INTERNATIONAL SUGAR JOURNAL

VOLUME LXXXVII/ISSUE No. 1038 JUNE 1985

Starch, glucose, isosyrup, yeast, alcohol ...

can be produced economically by our advanced technological processes. We build plants for the food and chemical industry throughout the world, in particular:

* Starch from corn (maize), wheat flour, cereals and starch containing tubers.
* Processing of starch to dextrose, total sugar, corn syrup, dextrin, isosyrup (HFCS), sorbitol (solution or powder) from dextrose or starch hydrolysate.
* Baking and active dried baking yeast from molasses.
* Ethanol and power alcohol from molasses and other raw materials containing sugar or starch, acetaldehyde from ethanol, acetic acid from acetaldehyde, acetic anhydride from acetic acid, etc.
* Plants for agglomerating pulverized material, wet separation and wet screening.

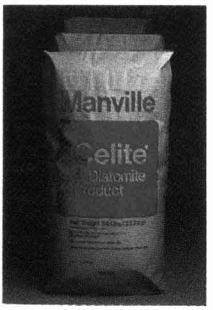
Please contact us for further information.

STARCOSA

a member of the BMA Group

Starcosa GmbH
PO Box 5105 D-3300 Braunschweig
Federal Republic of Germany
Telephone (05 31) 804-0
Telex 952 456

Your partner for food and chemical industries



Manville

When you buy Manville Celite® filter aid, you get more than just filter aid.

Celite filter aid comes with something extra: technical expertise, from your Manville filtration specialist.

His knowledge and experience can help make your filtration operation more efficient and economical. He's an expert at solving problems, from analysing your filtration process to selecting the right product and advising on its optimum use.

And behind him stands the Manville organisation. For over 50 years we've set the standard for product quality, technological leadership, and service to our customers.

So when you need solutions to your filtration problems, call on the company that offers more than just filter aid.

Contact Manville (GB) Ltd.,
Ryde House, 391 Richmond Road,
Twickenham, Middlesex, TW1 2EQ.
Tel: 01 891-0833. Telex: 928635.

Editor:
D. LEIGHTON, B.Sc., F.R.S.C.

Assistant Editor:
M. G. COPE, M.I.L., M.T.G.

UK ISSN 0020-8841

Annual Subscription:
£40.00 post free

Single Copies
£4.00 post free

Airmail: £24 extra

Published by
The International Sugar Journal Ltd.,
23A Easton Street, High Wycombe,
Bucks., England HP11 1NX
Tel: 0494-29408 *Telex:* 21792 REF 869

Printed by Adams & Sons (Printers) Ltd.,
Blueschool Street, Hereford.
Telephone: 0432 54123.

INTERNATIONAL SUGAR JOURNAL

Volume 87
Issue No. 1038

CONTENTS June 1985

99 Notes and comments

* * *

Technical articles

103 **The sugar refining process at the rebuilt Arlöv refinery in Sweden** — *continued*
By Gert Å. Åkesson and Kaj A. Lilja

106 **Performance of a coal fired fluid bed for pulp drying** — *continued*
By D. C. Hogan, R. J. Parker and J. D. F. Wilkie

113 **Development of new instruments for sugar mills**
By S. R. Reichard

* * *

119 Sugar Industry Technologists Inc.

120 Correspondence

105, 112, 118-120 Brevities and statistics

* * *

Abstracts section

56A Cane sugar manufacture

60A Beet sugar manufacture

62A Sugar refining

63A Laboratory studies

65A By-products

* * *

x *Index to Advertisers*

Published by

The International Sugar Journal Ltd.

23A Easton Street, High Wycombe, Bucks., England HP11 1NX.

Telephone: 0494-29408 *Telex:* 21792 REF 869

US Office: P.O. Box 143773, Coral Gables Station, FL 33114-3773

Inquiries regarding advertising should be addressed to the above offices or to the appropriate representative

UK: T. G. Scott & Son Ltd.,
30-32 Southampton Street, London WC2E 7HR
Tel: 01-240 2032 *Telex:* 299181

France MaG-Watt International,
6 rue des Acacias, Vert-le-Grand 91810 Essonne
Tel: (6) 456-00 15

Belgium, Holland and West Germany: G. Arnold Teesing B.V.
Prof. Tulpstraat 17, 1018 GZ Amsterdam
Tel: 020-263615 *Telex* 13133

Japan: Shinano International,
Akasaka Kyowa Bldg., 6-14 Akasaka 1-chrome, Minato-ku, Tokyo 107
Tel: (03) 584-6420 *Telex:* J27850 Sinanoco

Latin America: Mr. Mario A. Mascaró,
7321 S.W. 82nd Street No. 2, Miami, FL, U.S.A. 33143
Tel: (305) 667-1724.

Notes and comments

Raw and white sugar trade

In a recent article, F. O. Licht GmbH have examined the importance of the differences in raw and white sugar trading on an international basis[1]. They point out that the developed market economy countries and the centrally planned economy countries in Eastern Europe have traditionally provided the best market for raw sugar, to be refined for domestic consumption, but their share of world imports has fallen drastically over the past few years, mainly owing to protectionist US sugar policy.

By contrast with this trend, the share of developing countries in imports has been growing but this increase has not been accompanied by any development of a refining industry. This may be attributed primarily to the fact that the premium of white sugar prices over those of raw sugar is generally insufficient to cover refining costs, let alone the amortization of new capital. Hence, the increase in demand by developing countries has benefited white sugar exporters and especially the EEC, which has a market share of nearly 50%.

Global white sugar imports climbed from 6.7 million tonnes in 1978/79 to 11.5 million tonnes in 1983/84. The total share of white sugar imports has risen from 33% in 1981/82 to an estimated 39% in 1984/85; as a result, the world sugar surplus appears to be concentrated mostly in raw sugar, which will place the burden of adjusting supplies to demand mostly on raw sugar exporting nations.

The major importers of raw sugar are the United States, Canada, Japan, the USSR and China. Licht note that North America is a declining market owing to the penetration of HFS in Canada and the US and the impact of the US quota system. The guaranteed price ensured to US sugar producers favours the production of sugar substitutes solely at the expense of raw sugar imports. Consequently, North American raw sugar import requirements have fallen from 5.5 million tonnes in 1980/81 to an estimated 3.4 million tonnes in 1984/85.

At the beginning of the 1970's Japan was a net importer of about 2.5 million tonnes annually; the combined effect of increased domestic production and lower sucrose demand owing to increased competition from HFS has reduced import demand to less than 2 million tonnes. It is clear that the improved production in the USSR in 1984/85 has not been the result of favourable weather and will lead to a significant reduction in raw sugar imports. It may well be that, in future, the USSR cannot be counted on to provide a significant outlet as in the past. China is likely to import around 1 million tonnes of raws in 1984/85, but future requirements will no doubt largely depend on world prices.

The significant fall in raw sugar import requirements has not been accompanied by a corresponding reduction in raw sugar output for export, which has led to an enormous raw sugar overhang. The countries hardest hit are those facing a shrinking market for preferential sugar in the US market and those with a small domestic market and a high dependence on the free world market. Without the various agreements that ensure good prices for Cuban sugar in the Comecon countries, ACP supplies to the EEC and quota sugar for the USA, many sugar industries would already be bankrupt. Licht observe: "One thing is clear; it will not be possible to maintain the current export structure as raw sugar production for export will have to be curtailed drastically and some countries may be forced to go out of export production altogether."

Only a few years ago, some analysts predicted a constant and significant increase in import demand for white sugar, based on the enormous potential for consumption growth in developing countries, the net shift of income towards these after the oil price rise of 1973/74 and the low price of traded sugar. Growth has slackened over the past three years, however, owing to world recession and the third world debt crisis; even oil exporting countries are facing a lack of foreign exchange following the fall in oil prices and demand in industrialized countries. With increasing self-sufficiency in Mexico, Peru and other countries, white sugar demand would have fallen to a greater extent than the marginal 0.8% extent expected for 1984/85 if it were not for an expected 1 million tonnes requirement forecast for India, which may well be a temporary phenomenon. A marked improvement in white sugar import demand will not occur before developing countries have overcome their economic problems.

World sugar production

E. D. & F. Man recently revised their estimates of 1984/85 world sugar production[2] which show an increase of some 2 million tonnes over their previous estimate, owing to upward adjustments for the USSR, Yugoslavia, South Africa and Thailand. The forecast, totalling 99,163,000 tonnes, raw value, shows a potential surplus of 3.5 million tonnes for the 1984/85 crop year, and Man note: "It has been the accumulation of such surpluses over the past four seasons that have continued to depress market prices. Moreover, there are no signs of a break in sight as even the preliminary forecasts for the 1985/86 campaign, at best, indicate a balanced situation.

"The major producers continue to maintain their exportable surpluses while the traditional importers are increasing their efforts to move towards self-sufficiency. The Soviet Union is a particular example of a country which has drastically reduced its reliance on world market imports in recent years while traditional exporters such as the EEC, Australia and Thailand have maintained their levels of production. It is the absence of

1 *International Sugar Rpt.*, 1985, **117**, 181-184.
2 *The Sugar Situation*, 1985, (408).

short-term competitive alternatives which have prevented these producers from switching to other crops. However, it is hoped that governments which have been instrumental in producing the sugar surplus will also be instrumental in finding outlets for them.

"Among the propositions currently mooted in sugar circles are the use of surplus sugar for alcohol production or as animal feed. While the outcome of such suggestions remains uncertain the near-term outlook for sugar prices will continue to be depressed. Moreover, even the possible welcome signs for the future, such as the proposed changes in the USA and EEC agricultural policies, will not have any effect on production incentives until at least the 1986/87 campaign starts."

The US Department of Agriculture has published its first estimate of production for 1985/86[3]; it totals 99.6 million tonnes, raw value, virtually unchanged from the 99.4 million tonnes forecast for 1984/85. Production of sugar from cane is forecast at about 63 million tonnes and sugar from beets at nearly 37 million.

Weather conditions have not been as favourable as last year owing to the late spring in Europe and drought in other areas. The USDA sees production in Brazil as 8.8 million tonnes, slightly less than last season. Large world supplies and low prices could have a dampening effect on Brazil's sugar production plans. (It was announced in May that production would be limited to 7,896,000 tonnes in 1985/86 against 8,850,000 tonnes in 1984/85.)

The largest regional increase is expected to occur in Asia, up 7% from 1984/85. China should continue to increase production as a result of greater incentives to growers. Indian output could rise by 15% while Pakistan's crop should recover from last year's bad weather and pests. Philippine output has fallen significantly in recent years and should fall again in 1985/86. Thailand's output should match the 2.5 million tonnes of last season and South Africa's crop is seen falling 11% from the 1984/85 record.

Ample amounts of autumn rainfall and heavy winter snow have assured good moisture supplies for early beet growth in the USSR, according to the Department, and although planting progress is late, beet sugar output could still be near last year's figure of 8.8 million tonnes.

World sugar prices

Lack of physical offtake and of fundamental influences resulted in a London Daily Price for raw sugar which fluctuated within a very narrow range during the first half of April. From a level of $108.50 per tonne on April 15—the same as on April 1—it started to slide during the second half of the month, borne down by the weight of surplus sugar available, and ended the month at $96 per tonne.

White sugar values were not affected to the same extent, and some business has been done, albeit at prices much lower than the costs of production. As a consequence, the LDP(W), which began the month at $131 per tonne, ended it at $132, with minor fluctuations during April between extremes of $134 and $129.50 per tonne.

Philippines sugar industry privatization[4]

The state-owned National Sugar Trading Corporation (Nasutra) has been privatized by the Philippines government. The new private firm—the Philippine Sugar Marketing Corporation (Philsuma)—now has exclusive rights in sugar trading for both the domestic and export markets. This was the function of Nasutra until sugar trading was deregulated last year. The Philippine Sugar Commission (Philsucom) has also been reorganized "to save the industry from imminent collapse" and to protect the interests of the country's 4½ million sugar workers.

Philsuma will be wholly owned by sugar planters and millers in proportion to their actual production. It will be administered by a chairman and eight commissioners, six of whom will be elected representatives of the sugar producers. The ex-officio commissioners will be the Minister of Trade, the Minister of Agriculture and the central bank governor.

Canada beet sugar industry in peril[5]

Farmers in Manitoba and Alberta are wondering if the beet sugar industry in western Canada is about to end; B.C. Sugars Ltd. of Vancouver has told them it could close the last two beet sugar factories on the prairies unless there is increased federal support for sugar beet growers and the company receives a better price. Federal support payments are given to the growers when the world price of raw sugar falls below the level at which beet sugar is viable, but it has become cheaper for B.C. Sugars to buy raw sugar on the world market, refine it in Vancouver and ship it across western Canada than for the company to remain in the beet sugar business. It has processing plants operated by subsidiaries in Alberta and Manitoba.

Closing the two plants would mean an end to a US $500 million a year industry in Western Canada and would leave Quebec as the only remaining beet-growing province. B.C. Sugars has been in contact with provincial and federal politicians about the problems besetting the industry. The real question is whether the federal government wants to keep it alive and preserve hundreds of jobs. As a short-term measure, farmers want more subsidies against the distressed world sugar market; in the long-term they want a national sugar policy with duties and tariffs on sugar imports to ensure security of the domestic industry.

3 *World Production & Trade;* through *Public Ledger's Commodity Week,* May 11, 1985.
4 *Standard Chartered Review,* March 1985, 37.
5 F. O. Licht, *International Sugar Rpt.,* 1985, **117**, 160-161.

The sugar refining process at the rebuilt Arlöv refinery in Sweden

By Gert Å. Åkesson and Kaj A. Lilja
(The Swedish Sugar Company)

Continued from page 89

Each stage has internal juice circulation, with the result that flow variations or brief stoppages of the flow do not cause problems. The residence time with normal flow is approx. 1 minute in each stage, for which reason high temperatures up to 110°C can be tolerated in the first stage.

Crystallization

This is illustrated in Figure 3. The boiling station has been grouped together at one site and the panmen carry out the work from the control room since all vacuum pans are completely automated. This has been a great success in the white sugar crops, where we now can repeat the boiling with great exactitude and thereby obtain an even and uniform quality of white sugar. We had certain fears that different qualities of raw sugar would require different values of the parameters which control the crystallization but this is not the case, the major reason for varying sugar quality being, instead, varying Brix. We experienced the most serious difficulties in automation of the 3rd crop boiling. The seeding involved requires manual work and even during the boiling itself, manual supervision is necessary. This is probably because the conditions are less constant than in white sugar strikes. The boiling process is controlled by a Siemens rheometer which consists of a cylinder which rotates within the vacuum pan. We have established a very high degree of agreement between the rheometer value and supersaturation in the massecuite.

The white sugar is crystallized in three stages (Table II). The sugar from the three stages is then mixed to a single sugar quality. For these three stages, we have three 50-tonne vacuum pans with stirrers. These are manufactured in stainless material and have calandrias with a heating surface of 250 m². For these three pans, we have four stainless steel receivers, two to pan No. 1. The receivers have an outer jacket of thin stainless steel sheet metal and air is blown in between the jackets partly to cool the massecuite but mainly to reduce the heat in the premises.

Table II. White sugar pan ratios

	Beet raw sugar	*Cane raw sugar*
1st	6.7	5
2nd	2.5	2.25
3rd	1	1

We have six ASEA-Weibull batch centrifugals for the white sugar, with a charge of 1000 kg: three are for 1st crop, two for 2nd crop and one for 3rd crop. The centrifugals are placed in a row and are emptied into a common screw conveyor where the three crops are mixed.

The recovery section also consists of three stages. The first crop is carried out in the same pan as the third crop of white sugar while we have a 30-tonne pan for each of the second and third crops. These two pans are of mild steel and have calandrias with external circulation. There is no stirrer. The first crop pan has one receiver and the second and third crop pans each have two receivers. Residence time for the third crop is approx. 36 hours. The centrifugal station consists in total of four continuous BMA K1100 centrifugals, two for the first crop and one each for the second and third. The sugar of the third crop is mixed with the syrup of the second crop to a magma. This is mixed with the massecuite of the second crop and is centrifuged together with it, i.e. we have double purging of the third crop. The mixed second and third crop sugar is dissolved and decolorized in the above-mentioned ion exchanger. Thereafter, this is removed from the refining process and constitutes the raw material for golden syrup.

The first crop sugar is dissolved and makes up partly the raw material for the golden syrup, while the remaining volume is recycled to the fine liquor.

Energy system

This is shown in Figure 4. We have three boilers, of which two are oil-fired. These will be converted to gas-firing in 1985. The third boiler is coal-fired and supplies approx. 50% of our energy needs. We have three older turbogenerators which supply power corresponding to the amount of back-pressure steam needed for the process. The remaining electric power supply needs are purchased from the grid.

The energy recovery system consists of a heat pump which supplies hot water at 100°C to the Malmö district heating network. From this system, we also take the greater part of our energy requirements for process heating and premises heating.

Vapour from the pans goes to a condenser K1 where it condenses against the refrigerant; this is vaporized and compressed in compressor C2. The refrigerant-gas condenses against the district heating water which is heated to 78°C. The compressor is driven by a turbine T and a generator G4 is mounted on the same shaft. The back-pressure steam from the turbine goes to the condenser K3.

The heating system supplies approx. 20 MW, of which 10 MW is recovered from the waste heat of the pans. The heating factor is approx. 2.0.

Staff

We have three shifts. Each shift has one shift manager and ten workers (Table III). Five are qualified process operators who command a large sector of operations. These also have the duty of keeping the equipment and its

Table III. Staff

		Number
Control room 1	Affination-Melting Carbonatation Filter-separators Resin plant	2
	Centrifugals	1
Control room 2	Evaporator Crystallization Crystallizers Drying	2
Raw sugar		2
Repairs		2
Electrician		1
		10

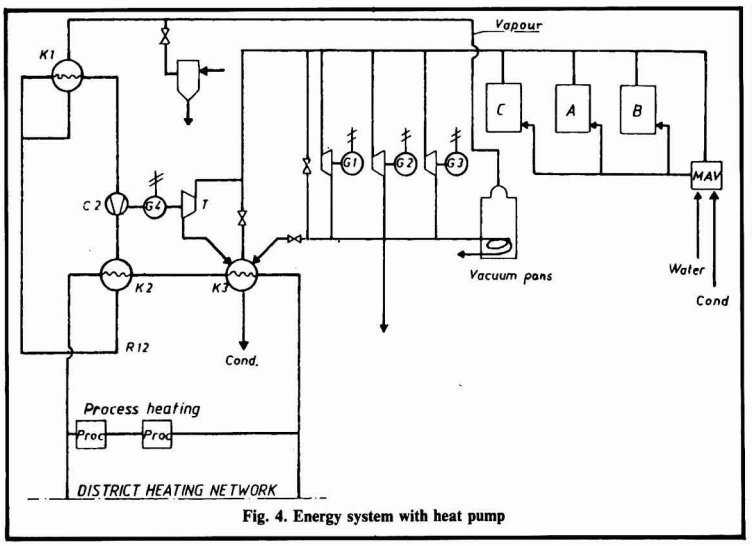


Fig. 4. Energy system with heat pump

surroundings clean. We have two repair workers on each shift. Their working duties comprise regular maintenance of the centrifugals, pumps and conveyors. It is our opinion that these "machine groups" cause the greatest number of maintenance operations (not the largest costs) and, consequently, it is of great importance to have access to repair workers round the clock.

Some experiences of 2½ years of operations

We refine alternately beet and cane raw sugar; the cane raw sugar is refined continously at times during the year, which allows us, when necessary, to use new ion exchange resin with 80-90% decolorization during these periods.

The same processes are used for beet and cane raw sugar, but we change the amount of washing water in the affination centrifugals, the lime volume in the carbonatation, and the cycle length in the ion exchanger station (see Table IV).

We choose to affine the beet raw sugar even if the colour is as low as 500 ICUMSA units. The low volume of washing water, 1.5% on the magma, does not give much affination syrup, but the

Table IV

	Beet raw sugar	*Cane raw sugar*
Affination wash water % on magma	1.5	2.5
Lime %	<0.3	0.7-0.9
Resin plant cycle length B.V.	100	40

decolorization is 60-70%. Naturally, a carbonatation plant is not built for the refining of beet raw sugar, but since we have a plant, we use it. The alternative would have been to use filter aids at the filter presses, which would have cost slightly less. The lime gives us 30-40% decolorization, which more than sufficiently outweighs the extra costs. One can accept a lower level of decolorization in the ion exchanger and, consequently, the cycle length may be considerably increased. We have chosen 100 bed volumes, but it is probably possible to select an even higher number. Table V shows the colour figures in the refinery for a "normal" beet raw sugar and a "normal" cane raw sugar.

The very low fine liquor colour in beet raw sugar is utilized in that we back-boil, which gives less remelt sugar which leads to lower energy consumption and reduced sugar losses (see Table V).

Table V. Colour

	Beet raw sugar	*Cane raw sugar*
Raw sugar	600	4000
After affination	230	1300
After carbonatation	150	500
After resin plant	40	115
Energy/steam on melt %	71	86

Here, energy consumption is calculated as that used in the refinery process from raw sugar intake to and including dried sugar. It is now considerably lower than in our old refinery, one reason for this being that we never need to evaporate sweet-water. Decolorization and filtration, which previously resulted in large volumes of sweet-water, now result together in less than 100 m^3/day, whereas we use approx. 300 m^3 in the melter.

Summary

The Swedish Sugar Company operates seven beet sugar factories and one refinery with a melt capacity of 600 tonnes/day. Modernization of the refinery was completed in the summer of 1981. The principal refinery processes were and are affination, carbonatation, filtration, decolorization and crystallization in six stages. Most of the old refinery has been renovated and several of the above processes have been wholly or partially modified, e.g. by use of continuous affination centrifugals, chamber-filter presses with on-site sweetening-off, ion exchange for decolorization and a three-stage falling-film evaporator. The sugar boiling station is completely new and is highly automated. Waste heat from the boiling station is recovered in a heat pump and used as process heat. Surplus heat is sold to the district heating network in the nearby city of Malmö.

The sugar refining process at the rebuilt Arlöv refinery in Sweden

Le procédé de raffinage de la raffinerie reconstruite de Arlov en Suède

La société sucrière suédoise opère avec 7 sucreries de betteraves et une raffinerie avec une capacité de refonte de 600 tonnes par jour. La modernisation de la raffinerie fut complétée au cours de l'été de 1981. Les principales phases du processus de raffinerie furent et sont encore l'affinage, la carbonatation, la filtration, la décoloration et la cristallisation en 6 étages. La plus grande partie de la vieille raffinerie a été renouvelée et différents processus de ceux mentionnés ci-dessus ont été entièrement ou en partie modifiés. On a par exemple installé l'affinage sur centrifuges continues, des filtres presses avec désucrage sur place, les résines échangeuses pour la décoloration et une évaporation à flux descendant à 3 effets. La station de cuisson du sucre est entièrement nouvelle et hautement automatisée. Les calories perdues à la station de cuisson sont récupérées dans une pompe à chaleur et utilisées à nouveau dans le processus. L'excédent de chaleur est vendu au réseau de chauffage régional dans la ville proche de Malmö.

Der Raffinationsprozeß in der umgebauten Raffinerie Arlöv in Schweden

Die schwedische Zuckergesellschaft hat sieben Rübenzuckerfabriken und eine Raffinerie mit einer Verarbeitungskapazität von 600 t/Tag. Die Modernisierung der Raffinerie ist im Sommer 1981 beendet worden. Die Hauptverfahrensschritte der Raffination sind Affination, Carbonatation, Filtration, Entfärbung und sechsstufige Kristallisation. Der größte Teil der alten Raffinerie ist renoviert und mehrere der oben genannten Prozessen sind teilweise oder völlig modifiziert worden, z.B. durch kontinuierliche Affinationszentrifugen, Kammerfilterpressen mit sofortiger Absüßung, Ionenaustausch für die Entfärbung und eine dreistufige Fallstromverdampfungstation. Die Kochstation is völlig neu und sehr stark automatisiert. Die Abwärme der Kochstation wird in einer Wärmepumpe wiedergewonnen und als Prozeßwärme weiterverwendet. Überschußabwärme wird an das Fernwärmenetz von Malmö verkauft.

El proceso de refinación de la refinería reconstruida de Arlov en Suecia

La sociedad azucarera sueca opera con siete fábricas de azúcar de remolacha y una refinería de una capacidad diaria de redisolución de 600 toneladas. Se ha completado la modernización de la refinería en el verano de 1981. Los principales procesos de refinación fueron y permanecen la afinación, la carbonatación, la filtración, la descolorización y la cristalización en seis etapas. El mayor parte de la refinería antigua se ha renovado y algunos de los procesos citados se han modificado enteramente o en parte, por ejemplo por uso de centrífugas continuas para afinación, de filtro-prensas a cámaras con lavado en-sitio, de résinas cambiadores de iones para descolorización, y de un evaporador en tres efectos de capa descendente. La casa de cocción es enteramente nueva y es automatizado en grande parte. Calor perdido de la estación de cocción se recupera por una bomba de calor y se usa en el proceso. El excedente de calor es vendido a la red de calefacción regional de la ciudad cercana de Malmo.

Brevities and statistics

Australian sugar exports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Canada	399,657	404,567	410,120
China	261,697	324,474	402,281
Finland	0	0	41,323
Japan	527,860	522,012	555,334
Korea, South	353,753	325,526	264,594
Malaysia	280,892	325,501	289,954
New Zealand	100,589	95,505	78,839
Papua New Guinea	31	657	19,814
Saudi Arabia	0	0	2,156
Singapore	81,048	106,236	95,517
USA	214,071	207,040	129,547
USSR	347,782	105,548	209,076
Venezuela	16,356	0	0
Other countries	6,877	8,252	5,289
	2,590,613	2,425,318	2,503,844

New Indian sugar factories[2]

Six more sugar factories are expected to start crushing in Punjab state by the end of 1986/87 under a plan to achieve self-sufficiency in meeting sugar requirements in the state. At present there are eight factories and production in the current season is expected to be around 160,000 tonnes. The new factories will be cooperatives and will have capacities of 1200 t.c.d. which might be increased gradually.

New Thailand sugar factories[3]

A consortium of Japanese firms led by Nissho Iwai Corporation has received orders for two sugar factories. United Farmers Industry Co. is to erect a 15,000 t.c.d. factory at Chaiyaphum, while Chaimongkol Refined Sugar Co. is to have a 12,000 t.c.d. factory at Supanburi. The factories are to go into production in November 1986.

Fructose-ethanol production from cane juice[4]

The conversion of cane juice into fructose and ethanol instead of making it into sugar is one of two biotechnological processes that have been developed at the University of Queensland. It is called the "Sucrotech" process, while the second, "Bio-Wastech" process is for the conversion of common organic wastes into high-value protein additive for animal feed. To promote both processes, a new company—Queensland Science & Technology—has been formed. The Sucrotech process involves fermentation of the sucrose and trials on laboratory and pilot scale indicated that an efficiency of 75% might be achieved, with the possibility of raising this to 90% within a year. There are hopes that the process could provide the basis for large-scale alcohol manufacture in Queensland as a petrol additive. The Bio-Wastech process has been successful in pilot-plant trials using piggery wastes and it is currently being adapted to handle distillery wastes and other effluents.

Philippines sugar crop reduction[5]

About 170,000 hectares of the estimated 400,000 hectares of cane land in the Philippines is idle, according to the Labour Minister, and farmers have been encouraged to shift to other, more profitable crops. The Philippine Sugar Commission expects sugar output in the current season to fall to 1,810,000 tonnes from 2,300,000 tonnes in 1983/84.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (2), 2.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 82.
3 *Zuckerind.*, 1985, **110**, 84.
4 *Australian Sugar J.*, 1984, **76**, 376-377.
5 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 104.

Performance evaluation of a coal fired fluid bed for pulp drying

By D. C. Hogan, R. J. Parker and J. D. F. Wilkie

Continued from page 94

The test commenced when the coal in the bunker reached a datum level; weighed quantities of coal were added as necessary and at the end of the test period the level of coal in the bunker was restored to the datum level. The total weight of coal used was recorded. Readings were taken of all relevant instruments at 30-minute intervals. Dried pulp production was collected from 30 minutes after the start of the test, to allow for the pulp dryer retention time, until 30 minutes after the end of the test. The weight of dried pulp collected was recorded. The dust from the cyclone discharge was collected and weighed separately for the first 5 hours of the test, but added back to the pulp for the last 4 hours in order to evaluate cyclone performance.

Air and gas flows were measured at the forced-draft fan inlet, in the pulp dryer chimney, in the low-pressure recycle duct and in the dilution gas duct, using a pitot tube. Isokinetic sampling was used to measure the grit and dust concentration in the gas at the chimney, in the recycle duct, and leaving the HGG. The gases were analysed for carbon dioxide and oxygen in the HGG outlet, bullring, dryer outlet and recycle duct.

Humidity measurements were made at the forced-draft fan inlet and the recycle duct. For the purpose of this test it was assumed that the humidity in the recycle duct would be similar to that at the pulp dryer chimney. Temperature traverses were undertaken in two directions at both the bullring and outfall to verify the permanently installed instruments and show the extent of temperature stratification.

The samples of pressed molassed pulp, dried pulp, cyclone dust and dust collected in the grit and dust testing at the pulp dryer chimney were analysed for water content, composition and trace elements. Coal samples were collected during the test, crushed and analysed for moisture, ash and trace elements. A composite coal sample was sent to an outside laboratory for an ultimate analysis and calorific value determination.

Surface temperatures were measured over the whole surface of the HGG, pulp dryer, outfall housing, fans and recycle ducts, in order to determine the heat loss by radiation and convection.

Control response tests were later undertaken on the dryer by applying step changes in coal feed rate and measuring the time taken for conditions to stabilize. A second series of tests was run after adjusting the ramp rate for the coal feed response to a step change. The effect of pulp feed rate changes on the outlet temperature was also examined.

Results

The plant operated very steadily throughout the nine hours of the test period, the readings taken showing little variation and so the average of the 19 readings are summarized in the tables.

Pulp quality

The pulp quality, as determined from the analyses at the start of the campaign, was satisfactory as can be seen from Column II of Table III. Comparison with Column III shows that the levels of trace elements are generally less than one-fifth of the permitted levels with the exception of molybdenum and selenium at one-third and iron at two-thirds of the limit value.

A comparison with Column I shows that the actual levels for iron and arsenic were lower than expected and although some of the iron and arsenic was found in the emissions to the chimney, there is still some to be accounted for. It would seem desirable, therefore, to carry out a mass balance of the trace elements from the analyses of materials from the 9-hour test.

Mass balance

A complete mass balance was difficult to produce, as only a very limited number of direct and accurate measurements could be made, with a large proportion of values having to be inferred.

The dried pulp and cyclone dust were directly weighed to an acceptable accuracy. The dust levels in the chimney and recycle duct were obtained by sampling isokinetically where the chimney was nearly 700 times the area sampled and the recycle duct was over 1000 times the area sampled.

The moisture contents of the pressed pulp, dried pulp, cyclone dust, chimney dust and recycle dust, were obtained by oven drying the collected samples. The pressed pulp mass was estimated from the various dried pulp outputs, plus the mass of water evaporated from them. The results are summarized in Table IV.

The coal used during the test was carefully weighed, recorded and sampled for analysis. The gas was also analysed at various points on a dry volume basis. These data and the water evaporated have been used to determine the mass flow rate of gas at the various points. The results are summarized in Table V.

The volume flow rate was determined at various points throughout the dryer system. The gas analyses at each of these points were then used to obtain the gas density and hence the equivalent mass flow rate. The results are again summarized in Table VI.

The samples of coal, molassed pressed pulp, dried pulp, cyclone dust and chimney dust have been analysed for trace elements. These have been related back to the mass flow rate to obtain a mass flow for each trace element. The results are shown in Table VII.

The quantities of ash entering and leaving the hot gas generator have been combined to provide an ash balance as shown in Table VIII. This gives a carbon

Table IV. Pulp and water mass balance

In		Out	
	tonnes		
Pressed molassed pulp	107.060	Dried molassed pulp	31.450
		Cyclone dust	1.111
		Dust emission	0.315
		Water	74.184
		Total	107.060

Table V. Gas mass balance from coal mass and gas analysis

In	kg/sec	Out	kg/sec
Combustion air	2.4487	Dry products of combustion	2.5524
Excess air	0.6513	Excess and ingress air	1.7701
Ingress air	1.1188	Water from pulp and air	2.3137
Water in air	0.0241	Water from combustion	0.1448
Water from pulp	2.2896		
Coal (less ash)	0.2485		
	6.7810		6.7810

Table VI. Mass balance from flow measurements

To HGG	In kg/sec		Out kg/sec
Coal (less ash)	0.2485	To chimney	6.7464
Air from combustion fan	2.0863		
Air from recycle	1.0021	To recycle	2.9613
Dry gas from recycle	0.9150		
Water from recycle	0.8836	Total	9.7077
Dilution	2.9613		
Air from recycle	0.0574		
Dry gas from recycle	0.0525		
Water from recycle	0.0507		
Water from pulp	2.2896		
Total	7.5857		
Ingress air to balance	2.122		
Recycle gas flow	30.5%		

Table VII. Trace element balance

	In mg/kg	In g		Out mg/kg	Out g	Recovery %
Arsenic						
MPP	0.2	6	MDP	1.1	31	58
Coal	7.3	53	Cyclone dust	3.0	3	
			Chimney dust (pots	44.0)	23	39
			(filter	474.0)		
Total		59			57	97
Lead		130	Product		48	37
			Chimney dust		59	45
					107	82
Iron		45,683	Product		24,455	54
			Chimney dust		10,420	23
					34,875	77
Copper		196	Product		136	70
			Chimney dust		46	23
					182	93
Insoluble ash		719	Product		486	68
			Chimney dust		24	3
					510	71
Soluble ash		2283	Product		2233	98
			Chimney dust		68	3
					2301	101

carryover which is much too low. The analyses give a 63.63% ignition loss and a consideration of the trace elements, in the samples collected at the HGG outlet, accounts for only 50-60% of the likely ash input in the coal. Therefore a revised balance has been produced and is shown in Table IX.

This balance has been used to produce the carbon balance shown in Table X.

Heat balances

The heat balance has been prepared using the calorific value determined from the coal samples, the temperature of the pressed pulp and air into the dryer and the temperature of the dried pulp and flue gas out of the dryer. The radiation and convection loss has been determined from the surface temperature measurements. **The results are summarized in Table XI, showing the simplified balance, Table XII, showing the full heat balance, and Table XIII showing the heat balance on nett output.**

Control response tests

In conventional coal-fired systems there is a significant thermal inertia which is not present with gas- or oil-fired systems. This precludes the use of a control strategy in which the fuel feed rate is adjusted to match the variations in pressed pulp feed rate or moisture content. The thermal inertia of the HGG was expected to be considerably less than that of a conventional system, but it was not possible to predict whether or not the alternative control strategies could be used without a more precise indication of the dynamic response times of the HGG system.

Tests were carried out on two occasions. The first tests indicated that the responses were slower than expected, and a second series of tests was undertaken with measurements recorded in greater detail.

In the first series of tests only the bullring and outfall temperatures were recorded. An initial change in demand coal feed from 65% to 52% with the outfall temperature in closed loop control from the pulp feed scroll speed, and with the recycle gas dilution valve at a fixed

Table VIII. Ash balance at HGG outlet

In			Out	Difference
	kg/hr			
Coal	27.57	Measured at HGG outlet	42.43	4.21
Recycle dust	8.81			
Sand	1.84			
	38.22			

Combustible carry-over 4.21 kg/hr or less than 10% of combustible in collected dust.

Table IX. Ash balance corrected to 63.63% combustible as found in collected material

In			Out	Difference
	kg/hr			
Coal	27.57	Estimated at HGG outlet	105.09	66.87
Recycle dust	8.81			
Sand	1.84			
	38.22			

Combustible carry-over 66.87 kg/hr or 7.27% on coal.

Table X. Carbon balance across HGG based on revised ash balance

In			Out	Difference
	kg/hr			
Recycle dust combustible	11.92	Estimated at HGG outlet	66.87	54.95

Net carbon carry-over 54.95 kg/hr or 5.98% on coal.

Table XI. Simplified heat balance

	In			Out	
	kW	%		kW	%
Coal	7385.0	92.87	Heat to water	6311.1	79.36
Heat in air	135.1	1.70	Heat to pulp	60.8	0.76
Heat in pulp	432.1	5.43	Losses	1580.3	19.88
	7952.2	100.00		7952.2	100.00

Table XII. Full heat balance

	In			Out	
	kW	%		kW	%
Heat in coal	7385.0	92.89	Heat in pulp water	6311.1	79.36
Heater in pulp water	383.5	4.82	Dry products of combustion	469.3	5.90
Heat in air from combustion fan, wet	48.9	0.62	Heat in ingress air	175.9	2.21
Heat in ingress air, wet	86.2	1.08	Water from combustion	447.9	5.63
Heat in pulp	48.6	0.61	Heat to pulp	60.8	0.76
	7952.2	100.00	Combustibles in pulp	118.6	1.49
			Radiation & convection	218.9	2.75
			Unaccounted	149.7	1.90
				7952.2	100.00

opening, caused a change in bullring temperature which was approximately exponential with a 30-minute time constant. With the quantity and temperature of the recycle gas fixed, it can be assumed that the bullring temperature response is a direct function of the change in energy release through the coal feed rate change.

A similar change in demanded coal feed from 52% to 62%, but with a fixed pulp feed scroll resulted in a response with a similar time constant.

The HGG control system limits the rate of change of the actual coal feed to protect against too rapid changes. During these initial tests the limiting rates were 1% per minute on reducing feed and 2% per minute on increasing feed. It was considered that these rates could be increased without sacrificing safety, and that this would improve the response of the system to a limited extent. For the second series of tests the rates were set to 5% per minute on a reducing set point and 7% per minute on an increasing set point.

The first two tests (Figure 4) illustrate the response to a change in coal feed rate with the pulp feed rate fixed throughout. The initial change is a reduction of coal feed rate from 70% to 60%, with a subsequent increase back to 70%. The changes in coal feed rate, bullring and outfall temperature are shown together with the temperature at the exit of the HGG itself before the recycle dilution is added.

Tests 4 and 5 (Figure 5) were a repeat of the first two tests, but with the outfall temperature in closed-loop control via the pulp feed rate. The observed bullring temperature responses are almost identical to those previously obtained, the time constant in each case being between 20 and 25 minutes.

Test 3 (Figure 4) investigated the response to a change in pulp feed rate with a fixed coal feed rate. Both outfall temperature and bullring temperature are affected, the bullring by more than would be expected, simply as a result of the change in temperature of the recycle gas. Another test in the first series had shown

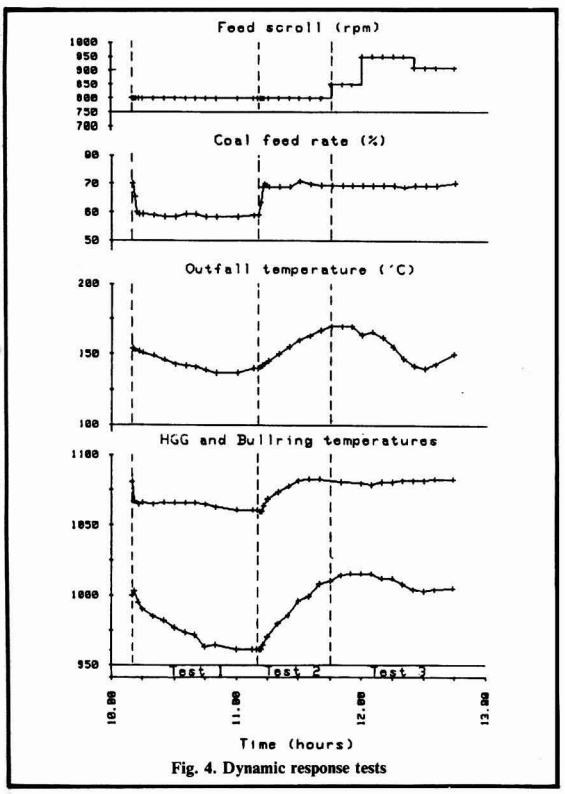


Fig. 4. Dynamic response tests

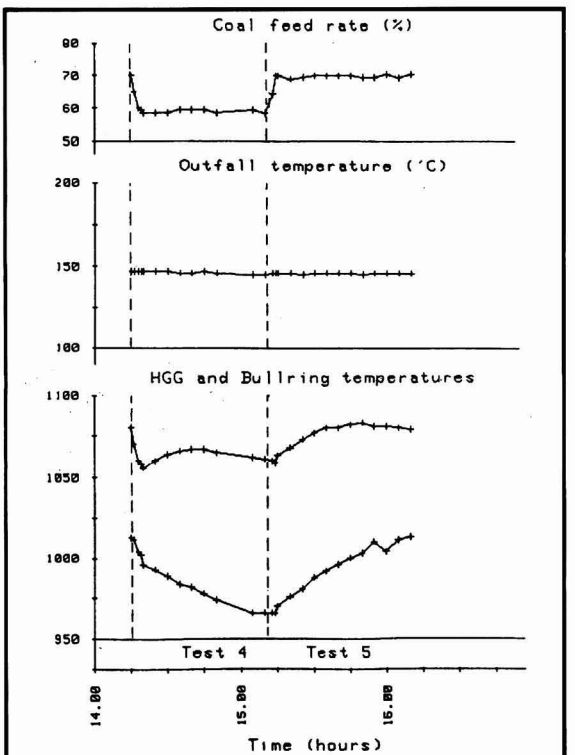


Fig. 5. Dynamic response tests

Table XIII. Heat balance on nett output

	In			Out	
	kW	%		kW	%
Coal	7385.0	100	Water from pulp	5927.6	80.27
			Dry products of combustion	379.2	5.13
			Water	447.9	6.06
			Heat to ingress air	130.9	1.77
			Heat to pulp	12.2	0.17
			Radiation & convection	218.9	2.96
			Combustibles in dust	118.6	1.61
			Unaccounted	149.7	2.03
				7385.0	100.00

that the bullring temperature was not sensitive to wide changes in recycle gas temperature.

Whilst the response of the bullring temperature was slower than expected, the response of the HGG outlet temperature was significantly different. The response to a reducing coal feed rate has a time constant of around 2 minutes (limited by the ramp rate) while the response to an increasing coal feed rate has a time constant of around 12 minutes. This non-linear response is not unexpected, knowing the characteristics of the HGG.

It would create difficulties for a control strategy based on modulating fuel, and this is further hampered by the response of the bullring temperature.

The bullring temperature response, in relation to the HGG outlet temperature indicates a substantial thermal inertia in the dryer bullring and ductwork. The ducting betweeen the HGG and bullring is longer in this pilot plant than would occur in most installations. Perhaps more significantly, it has been found that the temperature profile at the bullring is much more even than with gas- or oil-fired dryers.

Thus, for a given average bullring temperature, the refractory lining will be hotter with the HGG. Further investigation needs to be made on other HGG plants to establish the extent to which this problem is unique to the pilot plant or common to all.

Discussion

Pulp quality

The pulp quality, as can be seen from Column II of Table III, is very satisfactory. Most trace elements are one-fifth of the

permitted level. Three elements – arsenic, molybdenum and selenium – are about one third of the permitted level and only iron at 65% is approaching the limit.

Comparison of the expected values in Column I with the actual values in Column II clearly shows a wide variation in the quantities of the different elements which are captured by the pulp. The capture levels vary from more than 85% for fluorine, cobalt, manganese, zinc and soluble ash to between 40 and 60% for arsenic, lead, iron, copper and insoluble ash and only 14% for mercury.

The samples from the first grit and dust test collected in the sample pots were analysed for trace elements related back to the weight of material collected in the pots and filters. These data are given in Column I of Table XIV. These quantities have been related to the actual levels in pulp and Column II shows the effect if all the chimney dust had been collected and added to the pulp. Comparison with the expected analysis in Column III still shows a considerable loss of trace elements.

Table XIV. Analysis of chimney emissions, revised pulp analysis and comparison with expected analysis

	Emission analysis	Revised pulp analysis*	Expected analysis
	mg/kg		
Arsenic	44	1.56	2.0
Lead	32	1.86	4.02
Iron	40,000	1139	1445
Copper	180	6.07	7.87
Ash % total	43.1	9.6	10.96

* The emission dust represented 0.83% on dried pulp.

Note: 90% of the dust was collected in the cyclone part and the remaining 10% in the glass fibre filter. This material, less than 5 micron, could not be separated completely from the glass fibre for analysis.

A full trace element balance was undertaken for the materials collected during the 9-hour test period. This included dissolving out the trace elements from the filters used in the grit and dust testing for separate evaluation. The results are shown in Table VII. The concentrations for arsenic and lead are given for the various sources and these clearly show the very significant increase in concentration at the smaller particle sizes. The contents of glass fibre filters showed very high levels of lead in particular and taking the contents of the filters into account separately has produced a much better balance.

The trace element balance is considered to be satisfactory, bearing in mind that the grit and dust testing procedure claims an accuracy of only ±25% and that the quantities being sought are approaching the limits of accuracy of the analytical technique.

The results indicate that higher levels of trace elements could be tolerated in the coal, taking into account the capture rate and margin remaining below the limit. The size of particles containing the trace elements shows that increased cyclone efficiencies are unlikely to increase the capture rate significantly. There is also a possibility of using lower-grade coals having higher levels of trace elements by not adding back the finer dust collected in the cyclone.

Temperature distribution

Figure 6 shows the position of readings taken at the bullring. Figure 7 shows the horizontal temperature traverse and Figure 8 the vertical traverse. The horizontal traverse was on the bullring, the traverse in the ducting nearer to the HGG.

The figures clearly show that temperature variations were negligible at less than 50°C horizontally and 10°C vertically.

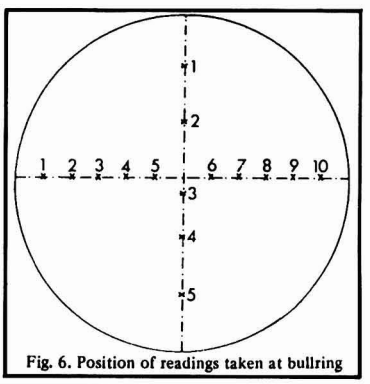


Fig. 6. Position of readings taken at bullring

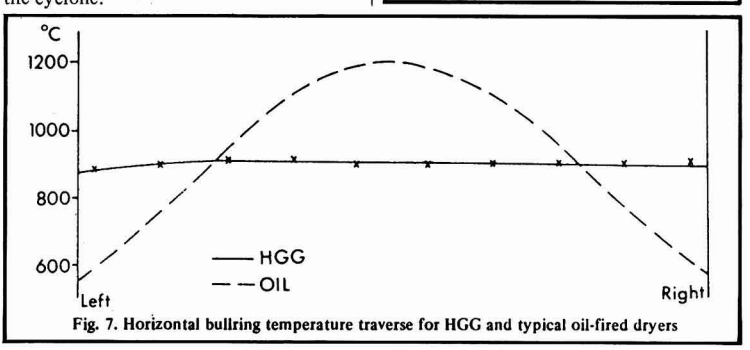


Fig. 7. Horizontal bullring temperature traverse for HGG and typical oil-fired dryers

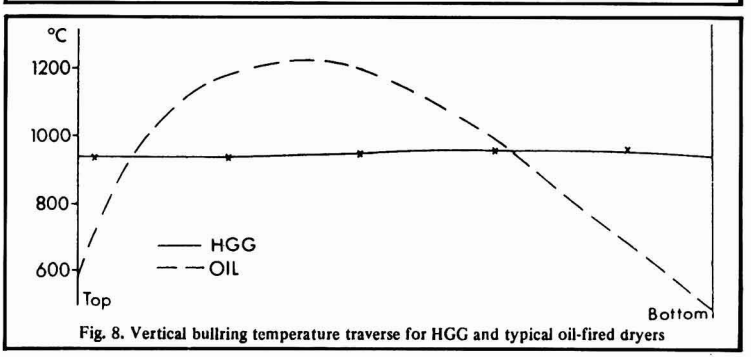


Fig. 8. Vertical bullring temperature traverse for HGG and typical oil-fired dryers

now available

Panmatic Vacuum Pan Boiling Control

- Precise Supersaturation Control
- Exact and Repeatable Seeding
- Universally Applicable for Vacuum Pan Crystallization

The Finnsugar "Panmatic" is the first system to continuously and precisely calculate and control supersaturation during the entire boiling sequence. The benefits are crystal clear:

Increased Production Capacity

The "Panmatic" System shortens crystallization time, with a corresponding increase in production capacity. This system offers the opportunity for complete pan house integration by using a host computer. The results are maximized capacity and minimized energy consumption.

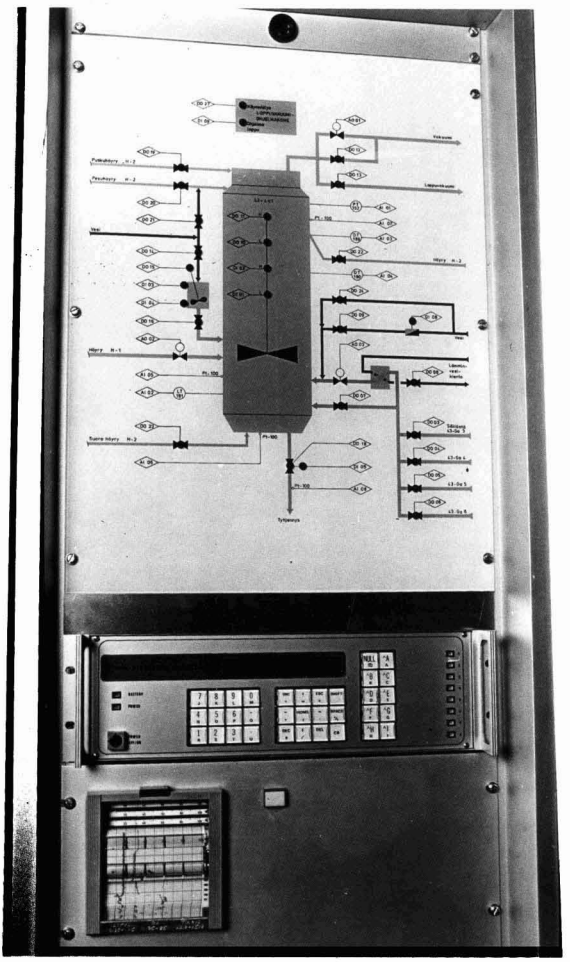
More Uniform Quality

Exact and repeatable seeding in connection with the fully automatic operation of the boiling sequence eliminates variations inherent in manual systems and guarantees accurate and repeatable crystal size.

Flexibility

The "Panmatic" System offers superior flexibility: it is universally applicable from refined boiling to C-boiling and the same controllers and basic program are used for each application. The "Panmatic" System has been in succesful plant scale operation since 1983.

To find out more about the Finnsugar "Panmatic" System please contact us.



RINTEKNO OY

Consulting, Engineering and Contracting in Fine Chemicals, Pharmaceuticals and Food Stuff Industry.

FINNSUGAR ENGINEERING

FINNSUGAR GROUP

Turnover US $ 500 million. Employees 4500 worldwide, 250 of which in research and development.

Rintekno Oy, Finnsugar Engineering, P.O.Box 146, SF-02101 ESPOO, Finland. Phone int'l +358-0-46981; Telex 122139 rinte sf.

ISJ Abstracts

Cane sugar manufacture

Quality of raw material from cane chopper-harvesters and its effects on the manufacture of alcohol and sugar

J. P. Stupiello and A. C. Fernandes. *STAB,* 1984, **2,** (4), 45-49 (*Portuguese*).

A review is presented of recent studies on the extraneous material and billet quality of chopper-harvested cane and factors which affect these, on deterioration of cane and their effects on factory processing.

Loss in juice quality of sugar cane variety NA 56-79 caused by *Diatraea saccharalis* Fabricius, 1794

E. Willink, V. M. Osores, C. A. Gargiulo and M. A. Costilla. *Rev. Ind. Agríc. Tucumán,* 1983, **60,** (1), 69-79 (*Spanish*).

Examination of cane of the major variety in the province (46% of the total cane area), in crops 2-5 years old, showed for each 1% of joints bored, Brix fell by 0.013%, pol in juice by 0.0171%, purity by 0.0442%, pol % cane by 0.0145% and available sugar by 0.0161%. From these and the calculated factory losses, it is estimated that sugar losses exceed 12,000 tonnes per crop.

Measurement of the milling rate in the tandem

G. J. Grillo O. and J. L. García C. *Centro Azúcar,* 1983, **10,** (2), 79-84 (*Spanish*).

A device for giving the instantaneous milling rate is discussed; it multiples a signal from a tachogenerator on the carrier drive (which measures the speed of the blanket) by a signal from a probe sensing the thickness of the blanket, and multiplies the product by a factor which includes the density of the prepared cane, width of the carrier and a proportionality coefficient to provide a direct signal in terms of weight of cane in arrobas per hour.

Improvement of heat balances with the object of a bagasse surplus

G. M. M. Costa. *STAB,* 1984, **2,** (5), 44-49 (*Portuguese*).

Examination of various alternatives leads to conclusions as to steps which might be taken in some older Brazilian sugar factories to improve the heat balances; they include replacement of old, small boilers, use of air preheaters, etc., on the steam generation side, and provision of insulation for heaters, evaporators, pans, etc., automation of control valves, reduction of water use in boiling, etc. In one example this produces a surplus of 19% of bagasse, and a 30% surplus is possible.

Sugar quality: revision of technology—objectives and perspectives

F. Zarpelon. *STAB,* 1984, **3,** (1), 51-55 (*Portuguese*).

In order to produce the best quality sugar for domestic use and for export, operational procedures in some sugar factories need to be amended, and a number of recommendations are made in respect of raw material quality, juice liming and sulphitation, heating, settling, evaporation, boiling, and sugar centrifugalling and drying. Other process operations discussed include clear juice screening, syrup screening and filtration, syrup flotation-clarification, and remelting of the sugar.

Algorithm for calculation of the error in approximation of functions

J. Ledón D. *Centro Azúcar,* 1983, **10,** (2), 3-9 (*Spanish*).

An algorithm is presented which permits calculation of an approximate function from a set of points, and the error associated with this approximation is given. The program, written in FORTRAN 10H, is used to calculate the variation in flow rate of steam generated by boiler No. 3 at Central Espartaco in Cienfuegos, Cuba, and the results are given in numerical and graphical form.

Reserve for the reduction of costs for the proper quantification of extraneous matter in the payment of sugar cane

C. Freixas C. and U. Vilariño C. *Centro Azúcar,* 1983, **10,** (2), 73-78 (*Spanish*).

Aspects of cane payment by quality which have caused difficulty are deficient quality of the samples and absence of proper measuring equipment, particularly scales, lack of qualified personnel for repairs, etc.

Method for calculating the contact time between the liming agent and the juice in hot liming systems

T. Prieto F. *Centro Azúcar,* 1983, **10,** (2), 99-104 (*Spanish*).

As an aid in designing full-scale liming equipment on a basis of experimental measurements, scale-up equations have been developed and are used in a worked example.

Costs and their reduction in electrical energy

F. C. V. da Costa. *STAB,* 1984, **2,** (5), 50-53 (*Portuguese*).

Economies can be achieved by improved use of existing equipment and by installation of new. Bought electrical energy should be minimized and factory-generated power increased and better employed. This may be done by reducing energy demand and consumption, and the importance of the load factor is indicated; the cost per kWh is halved by an increase in the load factor from 20 to 100.

Fibre length ratio as index for cane preparation

G. S. C. Rao, K. V. Rao, V. M. Murudkar and R. Narasimhan. *Proc.*

32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India), 1982, (1), A.11-A.20.

Comparison was made between the cane preparation performances of a fiberizer and a shredder, showing that the proportion of long fibres, i.e. >10 mm, was greater at 86.64% from the fiberizer than from the shredder (78.19%). Trials indicated that the percentage of broken cells increased with fibre length, which is ideally the mean internode length. Use of the fibre length ratio

$$=\left(\frac{\text{Mean observed fibre length}}{\text{Mean ideal fibre length}}\right)$$

as a cane preparation index is suggested.

Observations on a sugar manufacturing process without addition of TSP in mixed juice

A. H. Dagade. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.1-M.10.

Addition of trisodium phosphate to mixed juice was discontinued at the end of 1981 (despite a phosphate deficiency in the juice); previously, up to 0.017% phosphate had been added. It was concluded that the new practice was of benefit in cutting the costs of phosphate and in reducing molasses and press cake formation as well as scaling, although the level of clarification mud was higher.

The whole reduced mill extraction

P. K. More. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.11-M.18.

See *I.S.J.*, 1982, **84,** 372; 1983, **85,** 178; 1984, **86,** 185.

Reduced extractions and performances (summarized)

P. K. More. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.19-M.28.

See preceding abstract.

An attempt to improve the working efficiency of a Dorr clarifier

R. G. Durve and N. S. Shinde. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.29-M.32.

When the crushing rate at the authors' factory exceeded 130 tch, excessive mud accumulated in the RapiDorr clarifier installed for the 1980/81 season, and turbid juice resulted in one particular compartment. A close examination was made of the clarifier and disclosed some minor structural defects that were blamed for the problem. After certain modifications had been made and Magnafloc LT-27 flocculant added at the rate of 1 ppm on cane, the problem was solved and the purity drop after 24-30 hours' retention fell from 4-5 to 2 units, while the amount of juice resulting from increased crushing could be handled at a higher Brix without affecting clarifier performance; non-sugars removal was improved, colour was lower than previously and there were no floating particles in the juice, while mud consistency was very good. The crushing rate reached a maximum of 3745-4005 tcd without impairing performance.

Continuous conditioning of *C*-massecuite

B. L. Mittal. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.33-M.37.

The requirements of optimum low-grade massecuite cooling are discussed, and reference made to various types of crystallizer. A continuous unit patented by the author (one has already been installed and performed to expectation) is described; massecuite passes down through a non-cooling and a water cooling zone in the inner of two concentric vertical tanks, and enters the annular space between the inner and outer walls where it is ripened. The massecuite then flows into a peripheral gutter around the outer wall, whence it is scraped into a reheater.

On recirculation of maceration liquid and mill extraction

J. P. Mukherji, N. A. Ramaiah and A. P. Chinnaswamy. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.39-M.49.

While experience in various countries, including India, has shown that mill extraction can be increased by raising the imbibition rates to e.g. 200 or 300% on fibre, the very much greater amounts of liquid to be evaporated could pose problems, particularly the greater amount of steam consumed. To overcome this, recirculation of the maceration liquid is suggested, and a scheme is described in which the recirculation is restricted to the last two mills in a 6-mill tandem. At a rate of 130% on fibre, the recirculation is expected to give a significant increase in extraction.

Some suggestions for improving exhaustibility of molasses in sugar factories in Maharashtra

D. S. Lande. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.51-M.56.

Comparison between average final molasses purities and yields in Maharashtra and Tamil Nadu over the 5-year period 1978/82 shows that the purities are at least 3 units higher in the former state, although the yields are lower. The author examines established means of improving molasses exhaustion, and suggests cooling not just low-grade massecuite but also *A*- and *B*-massecuites (at one factory this led to reductions in *A*- and *B*-heavy molasses purities of 2.5-3.0 and 3.0 units, respectively) and adopting a 3½- or 4-boiling scheme instead of the conventional 3-massecuite system. Preliminary studies on a 3½-boiling system (in which a *B*-1 massecuite was double-cured and the sugar used as seed for *B*-massecuite, sugar from which was used as seed for

A-massecuite) showed a 2-3 unit drop in final molasses purity. However, the scheme does necessitate availability of increased boiling house capacity and increased steam consumption.

Sugar dust collection/fly ash collection systems for sugar industries

J. B. Biscuitwala. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.57-M.60.

The representative of a company specializing in project engineering and systems designing gives information on sugar dust and fly ash collection systems installed in specified Indian sugar factories.

The role of polysaccharides in unknown losses

P. F. Jain, P. G. Sankalecha and B. N. Pawar. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.61-M.66.

A brief account is given of problems encountered at Ravalgaon where unknown losses increased despite strict maintenance of mill sanitation. Noticeable drops occurred in purity across the mill and in mixed juice, curing of low-grade massecuite proved difficult, and a spongy, white granular mass was found below the mill juice gutter at the juice weighing tank. There was no obvious problem with evaporator or pan scale, nor was any change found in the shape of sugar crystals. Polysaccharides were blamed for the phenomena.

Low-grade massecuite curing in a Walkonti-10 continuous machine at Ravalgaon

P. F. Jain, C. N. Ahire and Y. S. Kulkarni. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.67-M.72.

The performance of a low-grade Walkonti-10 continuous centrifugal installed at the end of 1981 is discussed with the aid of tabulated data, showing a number of benefits by comparison with previous batch machines, including reduced molasses yield (although final molasses purity remained about the same, while *C*-light purity was higher than with the batch machines), better and more uniform low-grade sugar, lower power consumption, lower space requirements and reduced maintenance costs.

A note on improvement in venting for efficient removal of non-condensable gases in the last body of evaporators in sugar factories

D. S. Lande. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), M.73-M.74.

Damage that can be caused to evaporator tubes by incondensable gases is mentioned; in the case cited, the gases furthest from the header of the calandria in the last effect of an evaporator accumulated and damaged nearby tubes, while those gases near the header were withdrawn satisfactorily. To overcome the problem, a separate header was installed and the incondensables led off through two pipes to the condenser.

How far the bagasse can be dried by the direct use of flue gases

R. D. Joshi and M. K. Vaidya. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.1-E.10.

It is stated that the moisture content of bagasse cannot be reduced to below 42.7% moisture by drying with unheated flue gases in a vertical dryer (for reasons that are explained), and that use of a horizontal dryer with heated flue gas is the only means of giving a lower moisture content. In order to save energy and release bagasse for paper manufacture, the use of cane trash as fuel is advocated.

An approach to optimum capacity of a milling plant

S. L. Gadsing. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.11-E.16.

Using material on cane milling in Hugot's "Handbook of cane sugar engineering" as basis, the author discusses optimization of cane milling capacity and derives a formula for calculation of the mill setting as a function of crushing rate.

A few concepts for improving the steam economy in sugar factories

A. R. Patil. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.17-E.32.

Developments in steam generation and consumption in India over the last 30 years are surveyed, and a conventional quadruple-effect evaporator system for a 1250 tcd factory is briefly described. It is shown how steam consumption can be reduced and its utilization increased by keeping the same identical heating surface area but increasing that of the 1st effect and then using 1st effect bleed vapour for pan boiling and 2nd effect bleed for juice heating; in an alternative scheme, some of the 1st effect bleed is also used for juice heating. More advanced modifications involve replacement of the first two effects with falling-film evaporators as well as the use of vapour compression.

A practical approach to good mill setting

R. B. Shinde. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.33-E.47.

The author bases a discussion on cane mill setting on his own experiences. Factors concerned mainly with the milling process itself are examined; they are ones that should be considered in deciding on a given mill setting.

Introduction of five-roller mills (the first time in the Indian sugar industry) at Madhi sugar factory (Gujarat state)

D. S. Patil. *Proc. 32nd Ann. Conv.*

Deccan Sugar Tech. Assoc. (India), 1982, (1), E.49-E.56.

See *I.S.J.*, 1983, **85**, 341.

Maintenance of sugar mills

P. B. Bargaje. *Proc. 32nd Ann Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.57-E.64.

Advice is given on maintenance of cane mills and auxiliary equipment, during and after the crushing season.

Selection of boilers

A. K. Shah and S. S. Kusumgar. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.65-E.68.

Factors to be considered in selection of a suitable boiler for a sugar factory are briefly discussed, and a smoke-tube unit considered preferable to a water-tube boiler for a steam output of 3-8 tonnes/hr at 150-300 psi.

Increased yield per tonne of cane with pressure feeders attached to standard mills

R. S. Kalawar. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.69-E.76.

Reference is made to the continuous toothed-roller pressure feeder as used in the Australian sugar industry, and case studies are described where such feeders could, in conjunction with a fiberizer, contribute to greater profitability through increased extraction and lower bagasse losses while providing more bagasse. Mention is also made of automatic cane feed control which, in six factories, has eliminated interruptions caused by choking or overloading.

The introduction of pressure feeders to an Indian sugar mill

V. B. Pansare and N. N. Rakate. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), E.77-E.84.

The first and last mills in a 6-mill tandem at an Indian factory were provided with heavy-duty pressure feeders while the second mill was equipped with a light-duty feeder; the other mills retained their under-feeder rollers. Results of the first season in which the continuous feeders were operated showed an increase of more than 20% in the crushing rate while milling performance was unimpaired.

Recent developments and modernization in sugar factories

S. L. Gadsin. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), S.1-S.8.

A survey is presented of measures adopted in certain Indian sugar factories (the information having been supplied in answer to a request from the Deccan Sugar Technologists Association), and aspects of cane milling, steam economy and saving of bagasse are discussed.

Recent developments and modernization at Ashok S.S.K. Ltd.

K. N. Kanawade, M. N. Kotasthane and B. W. Mohite. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), S.9-S.14.

Modifications to factory equipment and processes at the title factory are outlined.

Recent developments and modernization in sugar factories

B. B. Pawar. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), S.17-S.20.

An outline is presented of measures whereby sugar factory efficiency could be increased in view of the rising costs of sugar production.

The performance of (BMA) HNEC continuous NK-1100 machines as *C*-foreworkers in Chalthan sugar factory

R. R. Unde and S. C. Bhatawadekar. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, (1), S.21-S.30.

The performance of the title centrifugals on low-grade massecuite has proved extremely good, with reduced molasses purity and yield % cane by comparison with the previous batch machines, as well as lower power consumption.

A note on working with a batch sulphur burner

R. K. Kulkarni. *Proc. 33rd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1983, (1), M.1-M.2.

After problems were encountered with a continuous sulphur burner, the unit was operated as a batch type without the melter. Results showed that operation was better than as a continuous burner, with a fall in sulphur consumption.

Semi-automatic vacuum pan boiling

V. S. Bagi. *Proc. 33rd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1983, (1), M.13-M.16.

A conductivity meter and controller plus a molasses/syrup feed control valve were used to provide semi-automatic operation of a low-grade pan. Results indicated the ability to boil a massecuite of 58-59 purity without formation of false grain or conglomerates.

Crushing rate and non-sugar input

D. G. Herlekar. *Proc. 33rd Ann. Deccan Sugar Tech. Assoc. (India),* 1983, (1), M.17-M.19.

When factory crushing rates are compared, generally no allowance is made for non-sugars quantities. An attempt has been made to correlate the crushing rate with the input of non-sugars on the basis of monthly data. Tabulated values show the discrepancies that can arise as a result of poorer non-sugars separation and hence of the greater amount that is recirculated.

Beet sugar manufacture

Heat diagrams for lime kiln and carbonatation gas

T. Baloh. *Zuckerind.*, 1984, **109**, 701-706 (*German*).

The diagrams constructed by Kimenov & Wyltschev[1] for calculations of the entropy and exergy of carbonatation gas cover range up to 0.16% (w/w), which is considered inadequate since, for instance, steam-saturated gas at 80°C has a moisture content of 0.52%. Moreover, the author points to errors in the exergy calculations. These facts, plus the advantage of having two enthalpy diagrams (one for gas leaving the lime kiln and the other for the waste gas from carbonatation), induced the author of the present article to calculate new diagrams, which are reproduced. Moisture data for both gases are tabulated for temperatures up to 100°C, and the procedure used in calculation of the diagrams is explained. For temperatures >100°C moist air diagrams may be used.

Preparation of a footing for *A*-massecuite boiling

S. V. Grigorov, V. I. Tuzhilkin and A. R. Sapronov. *Sakhar. Prom.*, 1984, (8), 15-17 (*Russian*).

A method is described for calculation of the parameters involved in preparation of *A*-massecuite footing based on *C*-sugar mingled with standard liquor. As criterion is used a white sugar crystal size of 0.78 mm.

Supplementary liming before 2nd carbonatation

V. A. Golybin, Yu. S. Serbulov, E. P. Filina and V. I. Elsukova. *Sakhar. Prom.*, 1984, (8), 17-19 (*Russian*).

Supplementary liming before 2nd carbonatation has been found to reduce juice colloids and lime salts, restrict the colour increase during evaporation and stabilize the alkalinity. Experimental determinations were made of the effects of temperature, residence time and lime consumption on the colour of filtered 2nd carbonatation juice; statistical analysis of the results gave optimum values of 85.6°, 5.9 min and 0.69% lime on beet, respectively.

Effectiveness of press-water recycling to diffusion

M. I. Daishev and V. O. Gorodetskii. *Sakhar Prom.*, 1984, (8), 19-21 (*Russian*).

A mathematical model of continuous diffusion based on the use of recycled press-water is briefly described, and its use to calculate the effect of recycling on losses and juice draft explained.

Regeneration of the percolation layer of the juice-cossettes mixture in a tower diffuser

G. K. Gorskii, A. G. Babak, V. P. Tsaruk and N. S. Karpovich. *Sakhar. Prom.*, 1984, (8), 30-31 (*Russian*).

Injection of circulation juice into the zone above the bottom screens in a tower diffuser has proved, in tests, to be an effective means of reducing the resistance to flow caused by packing of the cossettes in the screen zone.

Washing sugar with 2nd run-off from *A*-massecuite

T. P. Matvienko, V. A. Shestakovskii, V. A. Onofriichuk and A. N. Mazur. *Sakhar. Prom.*, 1984, (8), 31-34 (*Russian*).

Tests were conducted at Dubno sugar factory on a washing procedure for white sugar, whereby the massecuite was spun to remove most of the mother-liquor, followed by washing with dilute 2nd run-off and then washing of the sugar with water. Most of the run-off from the first washing was mixed with that from the second washing and part used for *A*-massecuite boiling and the rest for the massecuite washing. Results of the tests showed an increase in white sugar yield, a reduction in 2nd run-off from the *A*-massecuite and a fall in the total amount of massecuite boiled in the 3-massecuite scheme. The overall economic effect is calculated.

Evaluation of the efficiency of heat exchangers and heaters

V. N. Gorokh, B. F. Us and K. O. Shtangeev. *Sukhar. Prom.*, 1984, (8), 41-43 (*Russian*).

Official instructions for evaluation of heat exchange equipment are considered misleading, and advice is given on a suitable approach to evaluation of equipment performance. Recommended performance data are given for types of juice heaters operating within schemes incorporating a quadruple-effect evaporator with concentrator and a quintuple-effect evaporator without concentrator.

Prevention of iron oxide incrustation in powerhouse boilers and turbines

I. L. Tomakh. *Sakhar. Prom.*, 1984, (8), 43-44 (*Russian*).

Recommendations are made on means of preventing deposition of iron oxide (as a corrosion product) in boiler tubes and (as a result of entrainment) in turbo-generators.

Thick juice storage? Yes, how and why?

R. Hulpiau and R. Pieck. *Listy Cukr.*, 1984, **100**, 173-175 (*Czech*).

A short account is given of the history of thick juice storage, and guidance is offered on preparation of the tanks to take the juice, suitable treatment of the juice prior to storage and on microbiological control. The quality of sugar produced from stored thick juice and storage economics are discussed. While the major disadvantage of the scheme is the increased fuel consumption, this can be offset by the financial gains resulting from the increased campaign processing.

1 *I.S.J.*, 1983, **85**, 54.

Technical and economic considerations on thick juice storage

A. Faaborg-Andersen. *Listy Cukr.*, 1984, **100**, 176-179 (*Czech*).

Experience with thick juice storage in the Danish sugar industry is described, and the economics are examined. While thick juice storage is a practical alternative to factory expansion without the high capital costs and reduces sugar losses associated with deterioration in climatic conditions as the campaign progresses and with long storage periods, the value of the extra white sugar produced has to be balanced against the extra costs of steam consumed in the post-campaign processing of the juice; at current sugar prices and with rising production costs (particularly those of energy), cost-effective measures must be found in order to make thick juice storage economically practical.

Chemico-technological factors in thick juice storage

K. Bohn. *Listy Cukr.*, 1984, **100**, 179-184 (*Czech*).

Laboratory and full-scale experiments on thick juice storage are reported, in which deterioration was negligible provided the initial storage temperature was below 15°C, the juice Brix 67-69° and the pH 8.5-9.0. Also of importance was a minimum possible bacterial count. The laboratory trials lasted 240 days, and the two factory tests 92 and 113 days. Formalin at 13 g/m^2 juice surface area was applied at 14-day intervals, and the juice remained without surface protection throughout storage.

Production of filter cake with low moisture content from carbonatation mud

A. F. Johnsen. *Sugar Tech. Rev.*, 1984, **11**, 187-208.

Research on pressing of carbonatation mud to a solids content of approx. 70% has been conducted for some years by the Danish sugar industry, since there are problems associated with treatment and handling of mud of higher moisture content. Two systems that are in use in four factories are described. In both, the 1st carbonatation mud is separated by filter-thickener after which, in one system, it is treated in a Lasta fully-automatic filter-press manufactured by a DDS subsidiary company under licence from Japan and especially developed for use in the sugar industry; the first stage is filtration, followed by pressing at 4-5 bar, sweetening-off and a final pressing at approx. 20 bar. Every other filter plate is a conventional recessed type, while the alternate plates (also recessed) are provided with rubber membranes. The filter cloths move up and down in adjacent chambers when the press is being emptied, so as to allow the cake to fall out, and are then washed with spray nozzles. In the second system, the mud is first treated by rotary vacuum filters and then by a DDS vacuum filter-press[1-3], involving both a low- and a high-pressure stage as with the first system; there is no sweetening-off stage, however. The major advantages of each type of filter-press are listed.

Managing the piling station to minimize losses

E. R. Muller and C. L. Peterson. *Zuckerind.*, 1984, **109**, 854-858, 860.

Investigations in 1980 and 1981 concerned damage to beet and deterioration in storage piles caused by different types of piler as used in Idaho, USA. In all the methods studied, the beets travel from the receiving hopper on a continuous belt through a blocking gate, then pass up an incline to a height of 5-6 m, drop 10-30 cm onto a cleaning screen, then a further 0.5-1.6 m into a tub from which they are fed to a rubber-flighted boom elevator, rotating on a gantry, which distributes the beets across the face of the pile. The pilers were either a single continuous unit as described or a double unit, with separation between the primary inclined conveyor and the cleaning screen. Seven configurations of screen were investigated, but all had grab rolls and/or rubber reinks. Results showed that the rubber reinks caused much less injury and tissue loss than the grab rolls, that beet injury rose with the number of rolls, and that time lost in piling accounted for about 10% of the overall piler operation time. Storage losses increased with weight loss, injury and/or temperature. A number of recommendations are made whereby piling losses may be reduced.

Maturing 2nd carbonatation juice

K. P. Zakharov *et al.* Sakhar. Prom., 1984, (9), 15-18 (*Russian*).

A large portion of the $CaCO_3$ dissolved in unfiltered 2nd carbonatation juice resulting from conventional purification as used in Soviet sugar factories is in a supersaturated state. One of the measures to reduce this supersaturation is ripening, whereby the juice is thoroughly mixed and held for a given time at 90°C. The effect of this on the lime salts content in the juice after subsequent filtration was investigated as a function of raw juice quality, the juice purification process used and carbonatation juice pH. Results showed that, where the juice was not limed before 2nd carbonatation, holding for 5 minutes reduced the lime salts content in the filtered juice, but longer ripening gave no further improvement. Where juice was limed before 2nd carbonatation, ripening had a positive effect only if the pH of the carbonatation juice was below optimum; otherwise, there was either no effect (when the pH was optimum) or there was a marked increase in lime salts (at a pH above optimum).

1 Madsen: *I.S.J.*, 1978, **80**, 314.
2 Madsen *et al.*: *ibid.*, 1980, **82**, 350.
3 Idem: *ibid.*, 1981, **83**, 123.

Sugar refining

The viscosity of dilute sugar solutions

L. A. Sapronova and A. B. Luk'yanov. *Sakhar. Prom.*, 1984, (7), 22-24 (*Russian*).

Mathematical treatment of data from the literature and of values obtained by the authors of this article has yielded a graph of viscosity *vs.* molar concentration for refined sugar solutions of 0-40% concentration in the temperature range 0-90°C. Appropriate equations for calculation of log viscosity are developed, and values of factors for substitution in the equations are tabulated for purposes of simplifying the calculations. A worked example is presented. This complements earlier work covering the concentration range 40-84%[1].

Cane sugar refining in a beet sugar factory

L. Toth. *Cukoripar*, 1984, **37**, 56-62 (*Hungarian*).

The Fremont, Ohio, beet sugar factory of Great Western Sugar Co. processes thick juice during a post-campaign period of 60 days. However, in 1978, 25,000 tonnes of cane raw sugar delivered by road was refined over a period of 138 days between April and September. Details are given of the raw sugar composition and of the plant operations, including affination and melting, carbonatation and filtration which proved more difficult than with normal beet juice processing because of the small particle size of the $CaCO_3$ and the high Brix of the liquor (75°). Equipment was especially installed for active carbon decolorization and ion exchange demineralization. Of the three vacuum pans normally used, the largest (of 48 m^3 capacity) was used to boil refined sugar from a 96.5 purity massecuite (made up of fine liquor plus green syrup), while the 40 and 28 m^3 pans were used to boil recovery massecuites of 92, 84 and 74 purity to give, after melting and reboiling, a sugar that came close to white sugar in quality. A 60 purity massecuite was also boiled. Some of the factory plant was repaired during the refining period, while that used for refining was overhauled during the 40 days' shutdown prior to the campaign, which proved to be unaffected by the raw sugar processing.

Adsorbent decolorizing systems—the pros and cons. Granular carbon

J. D. McManus. *Proc. 43rd Ann. Meeting Sugar Ind. Technologists*, 1984, 92-95.

On the basis of experience with the granular carbon station at the Westcane refinery of Atlantic Sugar Ltd. in Canada, advice is given on operation and supervision of carbon decolorization plant. The station, comprising six adsorbent columns operating in three parallel lines, suffered a loss of just under 4% in 1983, while expected decolorizing performances is at least 80%, and inversion no greater than 0.05%. Costs of the carbon and plant operation are indicated.

Five-year review of the Revere low-temperature carbon regeneration system

W. L. Reed and M. O'Brien. *Proc. 43rd Ann. Meeting Sugar Ind. Technologists*, 1984, 108-124.

Operation and performance of the granular carbon plant at the Charlestown refinery of Revere Sugar Corporation[2] since 1974, particularly regeneration of the spent carbon at 1000-1200°F, are reported. Carbon loss averages 4.80% by volume (3.49% by weight). Annual average colour removal has ranged from 65.1% to 79.7%, and in 1984 was 69.5% at an average colour input of 979 units.

Computer control of the white sugar refining process

D. T. Schweitzer. *Proc. Amer. Contr. Conf.*, 1983, **2**, 372-375; through *Ref. Zhurn. AN SSR (Khim.)*, 1984, (14), Abs. 14 R425.

The system described is based on measurement of four variables: pressure and massecuite temperature, level and Brix. The optimum graining point is determined from the pressure and temperature, while the level and Brix are required for syrup feeding. The pressure regulator is actuated by the vapour withdrawal valve and its setting determined by computer. The syrup feed valve is also linked to the computer which gives commands for its opening and closing as a function of massecuite concentration. The steam pressure in the calandria is controlled by a DDS system with dispatcher, which is also used to maintain a given supersaturation until graining. Use of a computer ensures a high degree of reproducibility and thus a high quality of massecuite. The program is so structured that one computer can control a number of functions simultaneously without any breakdown. The system has resulted in a considerable increase in pan throughput while maintaining a constant high quality of massecuite.

Continuous vacuum crystallization at Nantes refinery. Energy saving in crystallization

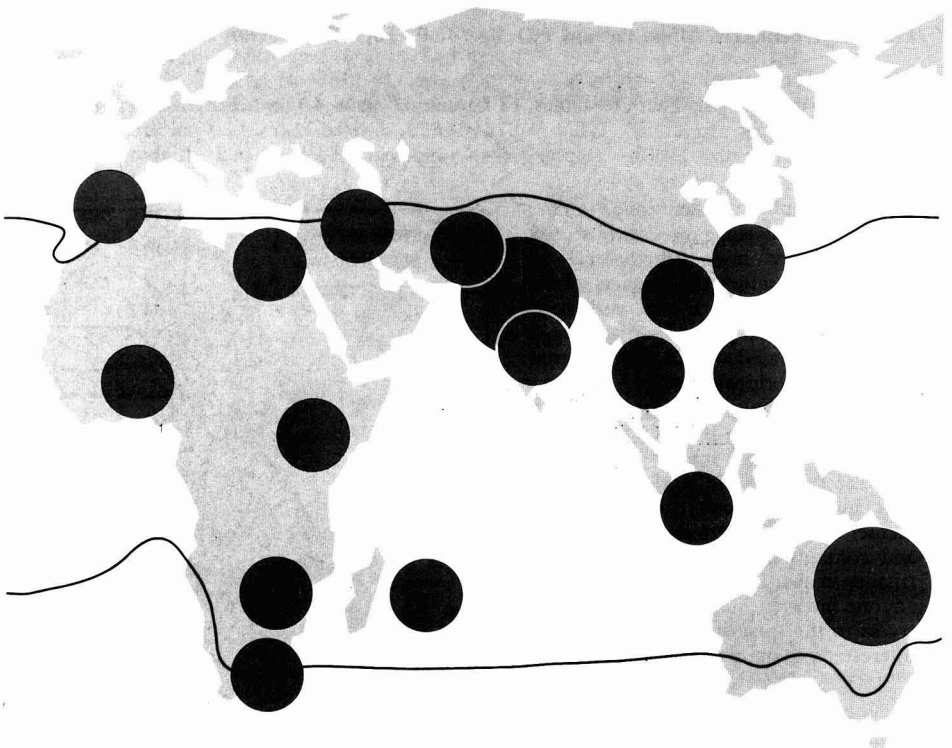
J. Cuel. *Ind. Alim. Agric.*, 1984, **101**, 591-597 (*French*).

The heat balance of the new scheme[3], which involves just two strikes and cooling of the *A*-massecuite under vacuum, is calculated, thereby demonstrating how the system has permitted a considerable reduction in steam consumption by comparison with the previous system. The advantages of vacuum crystallization over conventional cooling with water are indicated, and the results reported earlier are confirmed.

1 Sapronova: *I.S.J.*, 1984, **86**, 7A.
2 Reed: *ibid.*, 1979, **81**, 134.
3 *ibid.*, 1984, **86**, 109-113.

HELMUT BLUME

GEOGRAPHY OF SUGAR CANE



VERLAG DR. ALBERT BARTENS

Helmut Blume

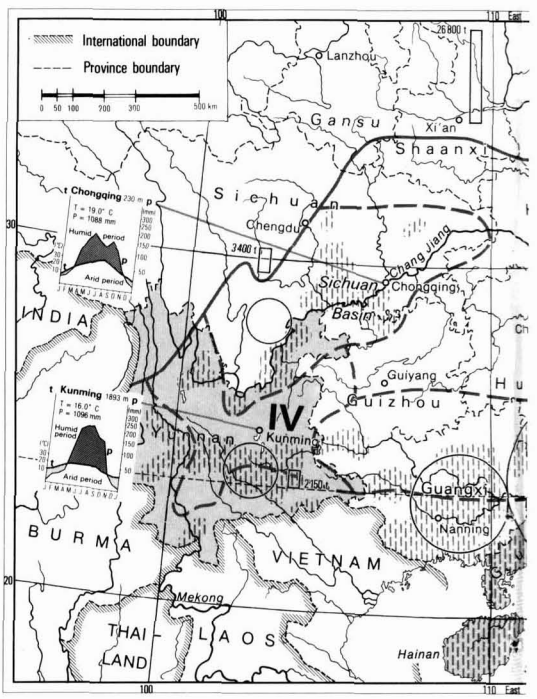
GEOGRAPHY OF SUGAR CANE

Environmental, structural and economical aspects of cane sugar production

Edited by: Verlag Dr. Albert Bartens, P.O. Box 38 02 50, D-1000 Berlin 38 (W. Germany)

1985. XX and 392 pages with 84 tables, 13 figures, 33 maps, 40 photographs and a world map of cane sugar production. ISBN 3–87040–033–1. Size 22.6 x 15.8 cm. Hardcover. Price: DM 180.– plus DM 6.– shipping costs (approx. US-$ 55.– incl. shipping costs)

The "Geography of Sugar Cane" is a major study analysing the world's cane sugar industry in a geographical approach. It examines the impacts of the natural environments as well as those of the organizational patterns on cane sugar production. Based on the author's comprehensive world-wide survey and case studies, the book investigates the efficiency of cane sugar production throughout the world and, finally, concentrates on cane sugar in the world's economy. This innovative book provides an immense array of up-to-date information and contains numerous original and intriguing maps. It will appeal as much to anyone involved in the cane sugar industry as to the specialist academic and the interested general reader.



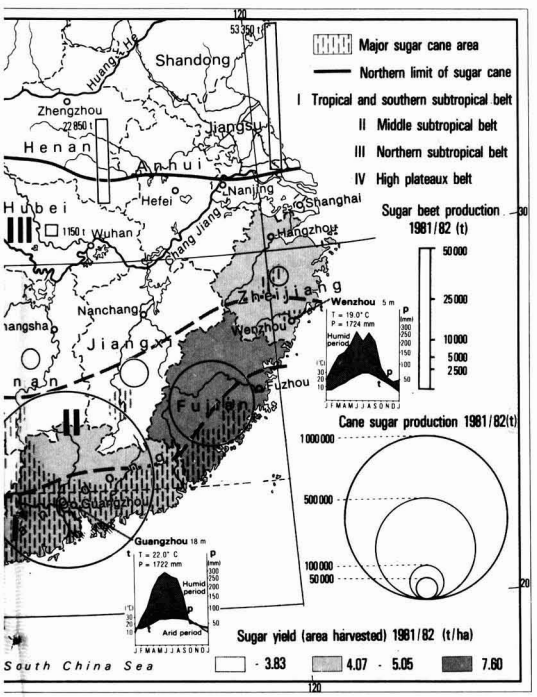
Map 27:
Cane sugar production in the People's Republic of China, 1981/82.

Sources: Guangzhou Institute of Geography, Academia Sinica, and Sugarcane Industry Research Institute, Ministry of Light Industry, Guangzhou, 1983.

TOPICS discussed:

- **All major sugar cane regions**
- **Influence of environment on yield**
- **Structural systems**
- **History of cane cultivation**
- **Economics of cane and cane sugar production**

The author:
Helmut Blume, Dr.rer.nat., Hon.D.Sc. (Durham, England) is Professor of Geography at the University of Tübingen, Federal Republic of Germany. He is the author of several successful books and numerous articles on various subjects in the field of geography.



CONTENTS:

A. Sugar cane and its use by man
Sugar cane as an agricultural resource.
Sugar cane and cane sugar production in the past

B. Sugar cane and environment
Environmental aspects of sugar cane production
The sugar cane plant and varieties. Environmental determinants, hazards and influences on yield. Classification of countries according to yield
Case studies of sugar cane agriculture in various environments
Argentina (Tucumán), Australia, Barbados, Brazil (Campos Region, Rio de Janeiro, Zona da Mata, Pernambuco), Colombia, Ethiopia, Guyana, India (southern), Iran, Iraq, Malawi, Peru, Portugal (Madeira), South Africa, Spain (Costa del Sol), Sudan, USA (Louisiana)

C. Organizational structures of cane sugar production
Socio-economical aspects and structural systems
Plantation systems, their history, development and influence on today's sugar cane agriculture
Case studies of main structural systems in commercial cane sugar production
Argentina (Jujuy), Australia, Bahamas (Abaco Island), China, Cuba, Dominican Republic, Egypt, Fiji, India (northern), Indonesia (Java), Jamaica, Japan, Kenya, Mauritius, Mexico, The Philippines, South Africa, Taiwan, Thailand, USA (Hawaii), Zambia

D. Efficiency according to structural systems and environment: a tentative comparative evaluation

E. Cane sugar in the world's economy
Cane sugar versus beet sugar
Cane sugar in the world trade
Classification of cane sugar producing and exporting countries

F. Conclusions (in English, French, Spanish and German)

Appendix, Bibliography, Index

ORDER FORM

I herewith order

..... copy(ies) "GEOGRAPHY OF SUGAR CANE" for DM 180.–
plus DM 6.– shipping costs (approx. US-$ 55.– incl. shipping costs)

Name/Full address (please print)

.....

.....

.....

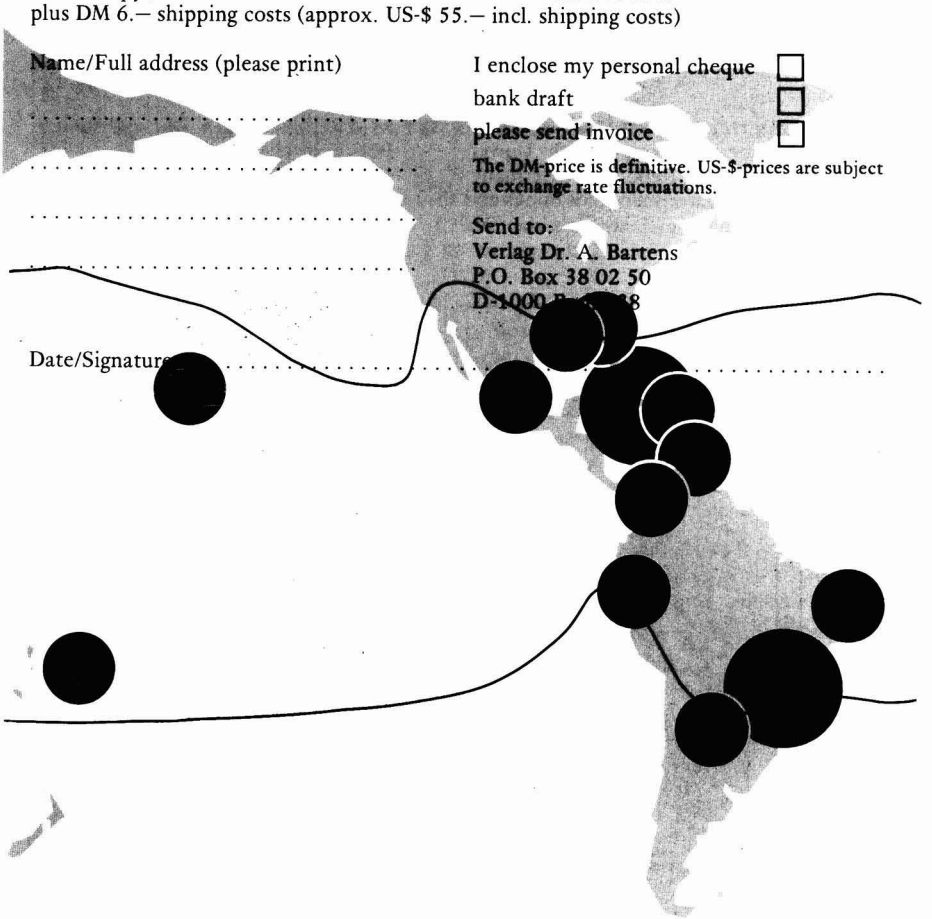
.....

Date/Signature .....

I enclose my personal cheque ☐
bank draft ☐
please send invoice ☐

The DM-price is definitive. US-$-prices are subject to exchange rate fluctuations.

Send to:
Verlag Dr. A. Bartens
P.O. Box 38 02 50
D-1000 B[illegible]8



Laboratory studies

Spectrophometric determination of inorganic phosphate in sugar cane juice and other sugar industry materials by means of vanadomolybdic reagent

B. Guzmán. *Rev. Ind. Agríc. Tucumán,* 1983, **60,** (1), 17-32 (*Spanish*).

The method of Rodella[1] for analysis of phosphate in sugar process materials has been studied. It was found that measurements at 400, 420, 440 and 460 nm and different P_2O_5 concentrations of the colour produced with the vanadomolybdic reagent were stable with time. The presence of sodium bisulphite in the range 100-1000 mg/litre (expressed as SO_2) did not effect the absorbancy of the coloured solution. Samples of primary, mixed and clear juice and syrup did not in general require pre-treatment but samples of juice from the rotary filter had to be centrifuged and analysis carried out on the supernatant so as to avoid inclusion in the measurement of the inorganic phosphate present as insoluble matter. Because of its simplicity the method is suitable for routine analysis.

Polluting capacity of filter cakes produced by Tucumán sugar factories

G. J. Cárdenas and B. Guzmán. *Rev. Ind. Agríc. Tucumán,* 1983, **60,** (1), 59-67 (*Spanish*).

The COD values of filter cake samples from Tucumán sugar factories ranged from 535,000 to 968,000 ppm on a dry solids basis. For material as it leaves the filters, with 75% moisture content, the COD ranged from 133,750 to 242,000 ppm. Practical difficulties in measuring BOD for heterogeneous and insoluble material limited results to only three samples, which were 39,750 to 71,598 ppm in the moist cake; this indicated that 1 tonne was equivalent to the pollution capacity of 733-1326 persons/day. Good agreement was found between COD and organic matter content, COD and C% and COD and (C+N)%. The relationship between COD and N% was poor.

Heat of combustion of filter cakes produced in Tucumán sugar factories

G. J. Cárdenas, B. Guzmán and S. M. Brú. *Rev. Ind. Agríc. Tucumán,* 1983, **60,** (1), 81-95 (*Spanish*).

Heats of combustion of 31 filter cake samples from 14 sugar factories and two seasons were measured and related to their composition. Graphs and linear regression equations are presented for the relationship between the heat of combustion and organic matter, volatile matter, fixed carbon and total carbon. The experimental values are compared with those calculated on the basis of the lipids, proteins, total reducing sugars and fibre contents of the samples and their individual heats of combustion. An equation was also obtained for the influence of the cake's water content on its heat of combustion. Ash from the cake showed no sign of melting up to 1000°C.

Influence of sodium sulphite on the effectiveness of purification of concentrated sugar solutions

A. P. Koziavkin, N. J. Odorodko and L. D. Bobrovnik. *Centro Azúcar,* 1983, **10,** (2), 35-48 (*Spanish*).

In order to determine the optimum pH for treatment of concentrated sugar solutions, such syrups, of 65°Bx and of various purities, were heated under reflux at different temperatures and the effects of different amounts of added Na_2SO_3 measured at intervals. The results are presented in tabular and graph form, and it is concluded on a basis of colour formation, change of pH and variation in solution composition that the optimum pH for effective sulphite action at 80°C was 7.40-7.85.

Effect of metallic impurities on the form and size of sugar crystals. I.

R. A. Hernández L. and P. Rosa A. *Centro Azúcar,* 1983, **10,** (2), 57-66 (*Spanish*).

Laboratory experiments were carried out in which sugar was crystallized from solutions containing Na, K, Ca or ferric ions, each in one of two concentrations. The presence of K was found to have a negative action on the formation of crystal nuclei; the largest crystals were obtained in the presence of Ca ions which are considered to favour crystal growth. In the presence of Na, K and Fe ions, the crystallization was poor or nil; with the latter, sucrose deposition on the surface in an ordered manner was inhibited and many cracks appeared. The higher levels of the ions had a greater effect than the lower concentrations.

Study of the interaction of calcium with different cane juice components

G. Fernández M., M. Darias P., Y. Rodríguez R. and L. D. Bobrovnik. *Centro Azúcar,* 1983, **10,** (2), 85-98 (*Spanish*).

Solutions were prepared containing 1.5 g $CaCl_2$ in 50 ml conductivity water, 15% sucrose, 0.01M of various non-sugars (including alanine, aspartic and glutamic acids, glycyl glycine), 0.5% of albumin and dextran, and also solutions of 15% sucrose, etc., which contained 1.5 g $CaCl_2$ per 50 ml. Fractions of the solutions were brought to pH 7.0, 8.0, 9.0 and 11.0 by addition of 2N KOH and the conductivity measured at 25°C. In a further series of experiments, 14-g quantities of a cation exchange resin KU-2,8 was added to 50 ml of each of the above solutions, stirred for 90 minutes, separated, and the calcium content measured and compared with that before resin treatment. The measurements are tabulated, and it is concluded from them that a complex is formed between the sucrose and Ca ions, the stability of which increases with pH. Complexes

1 *I.S.J.,* 1977, **79,** 115.

are also formed between Ca ions and glutamic and aspartic acids, the strength of the interaction increasing with pH. It is inferred from the results that complexes are formed between Ca ions and glycyl glycine and also between Ca ions and albumin and dextran, the interaction increasing with pH. The presence of sucrose influenced the interaction between the Ca ions and the various substances studied.

Sucrose crystal growth activation energies from pure and impure solutions

V. Maurandi, G. Mantovani and G. Vaccari. *Zuckerind.*, 1984, **109**, 734-739.

In continuing their investigations of crystallization kinetics, the authors compared growth rates of large sucrose crystals (weighing approx. 100 g) in pure and impure sugar solution at 15, 20 and 25°C and relative flow rates of 1.6 and 16 cm/sec. The growth rates were determined by weighing before and after immersion. Results substantiated the earlier finding that the activation energies of both the surface reaction and mass transfer were largely independent of purity, what little effect the impurities did have being almost the same as that of temperature. The mass transfer activation energy was much lower than that of the surface reaction, even in the impure solutions.

The effect of temperature on calcium carbonate solubility in water and aqueous sugar solutions

N. M. Podgornova, V. M. Perelygin and I. F. Bugaenko. *Sakhar. Prom.*, 1984, (8), 23-25 (*Russian*).

Reference is made to differences between $CaCO_3$ solubility as found by various authors, and experiments are reported on determination of carbonate solubility in 15% and 60% sugar solutions at temperatures in the range of 25-95°C. Data are tabulated, and it is recommended to carry out 2nd carbonatation at 80-85°C; at >85° there is a sharp increase in solubility, which would lead to accumulation of carbonate in the juice and increased scale formation in subsequent processes. Equations derived from that of Cesaro & Russo defining the relationship between $CaCO_3$ solubility and temperature[1] have given values in close agreement with the experimental data.

A rapid method for determining the degree of contamination of beet cossettes with mucilaginous bacteriose

Yu. B. Navrotskii, A. A. Lipets, A. M. Shevchenko, V. P. Evich and M. A. Isakova. *Sakhar. Prom.*, 1984, (8), 28-30 (*Russian*).

An indirect method of determining the degree of contamination of beet tissue by slime-forming bacteria such as *Leuconostoc mesenteroides* and *L. dextranum* is based on red coloration of the tissue in the presence of an alcoholic solution of methyl red (healthy tissue changes to yellow). The pH of affected cell juice falls to a value in the range 4.2-6.0, depending on the degree of contamination. The procedure involves adding 30 ml of a 60% ethanol solution containing 0.1% indicator to 300-400 g of beet brei in a 1-litre flask, to which is added distilled water; after 1 minute, the solution is poured off and the solids dried with filter paper and weighed. The red portion is weighed separately and expressed as a percentage of the whole. Application of the method at one factory is mentioned; the adverse effect of the bacterial infection on juice quality is discussed.

Viscosity of sugar solutions

M. Mathlouthi and P. K. Kasprzyk. *Sugar Tech. Rev.*, 1984, **11**, 209-257.

A review, with 155 references to the literature, is presented of the theory and basic relationships of viscosity of pure and impure solutions, including sucrose, massecuite and molasses. It is pointed out that most of the equations involved are derived from polymer studies, and that empirical relations used in the sugar industry are generally adapted from the basic equations. Methods used for viscosity measurement are surveyed, and application of the knowledge of the rheological properties of molasses and massecuites to establishment of optimum conditions for crystallization, molasses exhaustion and pipeline conveying is discussed. The effects of specific non-sucrose components on the viscosity of sucrose and of beet and cane molasses are indicated by tabulated values of their viscosity index.

The density of ammoniated sugar solution

G. Halasova, A. Smelik and E. Belajova. *Listy Cukr.*, 1984, **100**, 169-173 (*Czech*).

The NH_4^+ cation can attach itself to the water molecule and thus bring about changes in the density of a given solution; the electron pair in the ammonium hydroxide molecule leads to ready acceptance of a proton from other compounds such as sucrose, which acts as a weak acid in water. The effect of 0.08% NH_4OH on the density of sucrose solutions of 20-68% concentration was studied with a dilatometer at temperatures in the range of 20-80°C at 10° intervals. Results showed that the ammonium hydroxide caused an increase in density at only the lowest concentration of sucrose, whereas it caused a fall at all other concentrations studied, particularly above 50%. In all cases, density fell with rise in temperature at constant concentration. The density pattern demonstrated qualitative and quantitative character of the intermolecular interaction of the components in the ammoniated sucrose solution.

1 *J. Chem. Educ.*, 1978, **55**, (2), 133-134.

By-products

Anaerobic filter treatment of molasses fermentation waste water

M. J. T. Carrondo *et al. Water Sci. and Technol.*, 1983, **15**, (8-9), 117-126; through *S.I.A.*, 1984, **46**, Abs. 84-1039.

Two anaerobic filters were used to assess the treatability of a high-strength acidic vinasse from fermentation of cane molasses; it contained up to 3000 mg SO_4^{--}/litre. The vinasse had to be neutralized and buffered before treatment. The filters operated at ambient temperature (18-29°C). After the start-up period, tests were carried out at hydraulic detention times of 2.5 and 5 days, organic loads of 2-12 kg COD/m^3 per day and hydraulic loads of 0.2, 0.4 and 0.5 m^3/m^3 per day; this was arranged by using diluted or undiluted vinasse of COD 10,000-50,000 mg/litre. COD removals varied from 57 to 79%, and removal rates as high as 6.8 kg COD/m^3 per day were obtained. Although gas outputs were reasonable, reaching 4.8 m^3/m^3 per day, the methane content was always below 40%, and high concentrations of H_2S were detected. The filters were operated for 7 months without sludge removal.

Saccharification of untreated agrowastes during mycelial growth of mushroom *Termitomyces clypeatus* on solid beds

S. Sengupta, A. K. Naskar and M. L. Jana. *Biotechnol. Bioeng.*, 1984, **26**, (2), 188-190; through *S.I.A.*, 1984, **46**, Abs. 84-1069.

The above mushroom was tested for use in production of reducing sugars from cellulosic wastes. Mycelia were grown on solid media containing bagasse or other wastes as carbon source. Formation of saccharifying enzymes was less on bagasse than on wheat bran, but formation of reducing sugars after 9 days was much greater, 71% by weight saccharification of the carbohydrates in bagasse was achieved, and the hydrolysate contained only glucose and no xylose.

The effect of wort acidity and yeast strain on the formation of fermentation products in alcohol fermentation of molasses

A. M. Kuts and V. F. Sukhodol. *Izv. Vuzov, Pishch. Tekh.*, 1984, (3), 126-127 (*Russian*).

Investigations of molasses fermentation at pH 4-7 showed that optimum for alcohol yield was pH 5.1 for V strains of yeast, 5.3 for G-75 hybrid and 5.4 for G-112 hybrid. pH shift away from these values caused a fall in the stability of the wort, but at all pH values the V strains yielded more alcohol than the hybrids. The active acidity of the wort had a substantial effect on the formation of alcohol impurities; the hybrids formed more volatile impurities than the V strains under all conditions, although the total volatiles in the wort fell significantly with pH rise from 4 to 7 regardless of yeast type, thus tending towards a higher quality of rectified alcohol. With rise in pH there was increase in the sugar consumption for glycerine and biomass formation, whereas the total sugar consumption in formation of aldehydes, acids, higher alcohols and complex esters fell. All the yeasts studied had a considerable ability for self-adjustment of the pH of the medium towards the optimum, although the hybrids were more capable of this than the V strains in the weakly acid and neutral regions.

Conservation of sugar cane syrup by application of gamma radiation

A. L. Van Zeller, A. J. de Oliveira and E. A. Zago. *STAB*, 1984, **2**, (4), 29, 32-36 (*Portuguese*).

Samples of syrup of about 63°Bx were irradiated with gamma rays from a ^{60}Co source and the effects of treatment on reducing sugars and total sugars measured. No significant changes were found for dosages of 10-40 kGy, nor for doses between 0 and 10 kGy. Microbial counts were made for syrup samples treated with these smaller doses, and the minimum irradiation dosage for inhibition of micro-organisms was calculated as 12.67 kGy. Fermentation tests with compressed yeast (*Saccharomyces cerevisiae*) were carried out on the treated syrups; no effect on efficiency was observed. Samples of syrup were irradiated with 10 kGy and stored with untreated samples under ambient conditions for 150 days; sugar loss was 1% against 15% for the controls, and apparent increases in viscosity of the latter were observed.

The ion exchange properties of beet pulp

N. P. Shelukhina and G. V. Koshchieva. *Sakhar. Prom.*, 1984, (8), 27-28 (*Russian*).

On the basis of the ion exchange properties of pectins, appropriate treatment of beet pulp (containing 20-25% pectins) will yield a product suitable for juice deliming. Cross-linkage of the pectin molecules is brought about by treatment with formaldehyde in an acid medium; the methylated acetoxy groups are converted to carbamyl groups by ammonia, while acid treatment frees the carboxylic groups. The resultant product was tested on lime salts removal; in H^+, NH_4^+ and Na^+ forms it had a deliming efficiency of 68.2%, 45.1% and 39.8%, respectively.

Separate treatment of distillery sludge: an approach to increase in the yield of alcohol

P. L. Kulkarni. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1982, BG.1-BG.4.

Experiments are reported in which sludge from the bottom of the fermenters was filtered (instead of being discarded with the distillery

waste) to provide an extra 1.2-1.5% alcohol.

Unconventional use of filter mud as a by-product for distemper and graphite substitute

S. T. Anjal and S. A. Kulkarni. *Proc. 32nd Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1982, BG.5-BG.10.

Tests were conducted on treatment of filter cake to provide a base for distemper; the process involved carbonizing of the mud over an open fire, whereby a black powder was obtained as a side-product which could be used as graphite powder substitute for use in iron moulding. The possible use of filter cake as a fuel together with bagasse is suggested.

Ethanol

Anon. *Proc. Econ. Int.,* 1983, **4,** (4), 35-36; through *Ref. Zhurn. AN SSSR (Khim.),* 1984, (14), Abs. 14 R367.

An experimental plant for alcohol manufacture from sugar factory waste is described. The yield of 99.8% alcohol is 15 m^3/day, and that of methane from the fermentation process 3000-15,000 m^3/day. Steam consumption is high at 1.2-1.76 kg/litre of absolute alcohol, depending on the alcohol concentration in the mash and on the target product purity. The medium, containing 5% alcohol (by volume), is heated and then transferred to two parallel operating columns for impurities separation by steam from two distillation columns to which the mash is sent next. The aqueous alcohol is concentrated to 96% in the first of two rectification columns; the bottoms are transferred to a column for impurities removal, while the bottoms from the distillation columns are used to preheat the initial feed and are then discarded. If the alcohol concentration is to be raised to 99.8%, a dehydration column is used with steam from the reboiler. Cyclohexane is used as dehydrating agent in the azeotropic process used.

Four years of experimentation on supplemented, super-pressed pulp

J. P. Vandergeten and R. Vanstallen. *Publ. Trimest. Inst. Royal Belge Amél. Betterave,* 1984, **52,** 75-84 (*French, Dutch*).

A report is presented of trials on ensilage and feeding of beet pulp pressed to 22% dry solids and supplemented with beet or cane molasses, urea, minerals and vitamins. Molasses fed *ad libitum* plus 1 kg straw per animal and a small amount of vitamin mixture have provided a daily ration suitable for beef cattle fattening.

The benefits of molassed sugar beet feed for today's dairy farmer

G. Macleod. *British Sugar Beet Rev.,* 1984, **52,** (3), 61-63.

Molassed sugar beet as a fodder for dairy cattle has the advantage of being a major source of energy and providing sufficient digestible fibre to prevent both the fall in rumen pH often associated with acid silage and the formation of lactic acid (which in large quantities can cause lameness) resulting from high-starch diets. The subject is discussed with the aid of graphs and tabulated data.

Dairy farmers, milk quotas and molassed sugar beet feed

G. Macleod. *British Sugar Beet Rev.,* 1984, **52,** (3), 64-65.

The question of feeding dairy cattle is discussed against the background of the EEC milk quotas, and the advantage of molassed sugar beet feed as a highly digestible, high-energy fodder that encourages the efficient utilization of available grass or conserved forage is discussed.

Considerations on the recirculation of substances in alcoholic fermentation and distillation

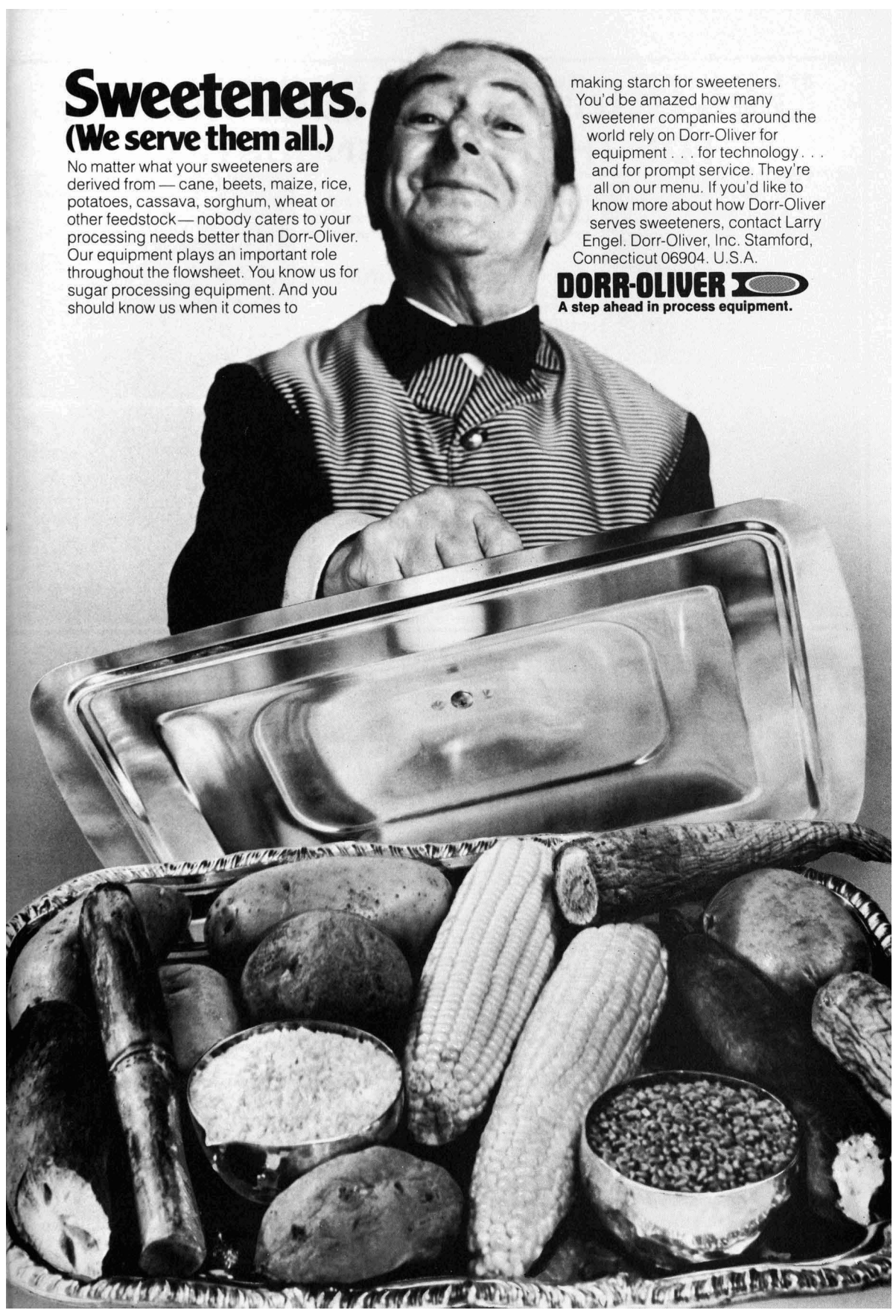
J. P. Stupiello. *STAB,* 1984, **2,** (5), 35-37 (*Portuguese*).

The inadvisability of recirculation in fermentation is indicated by graphs showing the inhibitory effect of certain impurities—lactic acid, acetaldehyde, *n*-propanol and glycine—while the effects of others are discussed. Centrifuging of the yeast can separate most of the impurities before returning the cells for further use. Contamination of refluxes in the distillation of the fermentate is also discussed, with mention of cooling of condensers, variation in pressure and condensate efficiency.

Galo Bravo distillery

Anon. *STAB,* 1984, **3,** (1), 4-7 (*Portuguese*).

A description is given of the title autonomous distillery, with details of the location, capacity, cane agriculture—varieties, planting methods, cultivation, fertilization, weed and pest control, harvesting, loading and transport as well as use of residues (bagasse, filter cake and vinasse)—and industrial details—cane reception, milling, juice treatment, fermentation, distillation, alcohol storage, and steam and electricity generation. Operational data from the 1984 season are listed.


Sweeteners.
(We serve them all.)
No matter what your sweeteners are derived from — cane, beets, maize, rice, potatoes, cassava, sorghum, wheat or other feedstock — nobody caters to your processing needs better than Dorr-Oliver. Our equipment plays an important role throughout the flowsheet. You know us for sugar processing equipment. And you should know us when it comes to making starch for sweeteners. You'd be amazed how many sweetener companies around the world rely on Dorr-Oliver for equipment . . . for technology . . . and for prompt service. They're all on our menu. If you'd like to know more about how Dorr-Oliver serves sweeteners, contact Larry Engel. Dorr-Oliver, Inc. Stamford, Connecticut 06904. U.S.A.
DORR-OLIVER
A step ahead in process equipment.

Each figure also shows the typical temperature profile for a single-burner oil-fired dryer with temperature differences of 600°C. This verifies the improved temperature distribution from the HGG installation.

Figure 9 shows the temperature distribution at the outfall duct and has been included to show that the various outlet and recycle duct temperature measurements are unlikely to have been affected by stratification of gas flow.

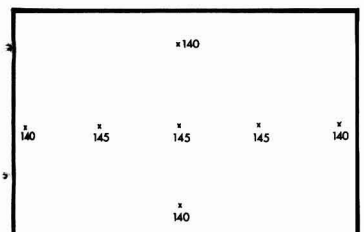


Fig. 9. Outfall temperature traverse, °C

Mass balances

The pulp and water mass balance (Table IV) shows a dried pulp production, including cyclone dust, of 32.6 tonnes in 9 hours or 87 tonnes/day with an evaporation of 197 tonnes/day of water. A previous test on this dryer gave a dried pulp production of 78 tonnes/day with an evaporation of 147 tonnes/day of water.

The output figures for the test compare very favourably with other tests undertaken on 2.0 metre pulp dryers. It would appear that the use of the HGG giving a high moisture content resulting from recycled gas has not adversely affected the pulp dryer capacity.

Gas mass balance

The balance shown in Table V has been derived from the coal mass, the gas analysis and the water evaporated. The significant feature is the high level of ingress air at more than 2.0 kg/sec. Part of this ingress air is utilized as combustion air, effectively reducing the effect of ingress to just under 1.2 kg/sec. The water content of the gas is 0.5687 kg water/kg dry gas.

The mass balance shown in Table VI is based on the gas volume measurements taken at the chimney, in the recycle ducts and in the forced-draft fan intake. This has been used in conjunction with the water evaporated to produce a balance, the densities used being based on the gas analysis.

To achieve a balance, an air ingress of 2.122 kg/sec is required; this compares favourably with that shown in Table V. A comparison of the combustion and excess air requirements in Table V with that available from the combustion fan verifies that part of the combustion air for Table V is derived from the recycle gas. The dry air required from the recycle gas is 1.0255 kg/sec, and from Table VI that supplied is 1.0595 kg/sec. The total products to chimney become 6.7810 kg/sec, comparing favourably with the measured value of 6.7464 kg/sec.

It should be remembered that the flow measurements are made in large ducts, particularly the chimney, using a limited number of sample points; accurate results cannot be expected for the gas flow measurements.

Ash balance at HGG outlet

The ash balance shown in Table VIII indicates a very low combustible carry-over. The analysis of collected material shows a 63.63% combustible content and the trace element balance shows a recovery of between 50 and 60%. Based on this analysis the corrected ash balance (Table IX) was produced. The corrected quantity is more than twice the actual quantity collected.

The expected accuracy for collection at this point would be not better than ±50%; this still leaves a wide discrepancy. It is interesting to note that the dust collected in the recycle duct by this method was less than 50% of the quantity collected by British Sugar using different equipment. This discrepancy is being further investigated.

Carbon balance across the HGG

The carbon balance shown in Table X is based on the revised ash analysis. The carbon loss is high but the samples were collected immediately at the HGG outlet and carbon would continue to burn in the hot gas ducting. Combustion of the nett carbon from Table X would result in a change of 1.42% CO_2 on dry flue gas. The actual change was 1.27 and so it would appear that not all the carbon was burnt.

The carbon balance also assumed that the combustible in recycle gas was all carbon, which is unlikely, and thus the nett carbon loss would be higher. There is some combustible material estimated at 0.55 kg/hr added with the dilution gas after the collection point. It seems likely from this evidence that the final carbon loss at the bullring is of the order of 1% on coal.

Heat balances

The simplified heat balance is shown in Table XI, in which the losses have been grouped together at just under 20%, giving just over 79% heat to water, with less than 1% heat to pulp.

Table XII shows the losses in more detail. The significant feature is the heat to ingress air at more than 2%. It should be noted, however, that this dryer has not yet been fitted with effective bullring and outfall seals.

Table XIII shows the heat balance on nett output, i.e. based on the change on heat content, and not on the absolute heat content above some datum. The combustibles in dust are assumed to have a calorific value of 23,250 kJ/kg, i.e. about half-way between those of dried pulp and carbon. The dust is equivalent to 12.58 kg/hr of carbon or a carbon loss of 1.37%.

It would appear that the equivalent carbon loss from the dryer is of the same order as the carbon loss from the HGG.

The unaccounted loss is just over 2.0%. This balance, however, does not take into account the heat input from combustion of dust in the recycle gas. The increase in heat input is just over 1%; the losses will also increase, however, since the water evaporated from this pulp dust has not been included, nor has its combustion loss. The corrected unaccounted loss is therefore estimated at 2.4%.

Although the data are shown in some cases to several places of decimals this is not intended as an indication of accuracy but to avoid rounding errors. The heat balance would not be expected to have

an accuracy better than ±2%. The radiation and convection loss is based on still air and is likely therefore to be higher in practice.

Other sources of error are in the gas analysis, owing to stratification of the gas stream at the HGG outlet, in the volume flow rate and in dust collection, owing to the duct size and number of sampling points. The major source of error is likely to be in the coal measurement; although the coal was accurately weighed, the estimation of total coal usage required the coal level in the hopper to be restored to exactly the same level as at the start of the text. A 3% error involves approximately 27 kg of coal and is a likely margin of error in assessment of coal level in a bunker.

Control response

The dynamic response tests have shown that the bullring temperature on the pilot plant responds significantly more slowly than the HGG outlet temperature. The extent to which this is a feature of the pilot plant alone has still to be established. The non-linear response of the HGG outlet temperature will make accurate control by fuel modulation extremely difficult. The present indications are that HGG – fired dryers are more suitable for a base-load operation with modulation of the pressed pulp feed to maintain steady conditions. Measurements of dried product moisture were not made during the response tests, since the principal interest was in the operation of the HGG. However, it is recognized that control of final product moisture remains the true aim of the control system.

Conclusion

The HGG-fired pulp dryer produces a satisfactory product with acceptably low levels of trace elements. The capacity of the dryer has not been affected by the HGG although the gas humidity is increased by recirculation. The gas temperature stratification at the bullring has been virtually eliminated. Sand and carbon carry-over from the fluid bed are both at very satisfactory levels. The calculated gas flows produce a satisfactory balance giving good comparison with the measured flow. The thermal balance shows a higher than expected unaccounted loss but this is most probably a function of the coal measurement. Thermal efficiency is acceptable although improvements will be made by reducing the ingress air.

Acknowledgements

The Authors wish to take this opportunity to express their thanks to the Directors of British Sugar plc for permission to prepare and present this paper, to the management and staff of Brigg factory for their invaluable assistance and co-operation with the performance tests, to the Energy Equipment Company Ltd. for the installation of test points in their plant, for the provision of additional staff and equipment to assist with the performance evaluation, and their help with the evaluation of the results, to Lodge Cottrell Ltd. for the high-temperature grit and dust testing at the HGG outlet and in the recycle duct, to the management and staff of British Sugar's Central and Research Laboratories for the analytical work involved, and in particular to Mr. R. T. Phillipson for his work on the trace element balances, to Messrs. H. E. Smith and D. Thomas of British Sugar Central Offices for their assistance with the performance tests and in the evaluation of the results, and to Mr. R. D. Morgan of British Sugar Central Offices for his work on the control response tests.

Literature

"Trace elements in dried pulp" by D. Hibbert, R. T. Phillipson and W. Woodwark *(Paper presented at the 23rd Tech. Conference, British Sugar Corp. Ltd.,* 1976).

"Technical Data on Fuel" edited by H. M. Spiers.

"Chemical Engineers Handbook" by Perry (McGraw-Hill), 1973.

"The Efficient Use of Steam" by Goodall (IPC) 1980.

Summary

A fluid bed hot gas generator was installed at Brigg sugar factory for use in pulp drying. An account is given of the installation and the performance testing which was carried out as well as examination of pulp quality, mass and heat balances and control response.

Evaluation de la performance dans le sèchage des pulpes sur lit fluidisé utilisant du charbon comme combustible

On a installé à la sucrerie de Brigg un générateur de gaz chaud en lit fluidisé pour le sèchage des pulpes. On décrit l'installation et l'évaluation de sa performance qui fut effectuée tant au point de vue qualité de la pulpe qu'au point de vue balance de masse et de chaleur et facilité de contrôle.

Bewertung eines kohlebefeuerten Fließbettheißgas-Erzeugers für die Schnitzeltrocknung

Ein Wirbelschichtheißgas-Erzeuger ist in der Zuckerfabrik Brigg für die Schnitzeltrocknung eingebaut worden. Beschrieben werden die Installation und die durchgeführten Versuche, sowie die Untersuchungen des Schnitzelqualität, die Massen- und Wärmebilanzen und die Regelungsempfindlichkeit.

Evaluación del funcionamiento en el secado de pulpa de una cama fluidizada empleando carbón como combustible

Se ha instalado en la azucarera de Brigg un generador de gaz caliente en cama fluidizada para uso en el secado de pulpa. Se describen la instalación y la prueba de funcionamiento que se ha efectuado tanto como el examen de la calidad de la pulpa, obtención de balanzas de masa y calor, y medición de respuesta a controles.

* * *

New sugar factories for India[1]

The Madhya Pradesh State Agro Industries Development Corporation is to set up a Rs 100 million sugar factory in Kareli Tehsil, in Narsinghpur District. It will have a crushing capacity of 1250 t.c.d. The foundation stone of a new sugar factory at Ghatampur, being erected for the Uttar Pradesh State Sugar Corporation Ltd., was laid on January 20, 1985; the factory will have a capacity of 1250 t.c.d. and it will cost Rs 106 million. The Corporation has applied for approval of the erection of 14 new sugar factories during the seventh Five-Year Plan period.

1 *Sugar Scene,* 1985, 3, (2), 15-16.

Development of new instruments for sugar mills

By S. R. Reichard
(Sugar Research Institute, Mackay, Queensland, Australia)

Introduction

As sugar mills become more automated, the need often arises to develop instruments especially suitable for the sugar industry. In recent years much of the design effort of the electronics group in the Sugar Research Institute in Mackay (Australia) has been devoted to devising just such equipment and four new designs have been completed at the Institute and handed over to equipment manufacturers. These are an instrument for measuring and controlling the reflectance of sugar in continuous centrifugals, a machine for detecting sugar crystals in molasses as an indication that a screen has been damaged in a centrifugal, a telemetry system for monitoring torque in mill tailbars and an automatic truck number reading system for cane transport. This paper outlines the basic operating principles and the physical features of the instruments.

A reflective meter/controller for low-grade sugar

The feed of massecuite and water to a low-grade continuous centrifugal can be controlled to produce a sugar of uniform colour and purity if a continuous measurement of the reflectance of the sugar near the top of the basket is used as the controlling variable. The principle was documented by Wright[1]. Further work in this field[2,3] confirmed earlier findings. Several commercially available instruments measure reflectance, but they all have to be placed close to the reflecting surface. They would have to be mounted inside the centrifugal, near the top of the basket, and would be unlikely to remain operational for long. There was need to devise a reflectance meter that could operate from a distance. A long-range light-beam switch, an instrument with an optical system capable of transmitting light and receiving its reflection over considerable distances (nominally up to 200 metres) was available. The optical

S. R. Reichard

system of the instrument appeared to meet the needs of this project, but its electrical output was a simple switch closure in response to beam obscuration. For sugar reflectance control, its electronic signal processing was too simple and had to be re-designed.

Physical features

The complete instrument for controlling reflectance consists of two units, connected by a multi-way cable. The first unit, the optical head, is mounted approximately one metre above the basket of the centrifugal, with its sensing light beam aimed through a small hole cut in the top cover of the centrifugal. This allows the sensing head to "see" from a safe

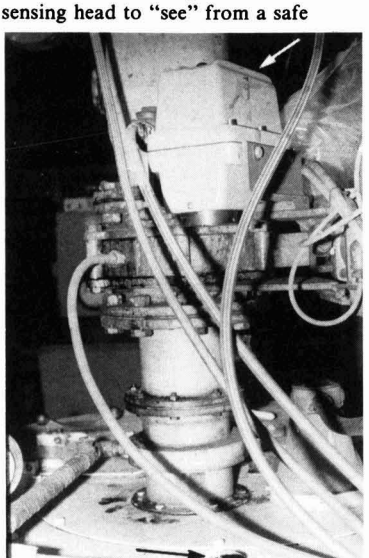


Figure 1. The reflectance measuring head (arrowed white) installed over a centrifugal; its light beam passes through the hole (arrowed black) in the centrifugal casing

distance the sugar as it leaves the basket. A second unit, mounted in a control room or control cubicle, houses the power supplies and amplifiers. The safety of the equipment is enhanced by the fact that the highest voltage in the unit mounted on the centrifugal is 15 volts. A prototype optical head is shown in Figure 1, mounted above its peep-hole in a centrifugal. The optical system of the instrument is shown in Figure 2. The light beam is chopped and this means that the measurement can be made unaffected by ambient light. Good stability is ensured by using a reference sample of light and processing it in an amplifier channel identical to that used for measurement.

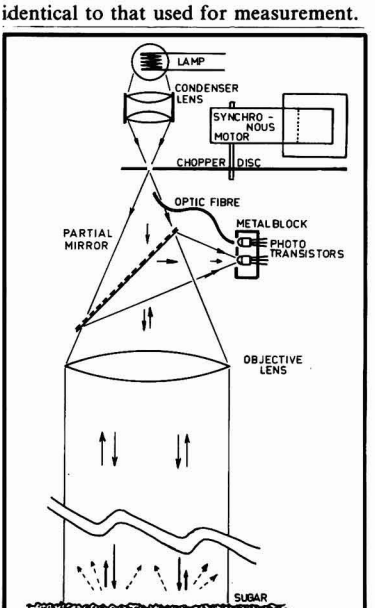


Figure 2. Optical system used in the sugar reflectance meter shown here simplified for clarity; in practice the optical path is folded to give more compact assembly

The output of this channel is then used to maintain the lamp at a uniform brightness. With uniform illumination ensured, the measuring channel just converts the measured reflected light

1 *Proc. Queensland. Soc. Sugar Cane Tech.*, 1977, 197-203.
2 Miller & Wright: *ibid.*, 1978, 79-84.
3 Hutchins *et al.*: *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 184-194.

signal to a 4-20 mA output proportional to sugar colour. A meter indication, presettable high level alarm and a lamp fault alarm are also provided.

Factory test and experience

The reflectance meter was installed in Goondi mill and tests were carried out over a period of two months. The results were reported by Reichard & Wearne[4]. The tests showed that the instrument was stable and accurate in the measurement of *C*-sugar reflectance, that it was robust and well able to operate in the factory environment, and that its output could be successfully used to control the massecuite feed, thus eliminating the need for operator attendance at the centrifugal. Several of these units are now being installed in Australian sugar mills.

Detector for sugar crystals in molasses

The screens in low-grade continuous centrifugals can become damaged, allowing sugar to escape into final molasses. Unless the damage is major, the operator often remains unaware of it, and the sugar losses can be significant and irretrievable. A machine for detecting abnormal presence of crystals in molasses was recently designed at the Sugar Research Institute in Mackay. The development is described by Reichard & Fitzmaurice[5]. The machine is extremely simple and effective. The operating principle can be explained by referring to Figure 3. A plain metal roll approximately 30 mm wide and 200 mm in diameter rotates slowly, driven by a small electric motor. The roll surface is in contact with the stream of molasses to be tested. A small quantity of molasses clings to the roll and is carried to a metal anvil bar which forces out most of the molasses over the ends of the roll. This molasses excess then falls back to the main flow. A small adjustable clearance (approximately 0.1 mm) exists between the roll surface and the anvil bar. A small amount of molasses passes through the gap and is then removed from the roll by a plastic scraper leaving the roll surface clean and ready to pick up the next sample of molasses. If there are no crystals in the molasses, the sample passes smoothly through the gap. However, if crystals larger than the gap are present, they are crushed between the anvil bar and the roll surface. As each crystal breaks, faint, but clearly detectable shock-waves are created in the metal of the anvil. An accelerometer (a vibration sensor) is rigidly attached to the anvil bar and produces electrical signals when vibrations (or shock-waves) are present in the anvil bar. In effect, the instrument collects a sample of molasses, crushes any crystals large enough to be caught between the anvil and the roll, and produces electrical signals from the resulting crunching noises. The accelerometer and its associated amplifying circuitry is so chosen that only the high frequencies (approximately 200 kHz) present in the sound of breaking crystal are amplified, and the low frequency vibration prevalent in sugar mills is filtered out. An analogue time-averaging integrator is included in the conditioning circuitry. Its output is suitable for plotting on a chart recorder. The recorder trace is near zero when the molasses is free of large crystals, and rises progressively as the rate of crushing crystals increases. A light signal is also available which flashes each time a crystal is detected. Two levels of crystal detection rate alarm are also provided.

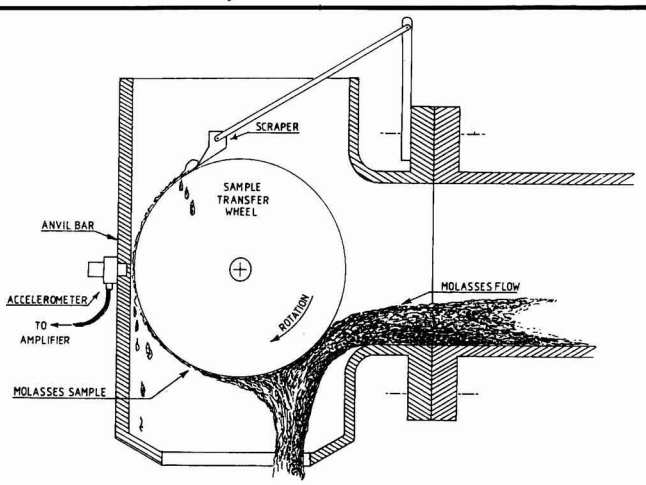


Figure 3. The crystal cruncher—principle of operation

Factory tests

The apparatus described above was tested at an Australian mill late in 1983. Figure 4 shows a prototype installed in the molasses outlet pipe on a BMA centrifugal. Test recordings of signals from the detector were made with the screens in good condition, and then repeated with screens that had been damaged to a varying degree. The results are shown in Figure 5. The upper recordings show "events", i.e. individual pulses triggered by the breaking crystals (or possibly other disturbances). The lower recordings show the analogue output of a time-averaging integrator, i.e. a trace indicating the pulse rate. Test I was made with good screens. Test II was with the same screens, after a 1.5 mm (1/16 inch) diameter hole had been drilled approximately in the middle of

4 *ibid.*, 1982, 405-411.
5 *ibid.*, 1984, 257-262.

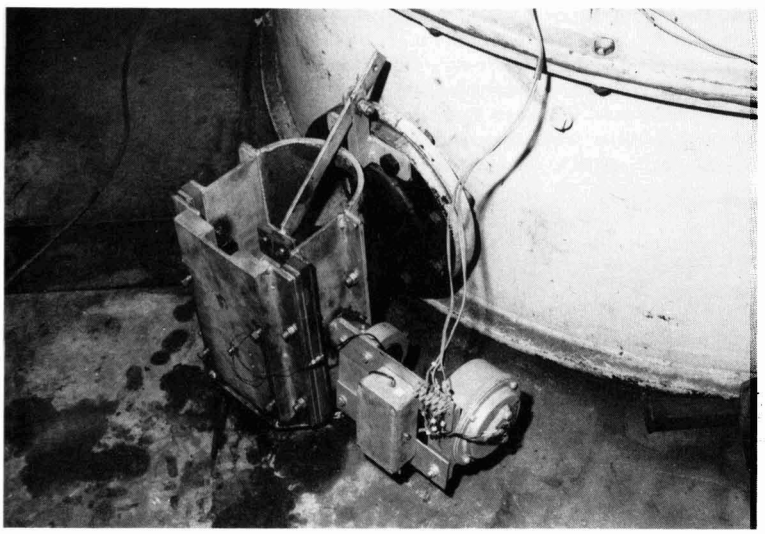


Figure 4. General view of the prototype crystal detector during the tests.

one of the screens. Test III was made with the same hole enlarged to 3.2 mm (1/8 inch) diameter. Then the drilled screen was replaced with another, extensively damaged unit. The effective hole size was 10,000 square millimetres (15.5 square inches). Test IV was then conducted and the outputs from the crystal detector were totally overloaded as shown in the recordings. The effectiveness of the machine in detecting even small holes in the screens is obvious from these recordings.

A telemetry system for torque monitoring

The desirability of monitoring the torque in rotating shafts is well known. The problems associated with the retrieval of a torsional signal from tailbars in sugar mills are also well known. The use of sliprings is simple in principle, but in practice the costs of installing and maintaining a successful system are high. Another method is to use short range telemetry, i.e. signal transmission by wireless means. Telemetry sets for continuous monitoring of torque have been available for many years. These sets supply power to the measuring circuitry on the shaft and transmit the torque signal from the shaft to a fixed receiver. They are designed for shafts smaller than sugar mill tailbars and they usually require the removal of a portion of the shaft or the modification of a coupling. Recently, a telemetry system was designed at the Sugar Research Institute specifically for the continuous monitoring of torque in mill tailbars. The system was described by Reichard & Vidler[6]. Like the commercially available systems, the new equipment feeds power to the measuring amplifier on the tailbar and retrieves a signal from the shaft using a set of magnetic coupling loops. However, the electronic circuitry is so designed that the electro-magnetic properties of the coupling loop are not critical, and therefore the coupling (effectively a rotary transformer) can be made to fit individual applications. Thus the equipment can be retro-fitted to a great variety of existing machines. The system was originally intended for mill control as described by Jacklin & Jenkins[7]. However, it has since been

6 *Ibid.*, 1981, 243-248.
7 *Ibid.*, 239-242.

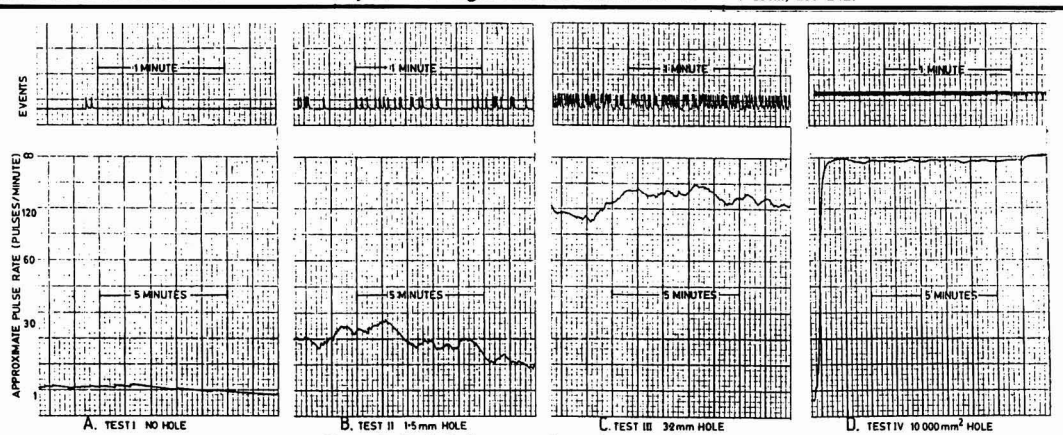


Figure 5. Typical chart recordings of crystal detection.

applied to a variety of tasks, for example, torsional vibration investigations, vacuum filter investigations, driving-chain testing and overload protection. Figure 6 shows an early model installed on a pressure feeder shaft of a 2.13 m mill.

from the shaft. One coil is wound on a mild steel ring former mounted on the shaft, the other is wound and retained on the inside of a second, slightly larger ring former. This larger former is located over the smaller ring, and attached by brackets to the gearbox

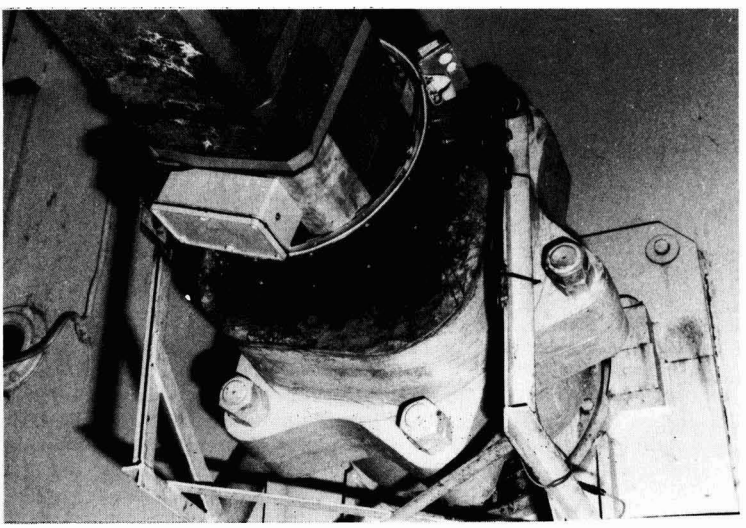


Figure 6. Telemetry installation on pressure feeder tailbar

Principle of operation

Inductive coupling between two coils is used for the wireless transmission of both power to the shaft and the signal

housing or other suitable stationary support. Figure 7 shows the mechanical arrangement of the two formers and coils. The section view through A-A

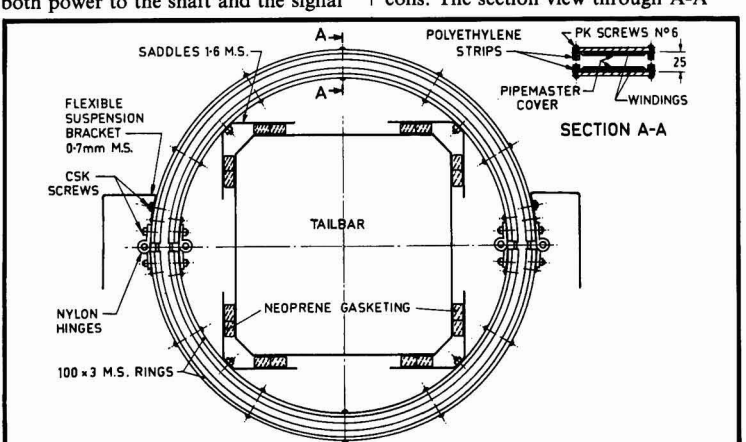


Figure 7. Mechanical arrangement of inductive coupling

shows the two windings, the fixed one on the inside of the larger ring, the rotating one on the outside of the smaller ring. Airspace separates them but they are coupled magnetically by a flux path that includes the widths of the steel rings.

The telemetry system is simple to install on existing machinery, and easy to calibrate and maintain where only a simple oscilloscope and multimeter are available. The standard output is a 2-10V signal proportional to torque with an adjustable high-level alarm. The circuitry is designed so that it will give a conservative high torque indication when component failure occurs. The system has been designed to be stable over a wide range of conditions. The linearity error is below 0.25%. The error due to temperature drift depends on the gain required in individual cases. In a typical tailbar application this is below±2% for a change of 25°C. This can be greatly improved by fitting a better class of device as the strain gauge pre-amplifier at a small additional cost.

An automatic cane bin identification system

Cane receival data entry can be facilitated by equipment which automatically reads and enters truck numbers into a computer file. In 1981 an investigation was undertaken by the Sugar Research Institute to determine whether any vehicle identification systems were available commercially, and whether they would be suitable for use on cane trucks in Australia. There were three systems which might be suitable, but none was without a serious drawback. They relied either on optical scanners, or on microwave transponders which made the system very costly if there were large numbers of trucks to be identified (as is the case in the Australian sugar industry). As a result, a new system was devised which reads reflective barcode labels using a solid state line-scan camera. It was described in detail by Reichard, Burns and Daly[8].

8 *ibid.*, 1983, 13-19.

Barcode labels for cane bins

The Sugar Research truck identification system uses a barcode for truck labels. A typical label is shown in Figure 8. It is made of a very durable reflective material similar to that used for road signs. The white bars represent the code, the black bars are spaces. Each digit of a number is represented by five white bars, two of which are always wide, the remaining three being narrow. A different combination of the two-out-of-five code is allocated to each of the ten numerals. The truck number in Figure 8 is "8742". The bottom digit (in this case 8) is a check digit. In this case it is calculated by dividing the truck number by 11 and taking the remainder.

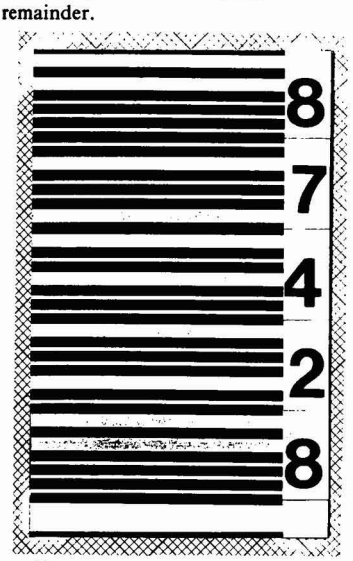


Figure 8. A barcode label for cane trucks

Reading and decoding of the barcodes

A truck number reading station comprises barcode label illumination lamps, a scanner and a decoding computer. The labels on the trucks are illuminated as they pass the reading station in order to give a high-contrast image of the barcode in the scanner. The illumination is from low voltage sealed-beam lamps. They can be run at a voltage well below their rating, so that their life is greatly extended.

The scanner consists of a line-scan camera and lamps. It is mounted beside the railway track, and aimed at the trucks so that the labels on the sides of trucks appear in the field of view of the camera as they pass the scanning station. The arrangement is shown in Figure 9. The line-scan camera designed for this application at Sugar Research is based on a solid-state linear array. The linear array is a row of 1028 photo-sensitive diodes which can be sequentially interrogated by a form of multiplexing circuitry. The linear array is mounted vertically, while the barcode bars are horizontal. If a real image of the barcode is formed on the array, and the diodes interrogated sequentially, a scan signal is produced consisting of high and low diode outputs. These diode outputs are converted to a series of long and short voltage pulses corresponding to the wide and narrow bars. This serial data signal is fed to interfacing circuitry and then to a microcomputer which decodes the information. Scans are made at a rate of approximately 145 per second, and each is evaluated by the computer as the label passes through the scanning line.

The decoding computer checks that the stream of data from the scanner contains the correct number of bars for each scan, and that there are two wide bars to every three narrow ones. Then digit values are allocated to each group of five bars, the truck number is assembled, the check calculation performed, and the calculated check digit compared with the scanned bottom digit of the code. If all these tests are in order, the scan is valid, and the number is fed out through an RS232 serial port. If any test fails, the scan is invalid, the data from it is discarded, and the next scan is processed.

Reading accuracy and success rates

Damaged, obscured or dirty labels may fail to yield a valid scan and may thus be "missed". The error detection built into the code ensures that numbers are either printed out correctly or not at all. This was confirmed in practical tests of the system over thousands of readings of barcodes on the sides of cane bins. The performance of a barcode reader can therefore be assessed in terms of its "success rate", i.e. the percentage of labels it can read.

A success rate of 100% is never attainable in practice; it depends on such factors as the amount and type of dirt collected on the labels, the speed with which the trucks move past the scanner, the distance between the scanner and the trucks, what temporary obstructions there may be in

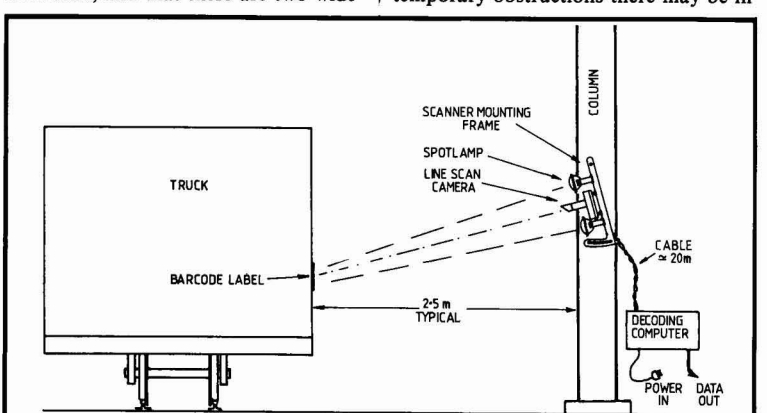


Figure 9. Sugar Research design of a cane truck number reading station

that space, the likelihood of label loss or mutilation, and the height tolerance that must be allowed in the placing of the labels on the trucks. Success rates can be greatly improved if the labels are periodically cleaned. They are improved further if the trucks are fitted with labels on both sides, and scanners are installed on both sides of the track.

Factory tests were conducted at an Australian mill over most of the 1982 crushing season. Success rates in excess of 95% were achieved without any cleaning of labels. This figure compares favourably with those quoted for other optical truck identification systems operating on railways. With minimal cleaning, such as for example a sprinkling of water twice a week, a single scanner can achieve success rates of 99.2% (twelve misses in 1500 number plates). If scanners were used on each side of the track, and labels on both sides of each truck, much better results can be expected because, if each scanner misses 0.8% of the labels, and the labels and scanners are independent of one another, the proportion of labels missed by both scanners would in theory be $0.8\% \times 0.8\% = 0.0064\%$, corresponding to a success rate of 99.9936%.

The solid state scanner is at least as successful at reading truck numbers as other optical scanners. It can achieve error-free number reading with a success rate far higher than that for human operators. It is particularly well suited to sugar mill conditions because the scanner can operate continuously with very little maintenance. Its installation and setting-up adjustments are similar to those for a closed-circuit televison camera and therefore familiar to sugar mill technicians.

Conclusions

The instruments that have been described above increase the tools available to the sugar technologists to monitor the performance of different aspects of the factory. Sugar Research Institute does not have its own manufacturing facilities and once a new design is finalized, patented and thoroughly tested, licensing agreements are arranged with suitable manufacturers to produce and market the equipment. Details of the manufacturers can be obtained from the Sugar Research Institute. The units described in this paper are covered by the following applications:

Australian No. 19999/83
—Load Monitoring Means
United Kingdom No. 8326403
—Load Monitoring Means
Australian No. 15348/83
—Article Identification Means
United States No. 435472 (1983)
—Article Identification Means
European No. 833015605
—Article Identification Means
United States No. 587963 (1984)
—Machine for Detecting Sugar Crystals in Molasses.

Summary

Four new developments from the Sugar Research Institute are described: a reflectance meter for continuous centrifugals, a machine for detecting sugar crystals in molasses, a short range telemetry system for monitoring the torque in cane mill tailbars and an automatic barcode reading system for cane truck identification.

Développement de nouveaux instruments pour les sucreries de canne

On décrit quatre nouveaux développements du Sugar Research Institute d'Australie: un mesureur de la réflectance pour les centrifuges continues, une machine qui détecte les cristaux de sucre dans les mélasses, un système de télémetrie à courte portée pour le contrôle du couple dans les tail-bars des moulins à canne et un système de lecture automatique de bar-codes pour l'identification des camions de canne.

Entwicklung neuer Instrumente für Rohrzuckerfabriken

Vier neue Entwicklungen des Sugar Research Institute in Australien werden beschrieben: Ein Reflektionsmeßgerät für kontinuierliche Zentrifugen, ein Gerät zum Nachweis von Zuckerkristallen in Melasse, ein Fernübertragungs-system über kurze Distanzen zur Aufzeichnung des Drehmoments der Verbindungs-stangen in Rohrmühlen und ein automatisches Strichcode-Lesesystem für die Identifizierung von Rohr-Lastwagen.

Desarrollo de nuevos instrumentos para ingenios azucareros

Se describen cuatro nuevos desarrollos del Sugar Research Institute de Australia; estos incluyen un metro de reflectancia para centrífugas contínuas, una máquina para la detección de cristales de azúcar en melaza, un sistema de telemetría de alcance corto para captar el torque de la espiga de salida, y un sistema automático para descrifrar codigos en barras para identificar camiones de caña.

* * *

Hungary sugar production, 1984[1]

Sugar production in Hungary in 1984 amounted to 407,000 tonnes, tel quel, against 476,000 tonnes during the previous year. However, the sale of sugar beet by the farmers rose from 3.47 million tonnes to 3.89 million tonnes, indicating that the percentage of sugar in the roots had fallen considerably.

Indonesia nears self-sufficiency in sugar[2]

Sugar production in Indonesia in 1985/86 is projected to reach 1.8 million tonnes, an increase of 200,000 tonnes over 1984/85 output and the government is continuing to give priority to expansion of cane area and factory capacity, as well as improvement in cane cultivation techniques and plantation and mill management whereby demand can nearly be met by domestic production. Population growth and increasing per caput consumption are expected to raise Indonesia's annual consumption of sugar to 2,665,000 tonnes by 1988. To achieve the necessary increase in production the Fourth Five-Year Development Plan stresses intensified planting and extension of plantations that use nucleus estates, development of 8000-12,000 hectare plantations and construction of sugar factories with capacities of 3000-5000 t.c.d. which will meet local demand and eventually export to markets both within and outside the ASEAN region.

1 C. Czarnikow Ltd., *Sugar Review*, 1985, (1735), 29.
2 *Indonesia Development News*, 1985, **7**, (5), 6.

Sugar Industry Technologists Inc.

44th Annual Meeting

The 44th Annual Meeting of S.I.T. will be held in St. John, New Brunswick, Canada, during June 2-5, 1985. In addition to a symposium on crystallization, under the Chairmanship of D. M. Humm of C & H Sugar Company, eleven papers are to be presented. These include "The changing world of white sugar manufacture" by Dr. M. C. Bennett, "Computerization of laboratory instruments" by Dr. C. C. Chou, "Current developments in colour research by SPRI" by Dr. M. A. Clarke, "Recent application of colour fractionation in CSR refineries" by D. J. Bardwell, J. R. Croker and N. H. Paton, "Theory and practice of counter diffusion of molasses and juice" by D. Scott, "The development of the sugar industry in the People's Republic of China" by S. K. Liu and Y. M. Huana, "The continuous vacuum mixer system at the Nantes refinery" by a representative of Beghin-Say, "Continuous vacuum pans on white sugar" by D. Bosse, "Automatic sugar boiling system using the rheometer" by T. Satori and H. Hoshimato, "Granulated sugar silo linings — the latest in fifty years of design" by A. P. Nielson, and "Repair and upgrading of the wooden lining of a granulated sugar silo" by A. D. Chapman.

Members attending the meeting will have the opportunity of a visit to see the operation of Lantic Sugar Ltd.'s refinery in Saint John, which has just celebrated its 70th anniversary.

Brevities and statistics

Argentina sugar exports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Raw sugar			
Canada	0	14,500	0
Chile	8,209	0	0
China	0	14,661	3,589
Egypt	0	11,623	0
Finland	0	16,131	10,284
Mexico	0	61,341	6,446
Morocco	12,000	15,000	14,000
Philippines	64,681	0	0
Portugal	0	49,272	14,698
Uruguay	1,350	0	0
USA	271,504	245,564	114,470
USSR	15,392	127,473	34,276
Venezuela	15,750	12,000	0
Other countries	180	0	0
	389,066	567,565	197,763
White sugar			
Chile	70,008	167,908	62,536
Kenya	0	12,392	0
Mexico	0	1,146	0
Nigeria	0	8,657	0
Paraguay	5,908	0	0
Peru	9,783	23,965	0
South Africa	0	29,661	0
Trinidad	8,913	0	0
Uruguay	0	24	217
USA	0	0	2,213
	94,612	243,753	64,966
Total exports	483,678	811,318	262,729

Zimbabwe distillery[2]

Zimbabwe is to erect a second fuel alcohol plant based on sugar cane. A 9000-hectare cane estate is planned for the distillery, studies for which have been performed by British and Indian experts. The African Development Bank will co-finance the project with a loan of US $30 million, together with the government and banks opening supply credits for the equipment.

Fiji sugar exports, 1984[3]

	1984	1983	1982
	tonnes, raw value		
Canada	0	0	16,936
China	20,537	44,082	43,708
EEC	181,934	181,032	168,961
Japan	30,309	0	14,092
Korea, South	12,569	0	0
Malaysia	67,803	53,068	36,547
New Zealand	22,418	23,177	71,763
Singapore	14,433	24,792	30,972
USA	35,509	18,987	31,746
	385,512	345,138	414,725

Rumania sugar production, 1984[4]

Beet sugar production in Rumania reached a record 805,500 tonnes, white value, in 1984, 45% more than in 1983. The beet crop amounted to 7 million tonnes against 4.82 million tonnes in 1983 and 6.7 million tonnes in 1982.

Spanish sugar quota offer by the EEC[5]

Spain has been offered a sugar quota of one million tonnes, made up of 950,000 tonnes of category A and 50,000 tonnes of category B sugar, under its accession agreement with the European Economic Community, according to the Executive Commission. For high fructose syrup, the Commission states that Spain has been offered A- and B-quotas of 75,000 tonnes and 8000 tonnes, respectively. In addition, it was agreed that Spain will be given a sugar intervention price higher than the normal rate if domestic demand outstrips supply.

European sugar beet area, 1985[6]

The second estimate of European beet areas is little altered from Licht's first estimate at the beginning of March[7]. In Western Europe, the largest change is a further increase of 20,000 ha for Turkey, partly offset by a reduction of 15,000 ha for Yugoslavia. The other amendments are of 4000 ha or less and the net change for Western Europe is from 2,548,000 ha to 2,561,000 ha. In Eastern Europe the Polish beet area is now expected to be 460,000 ha instead of 485,000 while that for Hungary is raised from 105,000 to 107,000 ha. All the other estimates are unchanged, and the total for all of Europe is now set at 7,426,000 ha instead of 7,436,000. The crop has had a bad start, with cold weather and frequent rain which have delayed sowings which could affect yields, particularly in Eastern Europe. Further, night frosts could damage already emerged seedlings.

New Cuban sugar factory[8]

A new sugar factory has been inaugurated in Villa Clara province and was built with the aid of consultants from the Soviet Union and East Germany, according to Havana Radio. The mill has a potential crushing capacity of 6600 t.c.d. to produce 700 tonnes/day of raw sugar.

Tanzania sugar factory reopening[9]

The Mahonda sugar factory in Zanzibar resumed production in December last after a two-year stoppage to facilitate major rehabilitation. This involved replacement of machinery and modification to cope with modern technology, and was funded jointly by the owners and the governments of China and Zanzibar. The factory, built in 1963 with a production capacity of 6000 tonnes of sugar per year, closed down in 1983 when production sank to 103 tonnes, for lack of local technical know-how, spare parts and foreign exchange. A special training program is being prepared for local technicians to replace those from China.

1 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, S100.
2 *Amerop-Westway Newsletter*, 1985, (136), 11.
3 *I.S.O. Stat. Bull.*, 1985, **44**, (2), 17-18.
4 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 134.
5 *Reuter Sugar Newsletter*, March 29, 1985.
6 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 215-217.
7 *I.S.J.*, 1985, **87**, 81.
8 C. Czarnikow Ltd., *Sugar Review*, 1985, (1735), 29.
9 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 178.

Brevities and statistics

US sugar import fee suspension[1]

On March 29, the US Secretary of Agriculture announced the suspension of import fees on raw sugar pending investigation by the US International Trade Commission. Operators and refiners who had withheld supplies from the market in anticipation of the suspension were expected to move sugar to the United States and prices were expected to move lower as a consequence until the nearby supplies were absorbed.

Correspondence

The Editor,
International Sugar Journal

Dear Sir,

Alcohol manufacture in Brazil

In your December 1984 issue you quote a report that the Brazilian fuel alcohol market for anhydrous alcohol is *decreasing* at a rate of 12% per annum and that our hydrated alcohol market is increasing at a rate of 30% per annum. Actually, as the figures for the last four years indicate, the Brazilian domestic market is growing steadily at an annual rate of 35%, mainly owing to the extraordinary performance of sales of automobiles running on neat hydrous alcohol.

	1981	1982	1983	1984
	million gallons			
Domestic market:				
Fuel—anhydrous	303	534	580	585
—hydrous	368	442	779	1,226
	671	976	1,359	1,811
Chemical industry	31	62	100	150
Other uses	75	91	103	164
Total domestic market	777	1,129	1,562	2,125
Exports	40	76	91	264
Grand total	817	1,205	1,653	2,389
Market growth	—	45%	38%	36%

Market growth is steady because ethanol automobile sales have been some 600,000 vehicles yearly and this alone means a consumption increase of 500 million gallons a year. Therefore, Brazilian production has to increase by at least 500 million gallons a year just to meet domestic growth.

The Brazilian domestic economy is quite active, as you can see.

Yours sincerely,
FERNANDO DE LA RIVA AVERHOFF
Comitê Esp. de Exportação dos
Produtores Brasileiros de Álcool

USSR sugar imports and exports, 1984[2]

	1984	1983	1982
	tonnes, raw value		
Imports			
Argentina	0	120,493	127,473
Australia	327,626	85,000	157,000
Austria	0	52,746	50,214
Brazil	909,150	1,005,024	362,115
Bulgaria	0	0	41,099
Canada	0	0	21,652
Colombia	21,400	35,000	36,000
Cuba	3,507,791	3,040,521	4,224,329
Czechoslovakia	51,965	1,083	0
Dominican Republic	53,568	286,131	193,777
EEC	735,431	897,567	1,263,322
Finland	0	25,981	4,300
Germany, East	7,870	225	21,652
Guatemala	10,745	0	64,373
Hungary	0	0	76,223
Mozambique	0	0	24,700
Nicaragua	0	22,750	5,079
Philippines	57,200	232,256	215,585
Rumania	3,247	61,723	45,255
Thailand	4,000	121,847	428,692
Zimbabwe	14,200	0	0
Unknown	0	9,743	0
	5,704,193	5,998,090	7,362,840
Exports			
Afghanistan	97,839	67,076	147,387
Benin	0	1,624	0
Bulgaria	0	4,330	0
Iran	0	0	65,728
Korea, North	0	433	0
Mongolia	38,605	36,667	32,854
Tanzania	2,733	0	0
Vietnam	10,826	5,413	10,826
Yemen, South	49,263	32,478	9,841
Unknown	4,297	0	0
	203,563	148,021	266,636

Japan HFS production cut planned[3]

About half of the 18 HFS producers in Japan plan to cut output during April-September in an attempt to boost prices which have fallen below production cost, owing to rising output and fierce competition. The 55% fructose product sells at 102 yen per kg against a production cost of 111 yen, but this is still below the refined sugar price of about 207 yen, kept artificially high to protect domestic beet and cane producers. After steep rises in the previous four years, HFS consumption rose by only 3% between 1982/83 and 1983/84.

International symposium on alcohol fuels

The seventh international symposium on alcohol fuels is to be held in Paris during October 23-26, 1986. It will be a continuation of the 6th symposium held in Ottawa in May 1984. The objective of the symposium will be to encourage exchanges on an international level among scientists, researchers, academics, economists, industrialists, public officials and businessmen concerned with the production and use of alcohol fuels. It will provide an opportunity for specialists to assess progress made in research and development, to examine the results of ongoing work, and to review the outlook in both industrialized and developing countries. French and English will be the official languages of the symposium and the proceedings will be published in a volume to be sent to all participants. Further information may be obtained from Mr. Pierre Leprince, Institut Français du Pétrole, B.P. 311, 92506 Rueil-Malmaison Cedex, France.

US refinery operations suspension[4]

Revere Sugar Corporation announced on March 25 that it was suspending refining operations at its only plant in Brooklyn, New York, owing to a lack of adequate financing. The Corporation is continuing to explore alternatives with several banks and buyers and hopes to be back in full operation shortly.

Great Western sugar factories sales[5]

The Mountain States Beet Growers Association is negotiating to buy eight GW beet sugar factories in Kansas and Colorado, together with their assets including white sugar stocks. Two of the factories are not operating and are now being used for storage. Michigan Sugar Company has tentatively agreed to buy Northern Ohio Sugar Company, a subsidiary of Great Western, which owns two beet sugar factories at Fremont and Findlay, Ohio. The Fremont plant is operational but the Findlay plant is used for storage. The purchase is conditional upon a commitment by growers to plant sufficient area to beet to justify opening the factories. The six GW factories in Nebraska, Montana and Wyoming bought recently by Tate & Lyle[6] will be operated by a new company, Western Sugar Co., headquartered in Denver[7].

Indian sugar imports and exports, 1984[8]

As against no imports in 1983, India imported 362,200 tonnes of sugar, white value, during 1984, all in the period September-December. The total included 197,200 tonnes from Brazil, 27,900 tonnes from Bulgaria, 24,900 tonnes from Cuba, 19,900 tonnes from France, 21,900 tonnes from the Philippines, 58,800 tonnes from South Korea, and 11,600 tonnes from the UK. Calendar year exports amounted to 284,126 tonnes, white value, and included 36,800 tonnes for Bangladesh, 47,500 tonnes for Egypt, 10,000 tonnes for Italy, 3 tonnes for Kuwait, 1500 tonnes for the Maldives, 15,550 tonnes for Nepal, 18,000 tonnes for North Yemen, 10,500 tonnes for Saudi Arabia, 17,400 tonnes for Somalia, and 126,873 tonnes for Sri Lanka.

1 *Amerop-Westway Newsletter*, 1985, (137), 1.
2 *I.S.O. Stat. Bull.*, 1985, **44**, (2), 45.
3 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 166.
4 C. Czarnikow Ltd., *Sugar Review*, 1985, (1736), 44-45.
5 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 206, 208.
6 *I.S.J.*, 1985, **87**, 81.
7 *Public Ledger's Commodity Week*, April 13, 1985.
8 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, S101.

Index to Advertisers

page

Contra-Shear Developments Ltd. x

Dorr-Oliver Inc. vii

Maschinenfabrik H. Eberhardt iv
Elba (Sales) B.V. ix

Finnsugar Engineering v
Fontaine & Co. GmbH ..... Cover IV

Krieg & Zivy Industries viii

Manville (GB) Ltd. i

Renold Conveyor vi

Starcosa GmbH ..... Cover II
Sugar Manufacturers Supply Co. Ltd. ii
Sugar Research Institute viii
Sulzer Delta Ltd. vi

I.S.J. BOUND VOLUMES

for 1983 are available at a price of £45.00. Volumes for 1982 are available at £40.00 while those for 1970-81 and certain previous years are also available at a price of £35.00, which includes 2nd class surface postage.

1st class surface or airmail postage costs will be charged extra if they are required.

reader inquiry service

If you wish to receive further information on the products and services mentioned in the advertisements please fill in the inquiry section of this card and post it to us.

photocopy service

We are able to supply one photocopy, for research or private study purposes, of most of the original papers abstracted in this journal. It should be noted that these are *not* translations but are in the original language of publication which, if not English, is indicated in italics in each abstract. The charge of £0.20 per page includes air mail postage and payment should be sent with the order.

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of £40.00 for supply by surface mail. The additional cost for air mail is £24.00.

FIRST FOLD

reader inquiry service

Please arrange for me to receive without obligation further details of the products referred to below which are advertised in your .....19.....issue.

Advertiser	Product	Page

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

SECOND FOLD

photocopy service

Please supply one photocopy of each of the following original papers, abstracts of which appeared in your .....19.....issue.

Page	Author(s)	Title

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

Payment of £ is enclosed

FIRST FOLD

THIRD FOLD AND TUCK IN

additional subscription order

Please send a further copy of your journal each month to the address below starting with the issue of

. . . . . .19 . . . . . .

Block Letters

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Signature . . . . . .

Date . . . . . .

I enclose cheque/draft/M.O./P.O. for £40.00/£64.00.

The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks,
England.

SUGAR BOOKS

Prices given below include insurance, packing and surface mail postage. They are approximate and subject to alteration without notice owing to fluctuations in currency exchange rates. Air mail postage extra will be quoted on request. Terms are strictly cash in advance.

Check your personal library against the list of basic books given below:

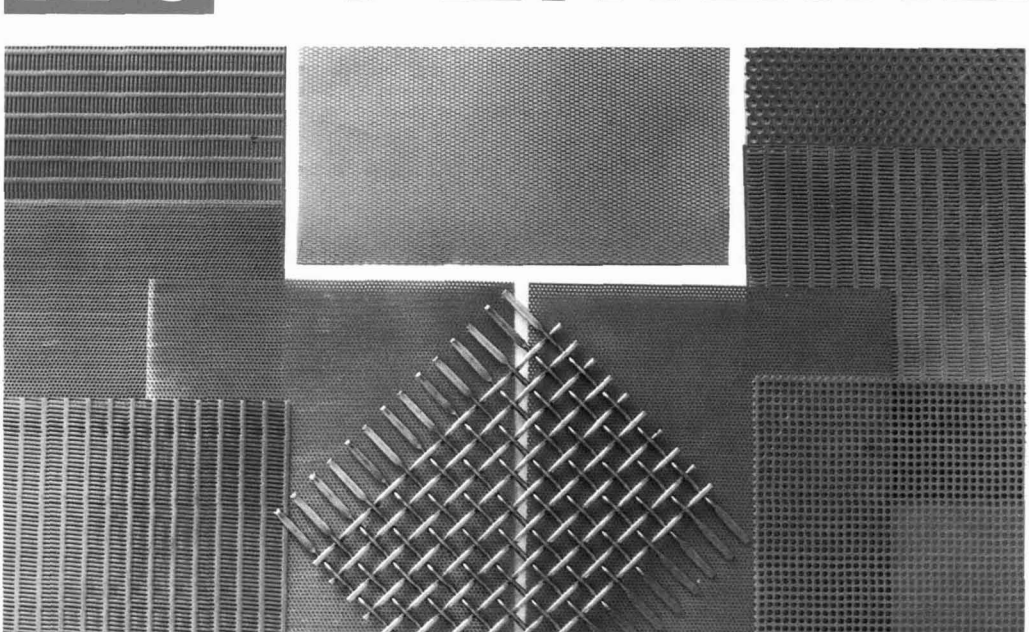
GEOGRAPHY OF SUGAR CANE: *Blume*	(1985)	**£51.40**
WSJ DIRECTORY OF THE WORLD SUGAR INDUSTRY	(1984)	**£230.00**
ELSEVIER'S SUGAR DICTIONARY: *Chaballe*	(1984)	**£55.40**
AUSTRALIAN SUGAR YEARBOOK 1984	(1984)	**£22.15**
F. O. LICHT'S INTERNATIONAL SUGAR YEARBOOK AND DIRECTORY	(1984)	**£39.90**
NOEL DEERR: CLASSIC PAPERS OF A SUGAR CANE TECHNOLOGIST: *Ed. Payne*	(1983)	**£83.25**
BEET SUGAR TECHNOLOGY (3rd ed.): *McGinnis*	(1982)	**£37.50**
UNIT OPERATIONS IN CANE SUGAR PRODUCTIONS: *Payne*	(1982)	**£32.05**
MANUFACTURE AND REFINING OF RAW CANE SUGAR (2nd ed.): *Baikow*	(1982)	**£98.30**
BY-PRODUCTS OF THE CANE SUGAR INDUSTRY (3rd ed.): *Paturau*	(1981)	**£46.75**
STANDARD FABRICATION PRACTICES FOR CANE SUGAR MILLS: *Delden*	(1981)	**£36.50**
THE EFFICIENT USE OF STEAM: *Ed. Goodall*	(1980)	**£48.75**
SUGAR ANALYSIS: ICUMSA METHODS: *Schneider*	(1979)	**£13.55**
CANE SUGAR HANDBOOK (10th ed.): *Meade-Chen*	(1977)	**£102.50**
PHYSICS AND CHEMISTRY OF SUGAR BEET IN SUGAR MANUFACTURE: *Vukov*	(1977)	**£64.75**
SUGAR BEET NUTRITION: *Draycott*	(1972)	**£16.15**
HANDBOOK OF CANE SUGAR ENGINEERING: *Hugot,* transl. *Jenkins*	(1972)	**£143.80**
PROCEEDINGS 16th (1974) SESSION ICUMSA	(1975)	**£7.80**
,, 17th (1978) ,, ,,	(1979)	**£22.75**
,, 18th (1982) ,, ,,	(1983)	**£18.00**
ANALYTICAL METHODS USED IN SUGAR REFINING: *Plews*	(1970)	**£24.50**
SUCROSE CHEMICALS: *Kollonitsch*	(1970)	**£6.25**
INTRODUCTION TO CANE SUGAR TECHNOLOGY: *Jenkins*	(1966)	**£52.20**
TECHNOLOGY FOR SUGAR REFINERY WORKERS (3rd ed.): *Lyle*	(1957)	**£18.95**

SUGAR BOOK DEPARTMENT

International Sugar Journal Ltd.

23a Easton Street, High Wycombe, Bucks., England

Fontaine



The outstanding maker of chromium plated nickel screens for continuous centrifugals. Also leading in brass, copper and stainless steel screens for batch centrifugals and filters.

Fontaine Screens have real conical holes or slots which are less prone to clogging, thus ensuring maximum filtering capacity and a uniform product.

Fontaine Pure Nickel Screens have a perfectly smooth working face, are acidproof, and are highly resistant to corrosion. The application of a hard-chromium layer to the working face ensures high resistance to abrasion and long screen life.

Fontaine screens are made according to the latest technology and are clearly leading in design and workmanship.

When you are thinking of screens, first think of Fontaine.

For full details contact FONTAINE & CO, GmbH, a member of the Putsch group.

Fontaine

Fontaine & Co. GmbH · 5100 Aachen/W.-Germany · Telefon (02 41) 15 40 33 · Telex 8 32 558
In the USA: H. Putsch & Company, Inc. · P.O. Box 5128 · Asheville, N. C. 28803 · Tel. (704) 6 84-0671 · Telex 577 443