, Europe and the world continues the high level of promulgation of such information set many years ago. It also covers trade, and gives details of the EEC market regulations for sugar, plus a useful section devoted to addresses of important international, EEC and West European organizations and of sugar companies and factories in EEC member countries. The book contains five graphs and three maps. While most of the information is given in English and French as well as German, many of the footnotes are given only in German, so that readers who wanted to be absolutely sure of their facts would have to resort to use of a dictionary unless their knowledge of German was adequate. However, for those readers wishing to acquire the relevant information, this is a very handy publication.

**F. O. Licht's International sugar economic year book and directory 1982.** 457 x 72 pp; 21.5 x 29.5 cm. (F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany.) 1982. Price: DM 116.00.

The 1982 edition of this well-known cloth-bound directory is identical in basic arrangement to previous ones, with the information updated. By far the most important sections are the two devoted to the beet and cane sugar industries, with addresses of relevant organizations, sugar companies and factories, and factory processing capacities. The one country omitted is the USSR, for which no details are given of the 324 factories known to be operational — this is because of lack of up-to-date information. Otherwise, the details for individual countries are as complete as possible, any errors being due to recent changes such as closures, completion of new factories and name alterations rather than to oversight on the part of the publishers. The year book also includes details of international and national sugar organizations, US sugar legislation, product reports from a number of sugar equipment manufacturers, a Buyers' Guide, a collection of articles on sugar economic matters, one on new equipment and processes in the sugar industry (by E. W. Krause), another on mechanical cane harvesting (by S. W. D. Baxter) and one on beet agriculture (by M. J. Durrant and R. K. Scott). A pull-out supplement of world sugar statistics for 1981/82 is housed in a pocket at the end of the book. The directory continues a tradition of high quality and is certainly to be recommended to those readers looking for the latest information on the sugar industry.

**The industrial utilization of sugar and mill by-products. A literature survey.** M. J. Kort. 275 pp; 21 x 29.5 cm. (Sugar Milling Research Institute, University of Natal, King George V Avenue, Durban 4001, South Africa.) 1982.

This is the 20th report in the series of surveys of the literature on sugar and by-products utilization and demonstrates how the literature continues to expand, as represented by 3258 references (out of a total of 3395 collected). The considerable interest that continues to be shown in the utilization of by-products, including use as animal fodder, is indicated by the total of 1275 references in this section, of which 333 concern live-stock feeding. As to be expected, much of the material relates to fuel alcohol manufacture. Food and non-food uses of refined sugar are covered by 350 references, while 360 are given to the subject of sacrochemistry, although no new directions of research have appeared in this field. The chapter on nutrition and toxicology carries 274 references, while the chapter headed "Other sweeteners, natural and synthetic" is the largest in the report, with 999 references — demonstrating the continued activity to find sugar substitutes and particularly

research bearing on glucose, HFCS, lactose, mannitol, sorbitol, xylitol and fructose.

This survey is a fine example of the type of reference literature that readers can rely on, since the compiler obviously takes great pains in his work; lapses, if there are any, must be very rare.

**Fermentation ethanol: an industrial profile.** M. R. Adams and G. Flynn. 26 pp; 21 x 29.7 cm. (Tropical Products Institute, 56/62 Gray's Inn Rd., London WC1X 8LU, England.) 1982. Price: £1.25.

This work is a brief introduction to the manufacture of fermentation alcohol from various materials, including cane juice and molasses. Alcohol yields from a number of different crops are compared, world production of fermentation alcohol is surveyed, standards of purity and strength to which ethanol is manufactured are explained, and definitions given of UK grades of denatured alcohol. Non-fuel uses of ethanol are outlined, and descriptions given of the process stages in molasses fermentation and preparation of a saccharified mash from cassava prior to fermentation. The distillation process is also outlined. Separation of the fusel oil fraction and recovery of CO<sub>2</sub> are briefly described, and the problems associated with the vinasse treatment and disposal examined. The costs of plants of various capacities for production of different grades of alcohol are given (based on prices in early 1981), and requisite equipment is listed. An appendix provides background information of the type needed for a feasibility study, and the work concludes with a list of references to the literature. There are more detailed (and much more expensive) books than this dealing with alcohol fermentation or including sections on it, but for those readers who know nothing or very little on the subject and would like to find out something of what has become a major field of interest, this is a worthwhile acquisition.

**1982 Hawaiian sugar manual.** 16 pp; 15.3 x 22.7 cm. (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, HI 96701, USA.) 1982.

The publishers have done well to concentrate on the Hawaiian sugar industry and to include only a limited amount of material on US sugar supply, consumption and prices in this latest edition of the Hawaiian sugar manual, rather than expand it to include world as well as Florida, Louisiana, Texas, Puerto Rico and US beet sugar statistics. As a result of enforced economies, the volume is much slimmer than in previous years, but it is a true guide to the Hawaiian sugar industry, without all the unnecessary trimmings. Details are given of Hawaiian sugar companies and their performances in 1981, sugar production in Hawaii from 1908 to 1981, a map showing the locations of the factories, and an outline of the 1981 season, with mention of the Experiment Station and California & Hawaiian Sugar Co. activities. For readers wishing to know about the industry of the islands, this is a very useful book.

**Advanced sugar chemistry.** R. S. Shallenberger. 323 pp; 14 x 22.3 cm. (Ellis Horwood Ltd., Chichester, Sussex, England; distributed by John Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England.) 1982. Price: £31.50.

The author states, as one of several reasons for writing this book, that "many of the tenets of general stereochemistry had their origins in the recognition and solution of a problem concerning the multiple stereo-

chemical attributes of the sugars (and) their mode of development and their original purpose seems now to need to be re-emphasized". One of the aims is to provide a reference work relating to sugar stereochemical properties, although the author does admit that much of the material associated with sugar stereochemistry is "conceptual and can be difficult". The work is divided into two chapters, covering: preliminary stereochemical material; the chiral nature of the sugars; the pseudo-sugars and first simple sugars; the acyclic structure of the sugars; ring forms of the sugars; the conformational structures of the sugars; optical rotatory power, a stereochemical property; stereochemical transformations; oligosaccharides; and sweetness, a stereochemical attribute. The reference to the literature are listed at the back of the book, together with a glossary of stereochemical terms and an author and subject index. The author, who is Professor of Biochemistry at the New York State Agricultural Experiment Station of Cornell University, has obviously spared no effort in the writing of this work and in the preparation of the numerous diagrams, such as the screw patterns of polarizability of selected pyranose structures in chair conformations and the structures of the reducing and non-reducing oligosaccharides. Readers interested in the subject of stereochemistry will find this a useful publication.

**Unit operations in cane sugar production.** J. H. Payne. 203 pp; 16.5 x 24.3 cm. (Elsevier Scientific Publishing Co., P.O. Box 211, 1000 AE Amsterdam, Holland.) 1982. Price: F1.120.00

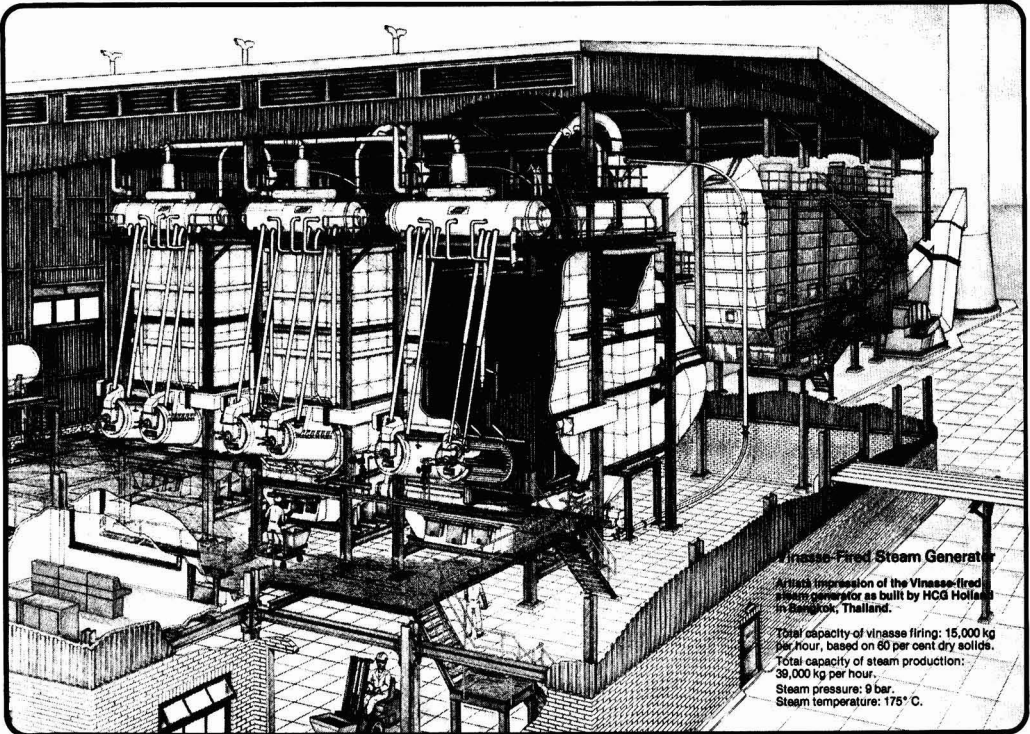
Dr. John Payne has drawn on his many years of experience in the Hawaiian sugar industry to compile a guide, in simple terms, to the unit operations employed in a cane sugar factory. He has embodied in it recommendations on procedures for attainment of optimum results, providing simple rules of thumb for assessment of those obtained and establishing targets for achievement. His basis is the type of operation found in Hawaii, which means that some aspects are not typical of world conditions, e.g. a raw material comprising two-year-old cane, rake-harvested under both wet and dry conditions. However, aside from this, the processing employed is largely common to most cane sugar countries, and so the book will be of benefit to a large number of technologists throughout the world. An extremely useful chapter is included on equipment maintenance, written in association with John W. Herkes, following the recommendations of which could save the cost of this book many times in a season. One might disagree with some of Dr. Payne's judgements but will still agree that this book is one of the really useful basic texts for the sugar technologist.

For just this reason it is a pity that the author has been ill-served by his publisher, who has presented the text in what appears to be a litho-printed reproduction of the original typescript — with all its limitations — instead of employing normal printers' typefaces which are easier to read and allow greater flexibility of headings and text division. A certain amount of editing, for instance to eliminate a confusing mixture of active and passive voices in some of the text, would have improved the book.

**Annual report 1981.** (Mauritius Sugar Industry Research Institute, Réduit, Mauritius.) 1982.

The first 53 pages of this report concern cane breeding and varieties, agronomy and plant physiology, diseases, pests, weeds, sugar manufacture and by-products. A number of fine colour photographs are included.

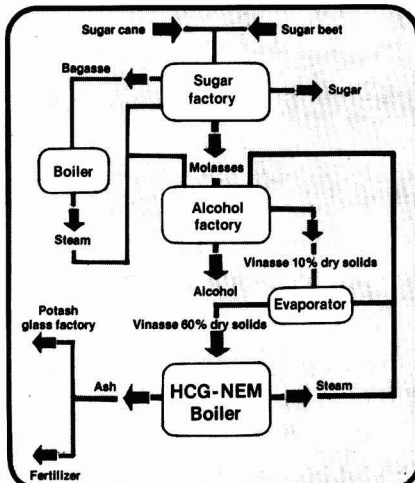
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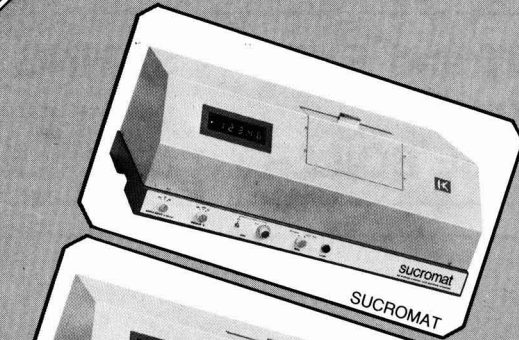
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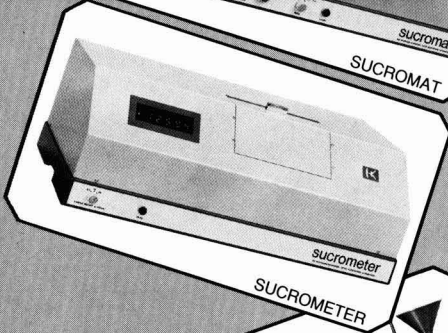
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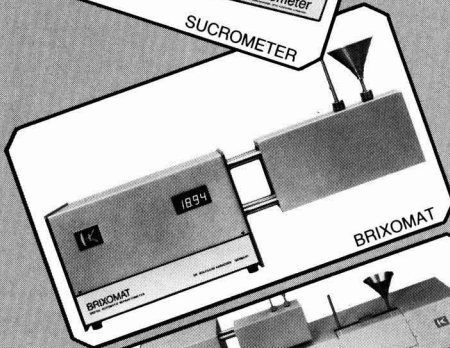
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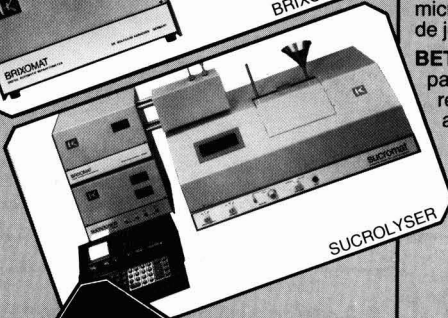
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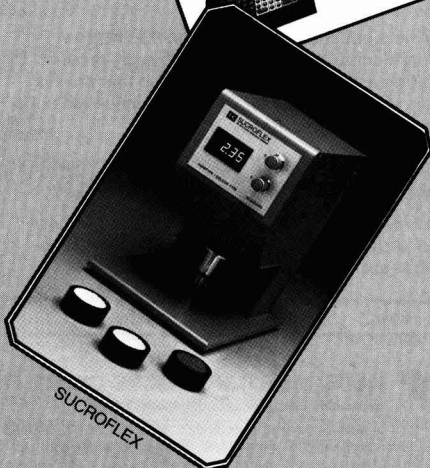
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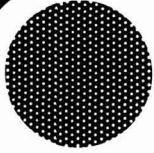
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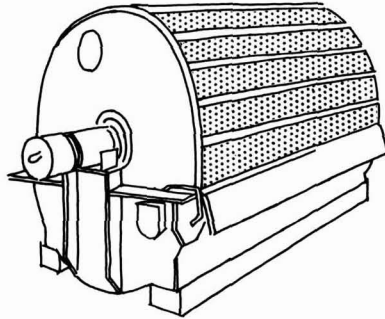


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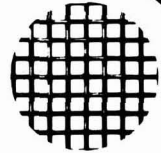
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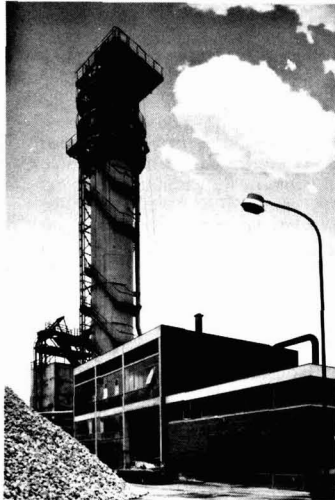


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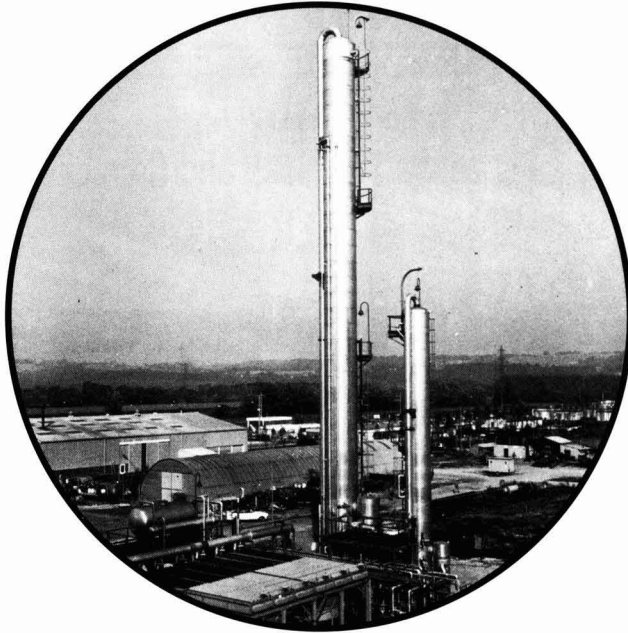
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# LABORATORY STUDIES

**The surface tension of sugar solutions.** D. E. Sinat-Radchenko. *Sakhar. Prom.*, 1982, (3), 28-31 (*Russian*). From an empirical formula for calculations of surface tension in terms of temperature and purity in the range from  $-10^{\circ}$  to  $+140^{\circ}\text{C}$ , Brix of  $0-90^{\circ}$  and purity of 55-100, a nomogram has been constructed and guidance given on its use by means of examples.

**Criteria for bone char evaluation.** C. C. Chou. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 20 pp. — Analysis of bone char for decolorizing, ash removal and buffer capacities is discussed, and disadvantages of the conventional column decolorization test listed. A batch decolorization test is described which determines the rate of adsorption, i.e. the amount of colour removed from 20 ml of  $30^{\circ}\text{Bx}$  reference liquor by 4 g of char in 1 hour, and the adsorption capacity, i.e. the amount of colour removed from 20 ml of reference liquid by 1.5 g of char in 4 hours. Test results are interpreted and compared for four situations, viz. where the batch test revealed a high adsorption rate and a low adsorptive capacity, high values for both parameters, a low adsorption rate and a high adsorptive capacity, and low values for both parameters. Advantages of the new test are presented. Details are also given of the method developed by Deitz for determination of dust attrition (DA) of granular active carbon, in which the DA is defined as the weight of dust collected on a pre-weighed glass fibre filter pad in a vibrating device operating at constant acceleration  $g$  during a given time with a known weight of carbon. The dust is transferred to the filter pad by an air stream. The two published methods for determination of the mechanical handling resistance of bone char typically give results that are either difficult to interpret or do not correlate with refinery experience; the T-bar abrasion test determines attrition provided the particle size is relatively small, but the results are also affected by particle geometry, while the ball pan hardness test applies all three forces (impact, crushing and abrasion) to the sample in a variable manner which is governed by the size, shape and density of the particles. The Deitz method is simple and relatively economical in laboratory manning.

**Phenolics in sugar products: their role in flavour and colour production.** M. A. Godshall and E. J. Roberts. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 24 pp. — The roles played by phenolic and other aromatic compounds in colour formation and production of flavour are assessed. Descriptions are given of colour-forming reactions of phenols and of means of determining phenolic compounds. Investigations to see if it was possible to remove phenolic substances and other constituents from soft sugars, using various adsorbents, are reported. While XAD-4 macroporous resin was the most efficient in removal, the less highly cross-linked XAD-2 resin was better as regards recovery and analysis of colorant and flavour. GLC analysis of a chloroform

extract of the material eluted from the resin revealed more than 100 compounds, most of them present in trace quantities. GLC-MS was used to identify 15 of the major components in the extract from a soft sugar coating syrup. The resins extracted at least 75% of the material contributing to colour and flavour.

**Colour and hydroxymethyl furfural in raw sugars.** M. A. Clarke. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 22 pp. — Changes were investigated in colour, pol, hydroxymethyl furfural (HMF) (measured spectrophotometrically) and sucrose, glucose and fructose (determined by HPLC) in raw sugars and a refined sugar stored for up to 3 years at  $100^{\circ}\text{F}$ . Results showed that colour formation occurred in the syrup layer surrounding the crystal, except in the case of a very highly coloured raw sugar, where colour within the crystal also increased. HMF does not seem to be correlated with colour formation although it may be an indicator of subsequent colour development. The fall in sucrose content was slightly less than pol loss.

**Methods of analysis and sugar processing technology.** J. F. Dowling. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 4 pp. — Descriptions are given of two areas in which automatic analysis is applied, viz. condensate sugar determination by a continuous flow analyser, and monitoring of remelt recovery operations by means of an automatic saccharimeter and a digital direct-reading refractometer; the refractometer used has given the same results as an Abbé instrument and is particularly beneficial with dark liquor.

**Kinetic and technological aspects of sucrose crystallization in supersaturated traditional molasses.** V. Maurandi and G. Mantovani. *Sucr. Belge*, 1982, 101, 85-103. Kinetic data from tests conducted on supersaturated molasses, involving the growth of single crystals, are discussed. A probabilistic method was applied to distinguishing between the effects of transport and of the surface reaction. It was found that the curves of  $v$  vs.  $C$  at constant temperature and non-sugars:water ratio (where  $v$  = growth rate and  $C$  = supersaturation) and of  $v$  vs. temperature at constant non-sugars:water and sucrose:water ratios had maxima. The value of  $W_d:W_t$  (where  $W_d$  is the resistance to the diffusion or transfer process, and  $W_t$  is the resistance to the overall crystal growth process when the surface reaction order is approx. 1) increased with temperature rise, thus confirming the validity of the laws of kinetics for both sucrose solutions and conventional molasses, i.e. the surface reaction governs crystallization rates at low temperatures, while transport determines them at higher temperatures. The surface reaction appeared to be slower with conventional molasses than with Quentin molasses because of the greater retarding effect of Na and K than of Mg and Ca, while resistance to the surface reaction increased exponentially with increase in the non-sugars concentration. The approximate activation energies of the surface reaction were of approximately the same order of magnitude as those for pure solutions, from which it may be deduced that the energy barrier does not alter significantly in the presence of molasses non-sugars, although this conclusion requires confirmation. Transport and total process energies decreased with temperature rise, as in pure solutions. Techniques used for low-grade working of Quentin molasses can be applied to traditional molasses with some modifications, allowing for the higher viscosity values of the latter molasses at the same non-sugars:water ratio (because of the very much higher saturation coefficients).

# BY-PRODUCTS

**Pulping and paper making from bagasse.** T. S. Venkataraman and P. S. Prabhu. *Maharashtra Sugar*, 1982, 7, (3), 9-12. — Bagasse composition, the technology of bagasse pulp manufacture and the manufacture of bagasse paper are briefly discussed.

**Ethanol production by *Zymomonas mobilis* CP4 from sugar cane chips.** Z. P. Shalita, M. D. White, M. Katz *et al. Biotechnology Letters*, 1981, 3, (12), 729-733; through *S.I.A.*, 1982, 44, Abs. 82-510. — Large cane chips (1-1.5 in) were fermented to ethanol by *Zymomonas mobilis* CP4. The process was carried out in two cylindrical glass fermenters of volumes 2.5 litres (laboratory scale) and 8 litres (bench scale), with circulation of the culture fluid through an external loop; this is similar to the EX-FERM system<sup>1</sup>. 89-96% of the sucrose was consumed, and ethanol yields were 90-97% of theoretical in the laboratory-scale fermenter and 83-90% in the bench-scale apparatus. By comparison, fermentation with *Saccharomyces* spp. gave 96-98% sucrose consumption, with ethanol yield only 75-79% of theoretical. The *Zymomonas* strain thus gave more efficient conversion than the *Saccharomyces* strain, at least on the laboratory scale. The results show that sucrose in agricultural-size cane chips can be fermented to ethanol.

**Agricultural use of sugar factory effluent. Study of mineral nitrogen movement in soils to which fertilizer was applied.** B. Guérin and F. Heitz. *Ind. Alim. Agric.*, 1982, 99, 133-145 (French). — Experiments were conducted on application of muddy flume-wash water from a beet sugar factory to agricultural land at a charge of 120-150 mm per campaign. Movement of the nitrogen in a thick loam soil was determined, and nitrate N leaching found to be minimum, even where the soil N content was high. Only some of the total N in the waste water proved to be available to the crop, and only over a prolonged period. On the basis of the findings, recommendations are made on application of effluent to land planted to corn.

**Single-cell protein from the thermo-tolerant fungus *Phanerochaete chrysosporium* grown in vinasse. I. Production and composition. II. Nutritive value.** M. B. Cardoso and J. R. Nicoli. *Nutr. Rep. Int.*, 1981, 24, (2), 237-248, 249-256; through *S.I.A.*, 1982, 44, Abs. 82-514. — The above fungus was grown on two samples of cane vinasse, of stated compositions, at 30° and 45°C in a batch process and at 45°C in a semi-continuous process. Biomass yields in the batch process were 15 g.litre<sup>-1</sup> in 75 hr at the lower temperature and 11.67 g.litre<sup>-1</sup> in 30 hr at the higher temperature; in the semi-continuous process the yield decreased in successive stages, to about 9% in the 5th stage. Crude protein content was 31-33% in each case. In rats, the protein efficiency ratio of the mycelia was 1.94 ± 0.20 and the apparent digestibility was 64.28 ± 2.08. Comparative values for casein were 2.46 ± 0.26 and 90.08 ± 2.29.

**The wet-air oxidation of rum distillery wastes.** R. Munoz-Candelario, M. Pedraja-Santos, A. Rodriguez-Ramirez *et al. NTSI Rep. PB80-224942*, 1979, (Feb.), 29 pp; through *S.I.A.*, 1982, 44, Abs. 82-521. — Conventional biological treatment of vinasse from rum distilleries in Puerto Rico was considered to be too expensive. The feasibility of oxidizing the vinasse by a wet-air oxidation process, with or without catalysts, was investigated. Batchwise aqueous-phase oxidation was carried out at 350-550°F and air pressures of 500-2000 lb.in<sup>-2</sup>. The maximum conversions obtained were 67.2% of BOD, 54.4% of COD, 58.8% of total organic carbon and 60.8% of total carbon.

**Enzymic hydrolysis of bagasse using a counter-current plug flow reactor.** S. Bhuwathanapurn, N. W. Dunn and P. P. Gray. *J. Ferment. Technol.*, 1981, 59, (5), 419-421; through *S.I.A.*, 1982, 44, Abs. 82-532. — A method is described which was used for the laboratory-scale simulation of counter-current hydrolysis of alkali-pretreated bagasse. Cellulase enzymes from *Trichoderma reesei* QM 9414 were used, with and without the addition of 1M urea to the liquid phase. A counter-current reactor has advantages over a stirred-tank reactor for hydrolysis at high solid:liquid ratios. In a 3-stage process, steady-state reducing sugar concentrations up to 63 mg.ml<sup>-1</sup> were attained.

**Influence of the burning of sugar cane prior to its harvesting upon the production of single-cell protein from bagasse pith.** N. I. Perotti de Galvez and O. E. Molina. *Biotechnology Letters*, 1981, 3, (12), 717-722; through *S.I.A.*, 1982, 44, Abs. 82-534. — A mixed culture of *Cellulomonas* sp. and *Bacillus subtilis* was grown on media containing 30, 40, 50 or 60 g alkali-treated bagasse pith/litre. Protein yield was higher when the pith came from unburned cane (UCP) than from burned cane (BCP). With UCP, maximum protein obtained per litre was 7.8 g, cellulolytic activity was 70% and the protein yield, calculated on hydrolysed pith, was 22%. Corresponding figures for BCP were 4.6 g, 55% and 17%. It is considered very unlikely that a chemical inhibitor is present in the BCP, because any such inhibitor would be removed by the hot alkaline pretreatment, and because extraction of the BCP with a 2:1 benzene:ethanol mixture did not affect the results.

**Treatment and agroindustrial utilization of vinasse. II. A new focus.** G. M. A. Silva. *Brasil Açuc.*, 1981, 98, 417-422 (Portuguese). — Further trials with the system described earlier<sup>2</sup> for vinasse treatment have shown that the amount of lime needed to raise the pH to 11 is not as great as indicated in laboratory experiments and that phosphate addition may be omitted, the lime being sufficient to provide good settling, which requires only 1½ hr in a Dorr clarifier, against 3 hr for juice settling. Data from application of the process in two distilleries are presented, as well as a summary of the advantages and disadvantages.

**Development of technology for improvement in the energy balance in production of ethyl alcohol from sugar cane molasses.** *Proc. 4th Int. Symposium on Alcohol Fuels Technol.* (Brazil), 1980, 119-122. — A process is described in which molasses is preclarified, fodder yeast recovered, and the spent wash treated by anaerobic digestion at 53-54°C, after which the effluent is diluted and used for irrigation of agricultural land.

<sup>1</sup> Rolz: *I.S.J.*, 1980, 82, 47-51.

<sup>2</sup> *Ibid.*, 1982, 84, 254.

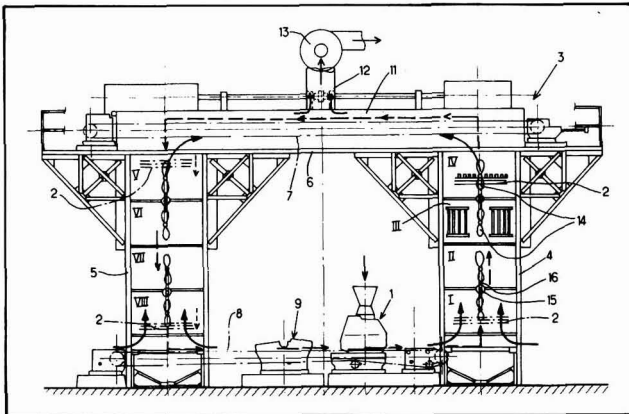
# PATENTS

## UNITED KINGDOM

**Calcium oxalate scale removal (from sugar factory evaporators).** Nissan Chemical Industries Ltd., of Tokyo, Japan. **2,011,480.** December 22, 1978; July 11, 1979; May 26, 1982. — The scale is removed by treating (at 20°-90°C) with (10-1000 parts by weight of) an aqueous solution containing Al<sup>+++</sup> and/or Fe<sup>+++</sup> ions and anions of HCl, HNO<sub>3</sub>, sulphamic, formic, acetic, propionic, oxalic, glycolic, malonic, malic, lactic, tartaric or citric acid [(0.1-40% of) Al<sup>+++</sup> ions and sulphamic, formic, acetic, glycolic or citric acid anions (in a cation: anion ratio of 3:2.5-6.0)] [made by heating Al(OH)<sub>3</sub> or metallic Al with the acid in water (and sulphamic acid added)].

**Drying tablet sugar.** Chambon Ltd., of London W.6, England. **2,012,402.** December 11, 1978; July 25, 1979; February 24, 1982.

Sugar tablets are moulded in the machine 1 and carried by horizontal plates 2 into a drying oven 3. This has a metal frame formed by two columns 4, 5 between which is an upper bridge 6. The columns 4 and 5 house, respectively, an ascending and descending bucket elevator for raising and lowering the plates 2, while the bridge 6 contains a horizontal conveyor 7 for carrying the plates 2 from column 4 to column 5. Plates carrying dried tablets are taken by conveyor 8 where the tablets are fed to a packing machine 9.

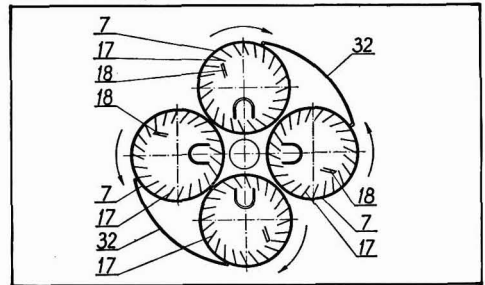


The oven 3 has a main air stream, indicated by solid arrows, equal to four times the minimum necessary to evacuate all the moisture from the sugar. This air is sucked in at the base of columns 4 and 5 and exhausts through pipe 12 which is fitted with an extractor fan 13. Each of the sections I to VIII in the columns of oven 3

is provided with a fan 14 belt-driven by a motor 15 to give a horizontal auxiliary air stream which mixes with the main air stream. Within each section is also provided a heat exchanger fed with steam under monitored control whereby the temperature and relative humidity in each section is maintained at chosen levels, permitting progressive drying of the tablets.

**Continuous centrifugal.** Biuro Projektow Przemyslu Cukrowniczego "Cukroprojekt", of Warsaw, Poland. **2,013,098.** January 22, 1979; August 8, 1979; May 6, 1982.

The centrifugal includes a central motor driven shaft which carries an upper and a lower horizontal disc. Between these are cylindrical baskets 7 mounted on bearings so that they can rotate with respect to the discs. Planetary gearing at the top of the central shaft engages with gearing on the baskets so the relative rotation takes place in addition to rotation of the whole assembly within the casing of the machine.



Masseccuite is fed into each of the baskets 7 through pipes 18 and centrifugal force causes separation of mother liquor from the crystals which are held against the perforated walls of the baskets between the vertical inclined baffles 17. As the baskets rotate, relative to the disc in the direction of the arrows, the sugar layer is carried into the region overlaid by shield 32. Here wash liquid and/or steam is applied to dilute the molasses which passes through the basket wall and is carried off separately from the main molasses flow. The washed sugar continues around, relative to the disc, and eventually is directed by centrifugal force along the baffles 17 and into the collecting channel through which it falls to be discharged from the centrifugal. If required, a vertical screw conveyor, linked by planetary gearing to the central shaft can be provided within each channel to remove the centrifuged and washed sugar.

**Treatment of cane juice.** J. A. Casey and I. E. Rojas. **2,013,645.** January 25, 1979; August 15, 1979; October 20, 1982. See US Patent 4,135,946<sup>1</sup>.

**Alcohol fermentation of molasses.** Alfa-Laval AB., of Tumba, Sweden. **2,013,716.** January 8, 1979; August 15, 1979; March 3, 1982. — Fermentation of carbohydrates to alcohol is inhibited by increasing concentration of the product. To overcome this, fermentation liquor is

<sup>1</sup> I.S.J., 1981, 83, 219.

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).



## Patents

maintained at an ethanol concentration no greater than 5% in a continuous fermenter, and a flow of such liquor is withdrawn and passed to a centrifugal separator which produces a yeast concentrate flow, a yeast-free flow and an impurity sludge flow. The last is discarded and at least part of the first is recycled to the fermenter. The yeast-free flow is distilled or extracted, at atmospheric pressure, to provide an alcohol-rich flow and a residual flow which is pasteurized at 60°-100°C before being recycled to the fermenter.

**Purification of sugar liquor by electrodialysis.** Syndicat National des Fabricants de Sucre de France. **2,014,188.** February 7, 1979; August 22, 1979. — Second stage sugar liquor of about 70 purity is brought to about 40°C and diluted to 30% solids content. It is passed through an anion exchanger to substitute low molecular weight anions (Cl<sup>-</sup>) for higher molecular weight anions, and the treated liquor is then subjected to electrodialysis in a multi-cell apparatus in which the alternate cells contain a diluted molasses of such a concentration as to bring its conductivity to the same order of magnitude as the sugar liquor. The impurities content of the liquor is thereby reduced (e.g. by nearly 20%, including a 40% reduction in the K<sup>+</sup> content). The anion exchanger may be regenerated by passage of the diluted molasses after use.

**Beet diffuser.** G. V. Genie, of Chaumont-Gistoux, Belgium. **2,015,893.** January 23, 1979; September 19, 1979; September 8, 1982. — See Genie: *I.S.J.*, 1981, **83**, 231-234.

**Continuous centrifugal.** Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **2,017,516.** January 25, 1979; October 10, 1979; March 17, 1982. See US Patent 4,205,999<sup>1</sup>.

**Process for obtaining glucose from cellulosic material (bagasse).** Purdue Research Foundation, of Lafayette, IN, USA. **2,017,707.** February 28, 1979; October 10, 1979. — Hemicellulose is removed from cellulosic material (e.g. bagasse) (by extraction with a dilute acid or alkali) and the residue extracted with a solvent (Cadoxen — 25-30% ethylene diamine and 4.5-7% Cd as its oxide or hydroxide, in water) which dissolves the cellulose content but not the lignin, which is separated. The cellulose may be precipitated from the extract and hydrolysed by an acid or enzyme (an endo-1,4-beta-glucanase, a *Trichoderma viride* cellulase) to give glucose in high yield. Alternatively the cellulose recovery stage may be omitted and the glucose produced direct from the solution in Cadoxen.

**Bagasse cellulose recovery and hydrolysis.** Purdue Research Foundation, of West Lafayette, IN, USA. **2,018,777.** February 28, 1979; October 24, 1979. Cellulose is extracted from waste materials, e.g. bagasse, by treatment with a solvent (in liquid or solid form) comprising (a solution in water of) a metal chelating agent (17% Na tartrate), a metal compound (6.6% FeCl<sub>3</sub>), a caustic swelling agent (7-8% NaOH) and an oxygen-scavenging stabilizing agent (6.2% Na<sub>2</sub>SO<sub>3</sub>). The solvent may be precipitated in solid form from the aqueous solution by addition of an organic solvent (0.25-1 volume of methanol). After extraction of the cellulose by contact of the waste material with the solvent, it is recovered by precipitation (by addition of water) and the solvent recovered and concentrated for

reuse. The cellulose may then be hydrolysed by acid or enzymatically to yield glucose; alternatively the hydrolysis may be carried out directly without isolation of the cellulose from the solvent.

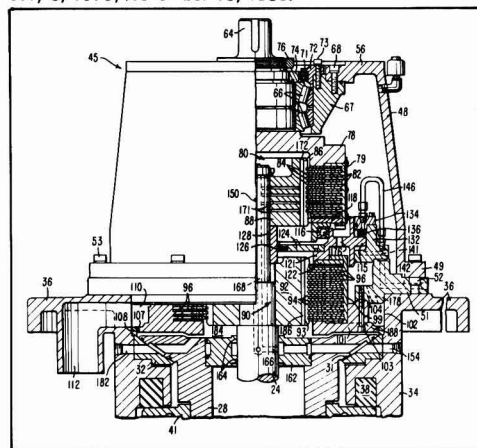
**Separation and analysis of a mixture of sugars.** Cenco Instrumenten B.V., of Breda, Holland. **2,019,564.** April 6, 1979; October 31, 1979; October 27, 1982. The mixture of sugars is mixed with at least one buffer and reagent, the latter an alkylene polyamine having at least two adjacent amino groups (ethylene diamine); this new mixture is passed through a separating column, held at a temperature below a selected maximum (i.e. at 20°-80°C) whereby premature reaction between the saccharides and reagent is avoided, hydrolysing any oligosaccharides present to monosaccharides, and raising the temperature of the separated fractions to 120°-180°C for reaction and detecting the reaction products (e.g. by photometric means).

## UNITED STATES

**Bagasse pith separation.** E. J. Villavicencio, of Mexico City, Mexico, *assr.* Process Evaluation & Development Co. **4,231,136.** August 28, 1978; November 4, 1980. Bagasse is fed to an upper depithing mill comprising a set of hammers rotating about a vertical shaft and surrounded by a screen within a housing. The fibrous part is held within the screen and tends to a vertical alignment, while part of the pith is driven through the screen perforations. The partly depithed fibre falls into a circular duct and is fed to the upper part of a second depithing unit, maintaining the alignment of the fibres. A liquid may be applied to the fibrous fraction before it enters the second unit, where pith removal is enhanced.

**Beet harvester.** C. J. Stekete, of Driewegen, Holland, *assr.* Vandenende B.V. **4,232,743.** February 8, 1979; November 11, 1980.

**Centrifugal drive system.** H. W. Cory, of Fairfield, Ohio, USA, *assr.* Force Control Industries Inc. **4,234,123.** July 5, 1979; November 18, 1980.



An electric motor drives the shaft 64 which, through the clutch-brake mechanism 45, drives the lower shaft 24 to which the basket is connected. Shaft 24 is supported by bearings inside tube 28 which has an outwardly-projecting, partly spherical surface 31 supp-

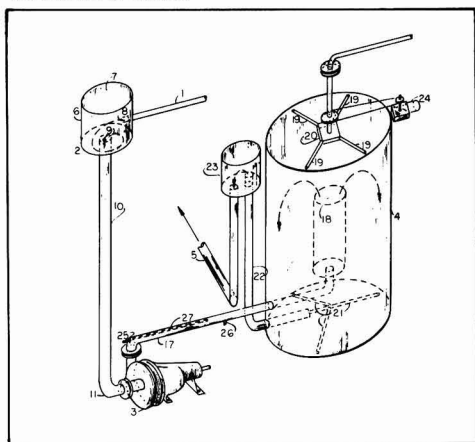
<sup>1</sup> *I.S.J.*, 1981, **83**, 221.

orted on the corresponding surface 32 of the bronze bearing ring which is connected to the frame. This permits gyration of shaft 24 about the pivoting centre 150.

Above and below point 150 is the clutch assembly 80 which includes annular plates 82 with notches which receive the lugs 79 suspended from the lower flange portion 78 attached to shaft 64. Annular clutch discs 84 interleaved between plates 82 are keyed to an annular hub 88 fastened to shaft 24. Beneath the clutch is a brake assembly with similar discs and plates, the former fastened to the shaft and the latter to the frame of the machine. By admission of hydraulic fluid to suitable pipes (only one, 142, is shown), the piston 115 is moved up against springs 136, when the clutch is engaged by pressure of the bottom clutch plate 118, attached to the piston, which closes up the stack of plates and discs. When piston 115 moves down, the brake pressure plate 122 is forced down, compressing the lower stack.

**Purification of evaporated sugar solutions.** N. L. C. Suzor, of Paauhau, HI, USA, *assr.* Davies Hamakua Sugar Co. (A) 4,234,349. April 16, 1979; November 18, 1980. (B) 4,234,350. May 7, 1979; November 18, 1980.

(A) Evaporator syrup entering cylindrical tank 6 tangentially through inlet port 8 is directed along the wall and forms a funnel which entrains ambient air at its apex. The entrained air forms large bubbles in the flow of syrup in the pipe 10 leading from tank exit port 9. The dimensions of pipe 10 are chosen to provide the mechanical agitator-mixer 3 with a suction static head slightly greater than the vapour pressure of the syrup, i.e. about 5 p.s.i., as well as to provide a Reynolds number of 600 – 1000 so as to maintain laminar flow. The mixer 3 is preferably a semi-open 3500 r.p.m. impeller-type centrifugal pump having straight radial blades attached to an impeller disc with a nominal clearance of about 1/4-inch between the blade edge and housing. This produces a vortex at the centre of the impeller and results in conversion of the syrup-air feed into a creamy liquor having minute non-sugar particles clinging to the surface of micron-size bubbles dispersed in the syrup. This creamy liquor is piped to the discharge point 18 within clarifier 4 somewhat below the bottom of tank 6.



Pipe 18 is sized so that the discharge rate is  $< 2 \text{ gal. min}^{-1} \cdot \text{ft}^{-2}$  (preferably  $0.5 - 1 \text{ gal. min}^{-1} \cdot \text{ft}^{-2}$ ) to avoid circulation currents. The top of discharge 18 is at least 6 inches below the scum removal pipes 19 which

collect scum and deliver it to central box 20 from which it is pumped away. The creamy liquor separates into a low-density scum, which floats upwards, and a clarified syrup which is withdrawn from clarifier 4 through pipes 21, 22 and passes over weir 23 into pipe 5 which delivers to the vacuum pan supply tank. A steam inlet 25 is provided in pipe 17 and controlled by thermostat to maintain syrup temperature at the desired level (between  $160^\circ$  and  $190^\circ \text{F}$ ) in clarifier 4. An inlet 26 is also provided for the injection of a flocculant.

(B) The clarification is achieved as above using a controlled addition of an anionic partially-hydrolysed polyacrylamide and maintaining a 6 – 12 inch layer of aggregated non-sugar particles and bubbles above the clarified syrup.

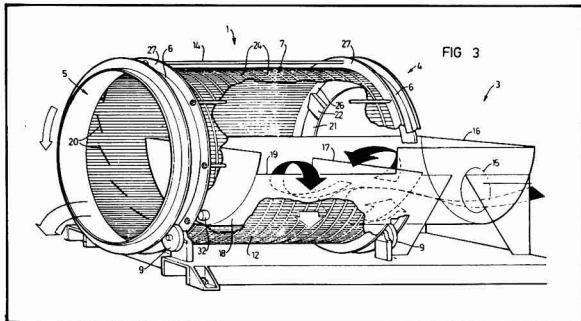
**Animal feed block.** K. L. Linehan, of East Burwood, Australia, *assr.* ICI Australia Ltd. 4,234,608. October 16, 1978; November 18, 1980. – (5-15% on total ingredients of) An aqueous medium (glucose, fructose, sucrose or molasses solution) at  $20 - 90^\circ \text{C}$  ( $> 40^\circ \text{C}$ ,  $55 - 80^\circ \text{C}$ ) is treated with 5-30% (5-15%) on total ingredients of active MgO and 3-50% (3-35%) of dicalcium phosphate, and the mixture blended [for 15-360 (15-120) min] at a temperature  $> 90^\circ \text{C}$  ( $45 - 80^\circ \text{C}$ ) to give a uniform mixture. Further ingredients (nutrients, vitamins, trace elements, additional Mg and/or Ca and/or phosphate sources, NaCl, traces of S, animal medicaments or pest treatments) or (1-10%) water may be added and the mixture fed into a moulding block where it is reacted at  $45 - 110^\circ \text{C}$  to give a substantially rigid alkaline block. The block composition is 30-70% (30-60%) molasses, 5-15% MgO, 3-15% dicalcium phosphate, 0-10% NaCl, 5-40% (0-10%) feed meal or urea or mixtures, 0-10% water and 0-1% trace elements and vitamins (and 25-45% dicalcium phosphate equivalent in the form of additional phosphate sources).

**Starch degradation by enzymes.** J. J. Marshall, of Miami, FL, USA, *assr.* Lifeline Products Inc. 4,234,686. June 7, 1979; November 18, 1980. – Starch, solubilized (by acid and/or enzyme treatment) and in a solution of pH 1.5-8.5, is brought into contact with (5 I.U. of activity per ml of reaction mixture of) a group of enzymes prepared by culturing *Cladosporium resinae* (ATCC No. 20495) (an  $\alpha$ -pullulanase, an  $\alpha$ -amylase and glucoamylase S) at  $30 - 70^\circ \text{C}$  (for about 20 min) whereby the starch is completely converted to glucose which is recovered (after enzyme deactivation, decolorization, crystallization and removal of crystallized enzymes). When glucose isomerase is incorporated in the enzyme mixture, fructose may be produced from the starch.

**Saccharification of cellulose.** M. Pilipski, of Clifton, NJ, USA, *assr.* M. F. Sturman and M. Ebert. 4,235,968. August 24, 1978; November 25, 1980. – Cellulose (e.g. bagasse) is steeped in a caustic (NaOH, KOH) solution to swell its cellular structure so as to render it more reactive and to solubilize the lignins and other compounds present. The solubilized lignins are washed away with a solvent and the prepared cellulose subjected to viscose processing (with  $\text{CS}_2$ ) to give a viscous solution of Na cellulose xanthate in aqueous NaOH, the aqueous phase removed to give a viscose residue intermediate which is hydrolysed by immersion in a bath of anhydrous liquid HCl (in a pressure chamber at low temperature to prevent boiling of the HCl) to yield usable glucose which may then be fermented to produce alcohol.

**Separation of solids from liquids by screening.** G. Burgess and E. W. Pitches, *assrs.* Contra-Shear Holdings Ltd., of Auckland, New Zealand. **4,236,999.** November 27, 1978; December 2, 1980.

The screen, for the separation of solids from liquids (effluents, juice, etc.), comprises a drum 1 which rotates about its horizontal axis and is supported by trunnion wheels 9 located in the circular channels 6. (The drive mechanism is not shown.) The wall 7 of the drum is formed by parallel spaced wires 12, preferably of the wedge wire type, attached at each end to the circular flanges 26 attached to the channels 6. The drum is held together by tie rods 14 connecting the inner flanges 27 of the channels 6.



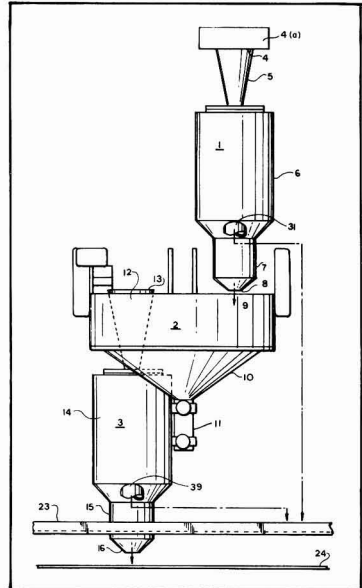
The feed suspension is introduced by a pipe 15 into a surge tank 16 from which it flows over a first weir 17 into a semi-circular reservoir 18 which extends into the drum for about two-thirds of the drum length. From the reservoir the suspension flows over a second weir 19 to fall onto the inner surface of the drum just below its mid-height and at an angle less than  $90^\circ$  to it and preferably tangentially. This produces a shearing action on the suspension which effectively separates the solids from the liquid which drains through the spaces between the wires. The solids would move down the inner surface under gravity and by the washing action of fresh suspension if the screen were stationary. The drum rotates counter to the feed, however, providing a tumbling action, and the solids are carried by diverter blades 20 towards the discharge end 5 of the drum.

**Glucose isomerase purification.** D. M. Jackson and Y. Tsuda, *assrs.* UOP Inc., of Des Plaines, IL, USA. **4,237,231.** November 13, 1979; December 2, 1980. An enzyme solution (at  $0-20^\circ\text{C}$ ) is brought to pH 3.5-5.0 with an acid [hydrochloric, citric, acetic, propionic, butyric and/or organic sulphonic acids (acetic acid)] and the proteinaceous solids collected and extracted with a [phosphate, imidazole or tris-(hydroxymethylamino)-methane] buffer solution (containing  $10^{-4}-10^{-2}\text{M}$  Co and/or  $10^{-3}-10^{-1}\text{M}$  Mg) at pH 6-8. Sufficient of a salt  $[(\text{NH}_4)_2\text{SO}_4]$ , an alkali metal sulphate or an alkaline earth sulphate is dissolved in the extract to provide 40-50% saturation and the solution separated from any solids, further salt added to give 41-60% saturation and the solids (containing purified enzyme) collected.

**Bagasse pith removal.** E. J. Villavicencio, of San Angel, Mexico, *assr.* Process Evaluation & Development Corp. **4,237,582.** August 28, 1978; December 9, 1980.

Bagasse is fed into the inlet 4 of an upper depither by way of a pin feeder 4a which meters the feed at a controlled rate. The bagasse is partially separated in depither

1, giving a pith fraction which passes out through discharge 31 and is delivered to a conveyor 23. The fibre fraction falls down into the chute 7 and from its outlet 8 into the inlet 9 of a fibre washer 2. This is a U-shaped trough having the inlet 9 at one end of the U. A series of rollers along the length of the U carry tines which engage with the fibres and repeatedly immerse them in the wash liquid whereby residual sugar, loosely-clinging pith, dirt, etc. is removed.



The fibres are drained at the exit end 12 of the washer and fall by gravity into the inlet 13 of a lower depither 3. Further pith is removed in the depithing chamber 14 and is separated through outlet 39 to fall onto conveyor 23, while the fibres fall into chute 15 and through outlet 16 onto the conveyor 24 which takes it to a digester for pulp manufacture. The linked structure of the two depithers and washer mean that the flow of material is governed by the single pin feeder 4a instead of separate feeders being required for each stage of treatment.

**Sugars separation.** H. Tu and J. E. Rojo, *assrs.* UOP Inc., of Des Plaines, IL, USA. **4,238,243.** May 29, 1979; December 9, 1980. — Components of an aqueous solution of a mixture (of sugars, of glucose and fructose) are separated by bringing it into contact with an adsorbent comprising a crystalline aluminosilicate (an X- or Y-zeolite) having an adsorptive selectivity towards one component which is adsorbed and later recovered by desorption with water. The silicon content of the adsorbent tends to dissolve in the solution, resulting in disintegration of the crystal matrix and, to prevent this, the adsorbent is pretreated by impregnation with [0.01-0.5% (0.05-0.2%) w/w of]  $\text{Al}^{+++}$  cations (as an aqueous solution of an Al halide), effecting a chemical reaction whereby dissolution of the silicon is substantially reduced.

**Sugar cane ripeners.** S. R. Siemer, of Fresno, CA, USA, *assr.* W. R. Grace & Co. **4,239,526.** September 4, 1979; December 16, 1980. — Ripening of cane plants is modified so as to increase their yield of sugar by application, 2-10 weeks before harvest, of a substituted urea which is

a member of a wide group, individually claimed and including aliphatic, aromatic and heterocyclic substituents.

**Preparation of low-viscosity polyether polyols.** W. C. Bedoit, of Louisville, KY, USA. **4,239,907.** January 15, 1979; December 16, 1980. — The polyether polyols (used in the preparation of rigid polyurethane foams) are prepared by reacting (over 2-7 hours) a polyhydric water-soluble initiator [sucrose (as a 50-86% w/w aqueous solution)] with (0.4-0.6 equivalents per OH equivalent of) ethylene oxide and (then with) (2.0-3.0 equivalents per OH equivalent of) an alkylene oxide (propylene oxide, butylene oxide, a halogenated alkylene oxide) in the presence of ammonia or an alkanolamine (diethanolamine) or alkylene diamine (ethylene diamine, 1,3-propane diamine) in the presence of water, at a temperature  $\geq 110^{\circ}\text{C}$  ( $60-110^{\circ}\text{C}$ ) in the absence of an added alkoxylation catalyst (in a reactor at a pressure of  $1.0-6.6\text{ kg.cm}^{-2}$ ).

**Bagasse treatment for the production of oil binders.** K. O. P. Fischer, of Chilliwack, B.C., Canada. **4,240,800.** October 23, 1978; December 23, 1980. — Bagasse, lixiviated to remove any sugar content and dried to 2-3% moisture content, is used as an absorbent for oil and is able to take up 15-20 times its own weight of oil. When screened to obtain fibres of 2-3 mm, this fraction can take up 20-27 times its own weight. The dust fraction, having a size of approximately 5 microns, can take up as much as 16 times its own weight of oil.

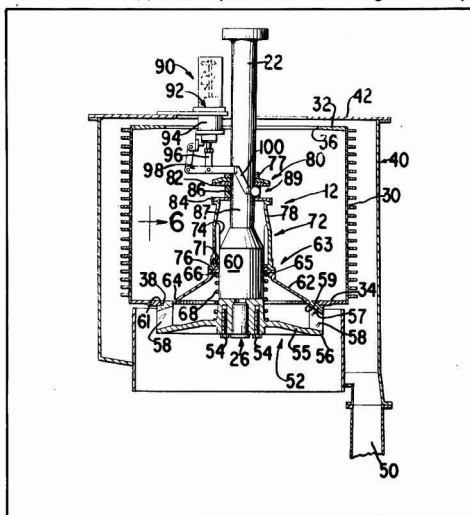
**Animal fodder from beet pulp.** S. A. Farrag, J. E. Hayes and L. W. Norman, *assrs.* U & I Inc., of Salt Lake City, Utah, USA. **4,241,093.** May 11, 1978; December 23, 1980. — Beet pulp is bleached with (0.5-50% w/w)  $\text{H}_2\text{O}_2$ , an alkali metal peroxide, ammonium persulphate,  $\text{SO}_2$ ,  $\text{NaHSO}_3$ ,  $\text{NaClO}_2$ ,  $\text{NaOCl}$ ,  $\text{Cl}_2$  and/or  $\text{ClO}_2$  (at  $20-90^{\circ}\text{C}$ ), separated (pressed) and dried to 4-8% water. The pulp contains 7-9% crude protein, 15-25% crude fibre, 60-70% N-free extracts and 2.5-5% ash, and can be used as a filler, extender or protein binder.

**Stabilizing  $\alpha$ -galactosidase.** B. M. Stein and J. C. Linden, *assrs.* Great Western Sugar Co., of Denver, CO, USA. **4,241,185.** February 23, 1979; December 23, 1980. The activity of mycelial bound  $\alpha$ -galactosidase (a suspension of *Mortierella vinacea* ATCC No. 20034) (used for hydrolysis of raffinose in beet molasses to sucrose and galactose, so increasing recovery) is stabilized by treating with [1-10% of an active site protection agent (galactose, sucrose, melibiose, fructose, glucose or raffinose) on dry weight of enzyme and] 5-25% (7.5-15%) of glutaraldehyde on enzyme dry weight, maintaining at pH 6.5-8.5 and mixing with minimal oxygen inclusion during 0.25-2 hr (0.5-1.5 hr).

**Simultaneous production of fructose and gluconic acid from glucose-fructose mixtures.** H. R. Müller, W. Kündig and A. Hedinger, *assrs.* Merck Patent GmbH, of Darmstadt, Germany. **4,242,145.** February 21, 1979; December 30, 1980. — The glucose content of a mixture with fructose (invert sugar, an isomerized glucose product) is selectively oxidized at pH 8-10 (pH 9-10) [and  $10-50^{\circ}\text{C}$  ( $25-40^{\circ}\text{C}$ )] with oxygen (as oxygen gas, air, or a mixture of these), activated by a noble metal (Pd) catalyst, terminating the reaction on formation of one equivalent per mole of glucose of total carboxylic acid plus carboxylate ion. The gluconic acid is extracted, in the form of its Na salt, by extraction with methyl alcohol.

**Centrifugal basket valve mechanism.** F. H. Wessel, M. F. Kluesener, D. L. Hurley and J. B. Bange, *assrs.* The Western States Machine Co., of Hamilton, OH, USA. **4,244,823.** August 17, 1978; January 13, 1981.

The shaft 22 of the batch centrifugal has an upper portion 87 of smaller diameter and a lower portion 60 with a larger diameter. To the end 26 of shaft 22 is fastened by bolts 54 a flange 55 at the periphery 56 of which are a series of vertical struts 58 supporting a ring 57. This ring is rebated to match the surface 38 of an aperture in the bottom ring 34 of the centrifugal basket which is thus supported by the shaft and flange assembly.



The basket valve 62 has a frusto-conical surface with a central bearing portion 65 which can slide up and down the wide portion 60 of the shaft 22 but is held upwards in the closed position for the valve by the spring 68 between it and flange 55. Above the valve is the sleeve section 72 having a frusto-conical section 78 secured by suitable means to the valve 62 and carrying flanges 84 and 82, connected by a short tubular section 86 to form an open annular channel 89. The inner diameters of the flanges and section 86 are a sliding fit around shaft portion 87 so that the sleeve section 72 can slide up and down shaft 22; internal ribs 74 ensure that the sleeve motion is axial about shaft portion 60 while a stop 71 in the latter ensures that the ribs, sleeve and valve rotate with the shaft. When the sugar in the basket is to be discharged, the valve actuating mechanism 90 is operated and the fingers on arms 100, located in channel 89, cause the flange 84 and so the rest of the valve mechanism to move down, compressing spring 68 and permitting sugar to pass downwards and outwards through the spaces between struts 58. When discharging is complete, the hydraulic cylinder raises the fingers in channel 89 and the spring 68 closes the valve again.

**Fertilizer production.** A. O. Wahlberg, of Turku, Finland, *assr.* Arex Oy. **4,246,018.** April 4, 1979; January 20, 1981. — A mixture of molasses and comminuted tree bark is subjected to heating under pressure at  $75^{\circ}-140^{\circ}\text{C}$  ( $120^{\circ}-130^{\circ}\text{C}$ ) for 10-120 min (10-20 min), the molasses having previously been treated with 400 g yeast per  $\text{m}^3$  and heated at  $30^{\circ}-40^{\circ}\text{C}$  (for 35-45 hr) until the pH is reduced to 3-4.

# BREVITIES

**New Kenya sugar factories<sup>1</sup>.** — The Kenya government is to spend 267 million shillings (\$24 million) on construction of the Kisiri Sugar Company's white sugar factory. The West German and Dutch governments will also be providing finance. Construction is planned to start of a 91.8 million shillings (\$8.2 million) white sugar factory at Nyauu, Nyanza province. The plant will be operated by Opapo Sugar Mills and will have an initial output capacity of 650 tonnes per day.

**Thailand sugar marketing<sup>2</sup>.** — A group of sugar factory owners, producing some 40% of Thai sugar output, who had previously refused to participate in a newly-established marketing company styled Thai Cane and Sugar Corporation Ltd., have now agreed to take up their share of the equity. The Ministry of Industry, the sugar producers and cane planters will have equal interests in the company which has been established to handle advance export sales of 600,000 tons of sugar per year for the next five years. Eight commercial banks have agreed in principle to extend credit facilities to the company to the extent of 1800 million Baht (48.4 million).

**Sugar expansion in China<sup>3</sup>.** — The Chinese sixth five-year plan was released on December 12, 1982. The 400 projects to be completed and put into operation in the plan period include new sugar factories with an annual sugar production capacity of 500,000 tonnes and, in addition, the capacity of the existing sugar factories will be increased by 1.48 million tonnes.

**US beet sugar production decline<sup>4</sup>.** — The US Dept. of Agriculture estimates beet sugar production in the 1982/83 campaign at about 2,800,000 short tons, raw value, compared with 3,290,000 tons in 1981/82. Total sugar beet tonnage is estimated at about 22,000,000 tons, produced at an average yield of 20.8 tons per acre on 1,064,800 acres. State by state yield and area estimates by McKeany-Flavel Co. Inc. indicate a total crop of 2,652,500 short tons, white value, or 2,838,175 tons, raw value, from a total slice of 21,712,000 tons.

**Yugoslavia beet area 1983<sup>5</sup>.** — In 1983 186,000 hectares are to be sown to sugar beet, according to official sources. This would be 50,000 hectares more than in 1982.

**Cane diffusion at Fairymead<sup>6</sup>.** — The Fairymead sugar factory at Bundaberg, Queensland, Australia, has operated since 1965 with a diffuser in conjunction with a milling tandem. Now a second diffuser unit has been installed and the diffusion system, of 150 t.c.h. capacity, is independent of the tandem which is of 350 t.c.h. capacity. Bagasse from the diffuser is sent to a roller-type dewatering unit before going to the boiler or bagasse store.

**New Nicaragua sugar factory<sup>7</sup>.** — Nicaragua is currently building a \$250 million sugar factory at Molocotoya, with assistance from West and East Europe. When operational in 1984 it will produce 110,000 tonnes of sugar a year for export. Nicaragua's main sugar outlet was formerly the United States but, with the reduction of its export quota to 58,800 short tons, it is now finding important buyers such as Mexico, the USSR, Iran, Bulgaria and Venezuela. The output of the Molocotoya project is reported to be contracted for sale up to the end of 1987.

**Bangladesh gur industry expansion<sup>8</sup>.** — India has won a \$10 million turnkey contract to build 14 small open pan sugar mills in Bangladesh. Each will have a crushing capacity of 200 t.c.d.

**Guyana sugar production 1982<sup>9</sup>.** — The autumn crop in Guyana was the largest since 1976 and reached 200,870 long tons, bringing production for the year to 287,725 tons of sugar to surpass the revised target of 280,000 tons. As a consequence, exports were 255,000 tons, of which more than 170,000 tons went to the EEC, 51,000 tons to the US, 24,000 tons to Canada and 125 to other Caricom countries.

## Brazil sugar exports 1982

	1982	1981	1980
	tonnes, raw value		
Algeria	200,630	212,215	129,695
Chile	72,968	8,120	48,376
China	146,938	12,883	0
Costa Rica	12,965	0	0
Egypt	364,849	198,838	146,523
Finland	56,600	0	0
Haiti	5,954	0	5,311
India	0	25,008	180,272
Indonesia	0	224,228	0
Iran	331,262	43,305	104,364
Iraq	169,479	117,220	181,484
Jamaica	46,618	8,120	0
Japan	17,850	0	0
Jordan	78,566	11,909	19,152
Kenya	35,685	0	0
Korea, South	14,250	0	0
Madagascar	8,877	0	0
Malaysia	0	0	10,160
Mexico	182,440	50,342	67,212
Morocco	68,000	37,600	116,000
Nigeria	14,020	10,435	27,639
Pakistan	0	0	86,999
Portugal	14,000	25,200	0
Saudi Arabia	92,130	37,675	0
Senegal	5,400	0	0
Somalia	5,402	0	0
Sri Lanka	0	0	61,176
Sudan	49,700	13,545	43,290
Sweden	10,450	0	0
Syria	14,290	36,710	13,598
Trinidad	6,539	0	0
Tunisia	49,340	0	24,292
Turkey	0	12,937	24,117
USA	285,552	945,894	805,942
USSR	354,520	366,438	501,791
Venezuela	362,199	271,373	15,470
Yugoslavia	10,610	0	0
Other countries	162	54	0
	<u>2,788,245</u>	<u>2,670,049</u>	<u>2,661,913</u>

**Mauritius sugar production 1982<sup>10</sup>.** — The 1982 cane harvest in Mauritius began on May 26 and ended on December 20. The 21 sugar factories crushed 6,581,862 tonnes of cane to yield 687,940 tonnes of sugar, tel quel, equivalent to 728,597 tonnes, raw value. This compares with 574,525 tonnes, tel quel (609,744 tonnes, raw value) produced in 1981. The cane crop harvested was the highest recorded in Mauritius and the average cane yield per hectare, at 82.4 tonnes, was also a record, comparing with the previous highest yields of 79.1 tonnes in 1976 and 1979. Unfortunately, sugar extraction, at 10.45% cane, is the lowest registered in the last 50 years (excluding 1960 and 1980 which were affected by major cyclonic disturbances). This poor performance is mainly attributable to excessive rainfall during the ripening season.

**Australian sugar exports 1982<sup>11</sup>.** — Australia's sugar exports fell 16% in 1982 from 1981 as new import quotas on sugar in the US cut shipments to that destination. A total of 2,504 million tonnes of sugar was exported, down from 2.98 million in 1981, while exports to the United States plunged to 129,547 tonnes from more than 811,000 tonnes in 1981, a reduction of 84%. Australia will be limited to sales of 232,400 tonnes for the US 1982/83 fiscal year (October/September) under the quota system. Countering the loss of the US market was the sale of 209,100 tonnes of sugar to the USSR, the first significant purchase by the Soviet Union since 1974. Japan was the major buyer of Australian sugar in 1982, taking 555,000 tonnes, down from 597,200 tonnes in 1981.

<sup>1</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 34-35.

<sup>2</sup> *Standard Chartered Review*, December 1982, 32.

<sup>3</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 37-38.

<sup>4</sup> *Sweetener News (McKeany-Flavel Co.)*, December 20, 1982.

<sup>5</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 52.

<sup>6</sup> *Australian Sugar J.*, 1982, 74, 447.

<sup>7</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 54.

<sup>8</sup> *Reuter Sugar Newsletter*, December 13, 1982.

<sup>9</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 54.

<sup>10</sup> *Mauritius Sugar News Bull.*, 1982, (12).

<sup>11</sup> F. O. Licht, *International Sugar Rpt.*, 1983, 115, 77.

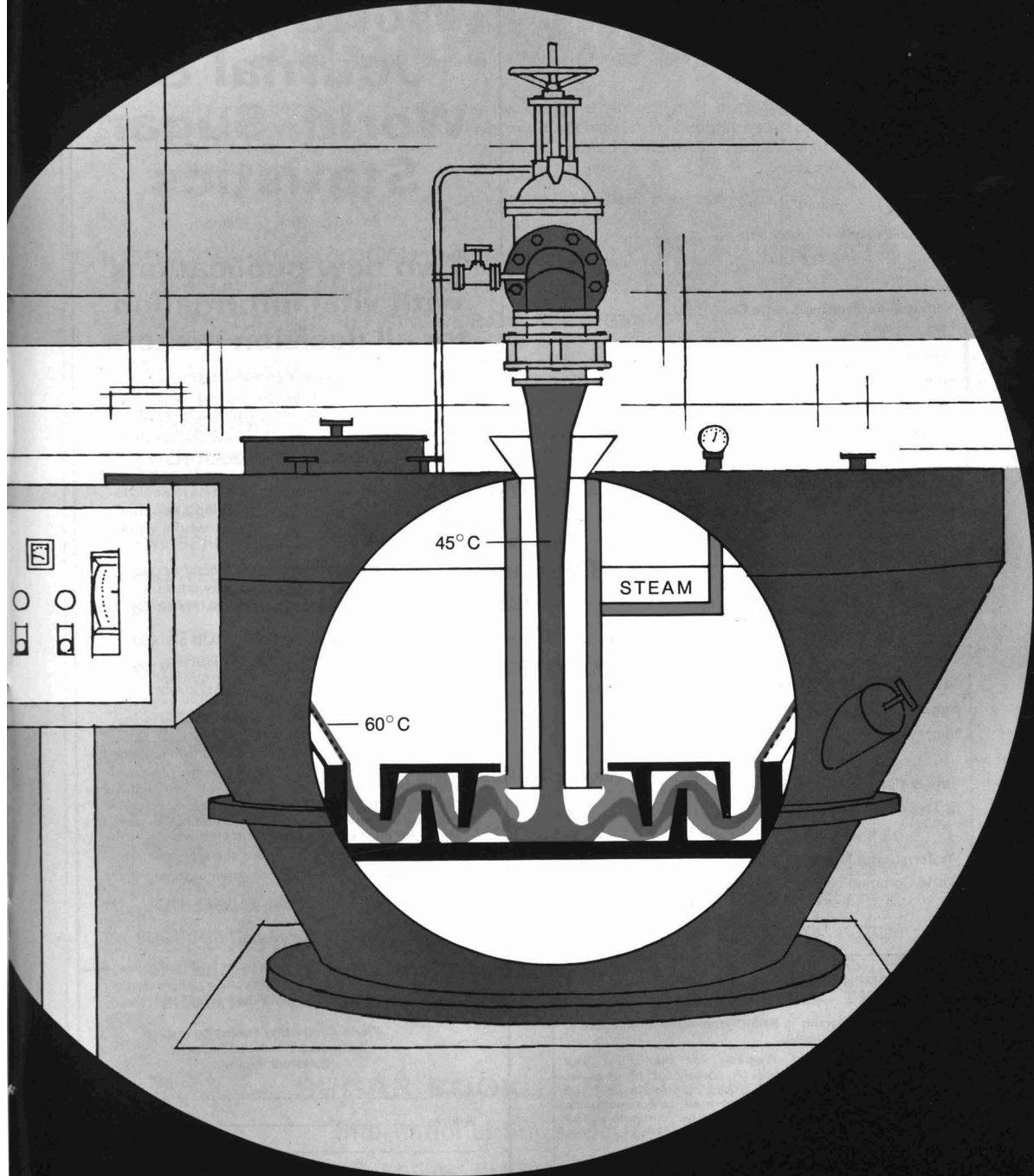


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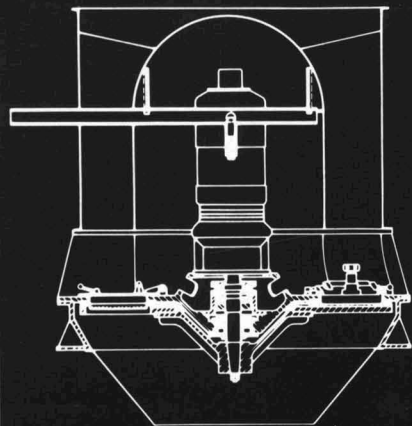
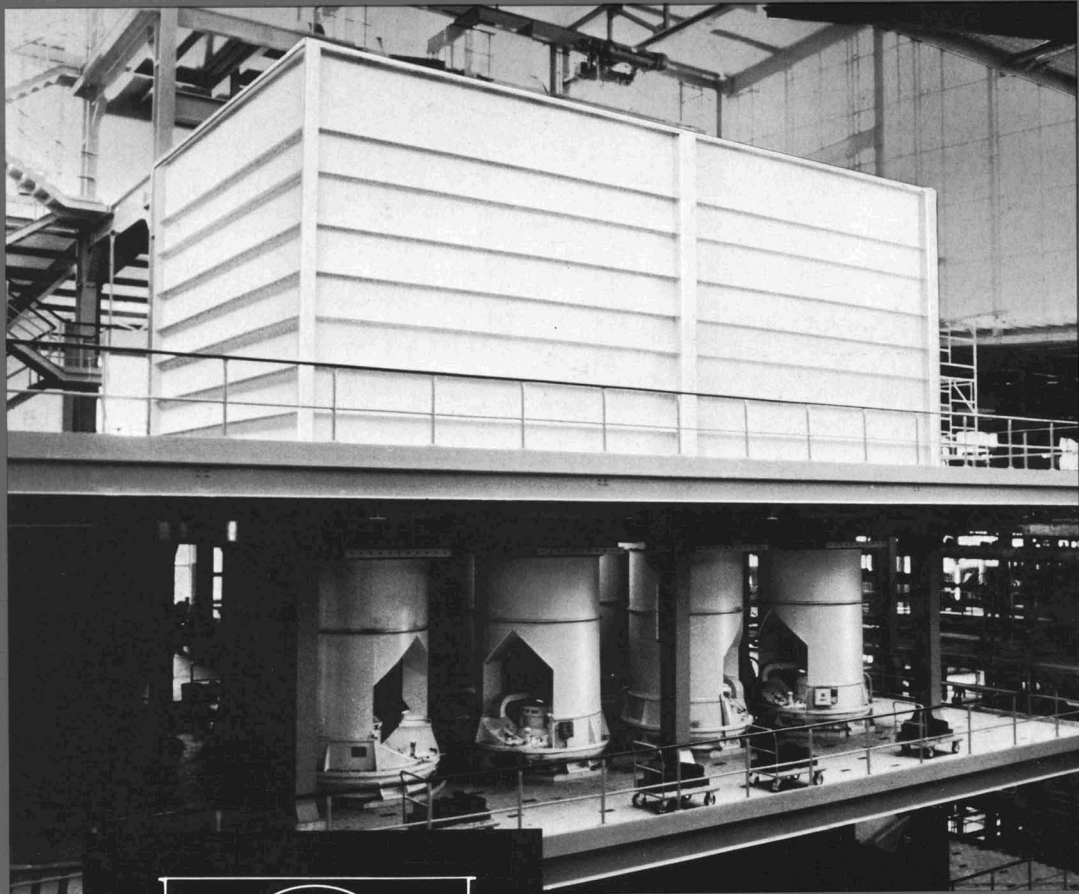
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**We believe  
Western States centrifugals  
are the finest in the world.**

**Our after-sales service  
helps keep them that way.**

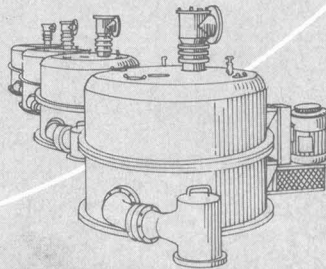
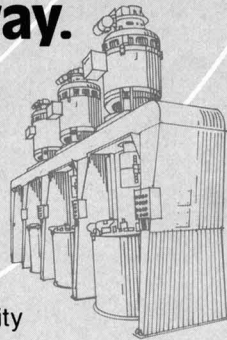
The robust design and construction of Western States centrifugals assure maximum operating efficiency and minimum operating cost.

Western States helps you maintain peak productivity of its centrifugals through its worldwide full service capability:

- Large spare parts inventory ready for immediate shipment.
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- Factory service and engineering personnel available for field service.

**Contact our Local Representative or Us**

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