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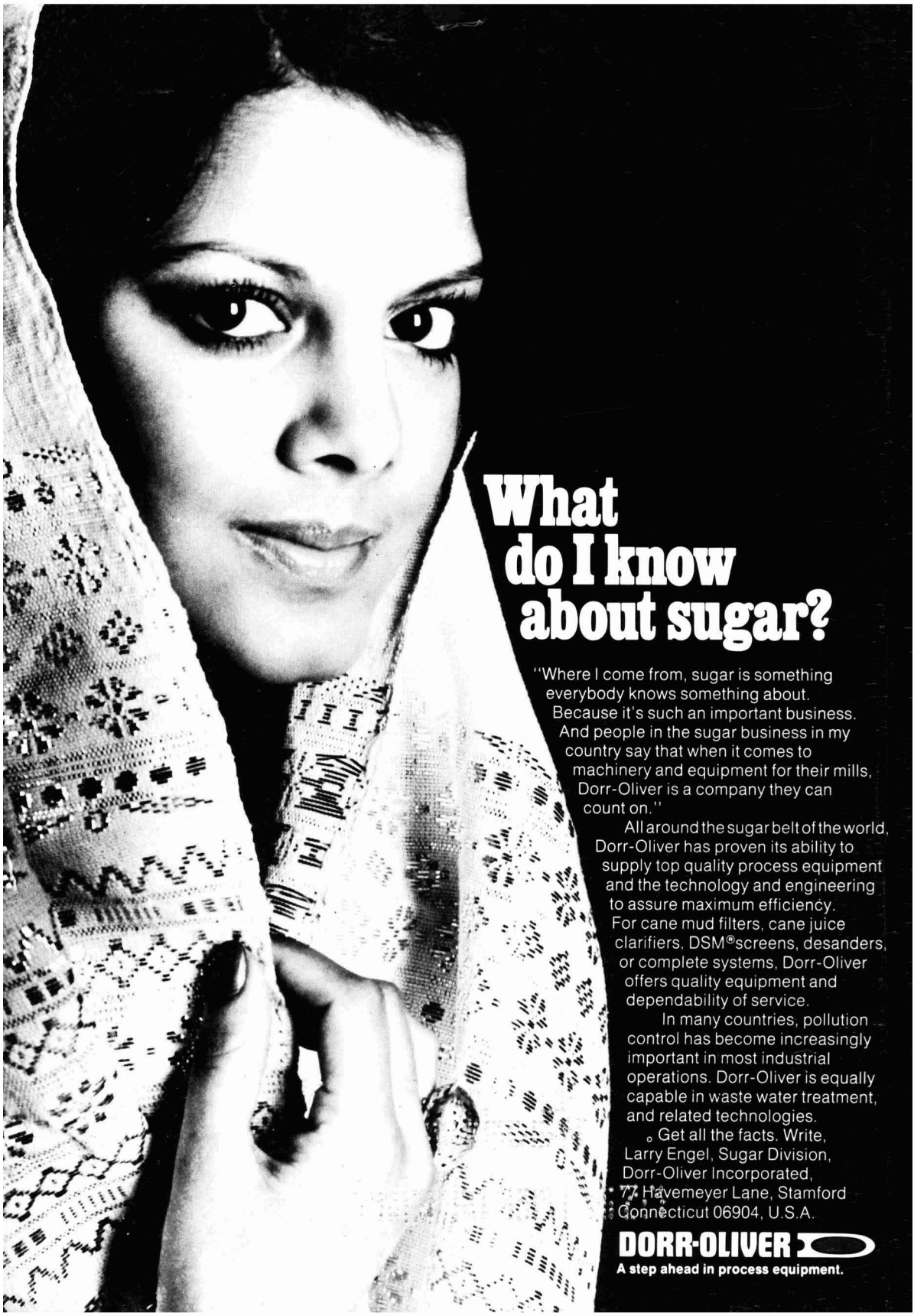
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NOTES AND COMMENTS

Sugar supply and demand in 1983

F. O. Licht GmbH have recently examined the prediction of sugar prices[1] on a basis of supply and demand and have examined the effect of using quarterly balances rather than annual figures. They used historical quarterly figures from 1980-82 and developed a model from which they could calculate corresponding figures for future quarters.

They conclude that, from a statistical point of view, there is little hope for a recovery in prices during the first two quarters of 1983. Production in this period is projected to remain fairly high if somewhat lower than in 1982. In the third quarter, production is heavily influenced by South America and in the fourth by Europe, although Africa and Oceania are also of influence. There is much talk of reduced plantings and it is very likely that production in the later half of 1983 will be markedly below that of the corresponding period in 1982.

Consumption is expected to grow by about 2% in the first half of 1983 and by about 3% in the second half. As a consequence, stocks will continue to grow in the first quarter but in a less pronounced manner than in 1982, while the drawdown in the second quarter will be more pronounced. The higher stocks in 1983 will limit upward price movements but psychological factors could bring about an improvement in prices when plans for production cuts begin to emerge early in 1983.

US sugar imports for re-export

Under a Presidential proclamation which has been announced, raw sugar is to be allowed to be imported into the United States free of quota on condition that it is re-exported after refining or "distilled into polyhydric alcohol". The Secretary of Agriculture is now authorized to issue details on the program and it is understood that consideration might be given to granting the same exemption in instances where the sugar will be re-exported later in the form of sugar-containing products[2]. In 1980 and 1981 the export of sugar by US refiners was considerable, owing to the possibility of reclaiming duty and fees paid on raw sugar imported up to three years before.

Mexico was the most important customer and refiners will hope to capture a proportion of this country's market in 1983; however, Mexico has already secured some of its supplies from Cuba and the EEC while a recent sharp rise in the domestic price is liable to reduce demand.

EEC farm price proposals

In December details were released of the EEC Commission's proposals for farm prices for 1983/84 which overall average about 4.4%. So far as sugar is concerned, however, it is proposed that prices for beet and for both raw and white sugar be raised by 4.0%. The intervention prices under these proposals would be 534.7 e.c.u. per tonne for white sugar and 443.4 e.c.u. per tonne for raw sugar. In addition, the Commission proposes reduction of the interest rate used in calculation of storage costs, in line with the fall in interest rates generally, and also proposes that the British "green pound" be revalued by 2.8% and the Dutch "green guilder" by 2.3%. The latter might help the Dutch sugar industry after July next, but it is reported that Suiker Unie, the Dutch sugar producing cooperative, was considering selling its sugar into intervention because the strength of the guilder meant that it could not be sold on the domestic market at the intervention price in competition with cheaper Belgian sugar.

European beet sugar production 1982/83

F. O. Licht GmbH recently published their second estimate of beet sugar production in Europe from the 1982/83 campaign[3]. While the EEC total is now expected to be 120,000 tonnes, raw value, higher than in the October estimate, the major change is expected in Turkey where output is expected to reach 1,730,000 tonnes against an initial estimate of 1,570,000 tonnes and 1981/82 output of 1,566,000 tonnes.

The Eastern European figure is almost the same as expected in October but this conceals a 400,000 tonnes drop in the USSR estimate and an increase of 282,000 tonnes in that for Poland. The European total is raised by a net 326,000 tonnes, bringing it to nearly the same level as the 1981/82 record.

	1982/83	1981/82	1980/81
	tonnes, raw value		
Belgium	1,195,000	1,120,000	868,000
Denmark	565,000	522,000	464,000
France	4,815,000	5,567,000	4,253,000
Germany, West	3,450,000	3,688,000	2,988,000
Greece	315,000	351,000	189,000
Holland	1,195,000	1,135,000	951,000
Ireland	212,000	183,000	161,000
Italy	1,293,000	2,226,000	1,934,000
UK	1,520,000	1,187,000	1,202,000
Total EEC	14,560,000	15,979,000	13,010,000
Austria	600,000	486,000	456,000
Finland	107,000	88,000	123,000
Spain	1,163,000	1,097,000	967,000
Sweden	385,000	374,000	326,000
Switzerland	120,000	135,000	105,000
Turkey	1,730,000	1,566,000	944,000
Yugoslavia	785,000	868,000	728,000
Total West Europe	19,450,000	20,593,000	16,659,000
Albania	35,000	40,000	40,000
Bulgaria	170,000	145,000	155,000
Czechoslovakia	850,000	747,000	810,000
Germany, East	710,000	747,000	600,000
Hungary	554,000	601,000	480,000
Poland	1,902,000	1,872,000	1,134,000
Rumania	690,000	663,000	553,000
USSR	7,100,000	6,200,000	7,150,000
Total East Europe	12,011,000	11,015,000	10,922,000
Total Europe	31,461,000	31,608,000	27,581,000

World sugar prices

The starting price of raw sugar on December 1 proved a high point and from £110, the LDP started to slide, to return to the same level on December 7, with reports of further purchases by the USSR. Thereafter the slide continued and values went below £100 at the middle of the month in spite of news of Soviet purchases of 500,000 tonnes of Brazilian sugar. News of a strike in the Dominican Republic came at the same time as a report that Brazil had sold its entire ISO export quota and prices edged higher, rising to £103, but with little trading around the holiday season it ended the month at £101.

[1] *International Sugar Rpt.*, 1982, **114**, 605-608.
[2] C. Czarnikow Ltd., *Sugar Review*, 1982, (1625) 202.
[3] *International Sugar Rpt.*, 1982, **114**, 629-631.

White sugar values followed those for raw sugar fairly closely but, perhaps assisted by the EEC's policy of releasing only limited quantities of sugar at the weekly tenders, the differential over raws increased slightly from around £35 at the beginning of the month to about £40 in the second half.

Indian sugar production puzzle for 1982/83

After bringing in a record crop in the 1981/82 season, it looked as though India was set for a 1982/83 crop as big or even bigger. The Indian Sugar Mills Association announced that, in the first six weeks of the new season, production had reached 283,000 tonnes, against 234,000 tonnes a year earlier. However, an ISMA spokesman was quoted[1] in December as saying that falling domestic prices may lead to mills reducing production. They lost more than 3000 million rupees in 1981/82, and the ex-factory price of raw sugar had dropped from Rs. 480 per 100 kg on October 1 to Rs. 320, against an average production cost of Rs. 500. Growing losses and restrictions on bank credit may force manufacturers to halt production by the end of January. Output in 1982/83 has been forecast at 7.9 million tonnes, white value, against 8.4 million tonnes in 1981/82.

The upsurge in production in the past two seasons has produced a glut on the domestic market. Meanwhile, export prospects are bleak because of low prices and reduced demand.

Officials at the Ministry of Agriculture said that the ISMA is using the threat of production cuts to force the government to abandon controls on prices and the distribution of sugar. Mills are required to sell 65% of their output to the government at an official price but are free to sell the rest on the open market. However, large releases from government stockpiles are depressing prices further, the ISMA spokesman said. The low sugar price may force mills to cut their prices to farmers from 20 to 13 rupees per 100 kg of cane and this may lead to a smaller crop next season.

New UK beet contract

The Sugar Beet Committee of the National Farmers Union has unanimously agreed to adopt a new pricing structure for the sugar beet contract to take effect from the 1983 season. It is the outcome of long and detailed negotiations between British Sugar plc and the NFU to overcome the protracted annual contract negotiations of the past, and offers a uniform price for all A and B quota sugar and a volume of C sugar equal to the B-quota (which is 10% of the A-quota). The purpose of the new system is to encourage the production of sufficient C sugar to ensure that the UK A and B quotas are regularly fulfilled and thereby withstand any pressure to reduce these at the forthcoming review and renegotiations.

The A quota is currently 1,040,000 tonnes, white value, so that the target production is this plus 20%, i.e. 1,248,000 tonnes. Sowings for the 1983/84 crop are reported to be about equal to the 201,000 hectares of 1982/83 which is expected to produce about 1,394,000 tonnes of white sugar.

Sugar market prospects for 1983

After their usual end-year survey of sugar market developments in 1982, C. Czarnikow Ltd. recently discussed prospects for 1983[2].

"World sugar production in 1981/82 established a record by a substantial margin. Though not quite up to that standard, output in 1982/83 is still expected to be the second highest on record. Yet consumption continues to lag far behind. In a free market production would soon be trimmed to match the size of the outlet, but the world market for sugar is not really free.

"It is perhaps in the nature of modern society that groups of people and of nations should tend to safeguard their own interests. Where trading is concerned specific markets then become closed to outsiders or to those who are not members of appropriate political or economic clubs. Within these markets prices tend to show a satisfactory return to producers, but there is usually some form of limitation to the size of the outlet. Accordingly surpluses which are produced have either to be stocked or sold elsewhere and, as they frequently bear only marginal costs, low prices are not the deterrent to excess production they would otherwise be.

"If it were not for these groups of interlocking protected markets economic forces would rapidly operate to bring supply and demand once more into balance and there would hardly be a need for an International Sugar Agreement. As it is, however, largely on account of protectionist policies, an astonishingly high level of stocks has been established and, hardly surprisingly, it is difficult to discern a will among producing countries to take appropriate unilateral action. Where individual countries may not be prepared to act, it might be possible to encourage them to operate in concert and this is presumably what a new ISA will aim to do.

"Is 1983 the year in which we shall negotiate a new International Sugar Agreement? Failure would be disastrous, for any further attempt would probably be delayed for some years, but it might almost be better to fail than to continue with current arrangements which not only can be seen not to operate but which perpetuate inequalities of sacrifice. It seems that, though viewpoints differ considerably, there is now a very real will to negotiate seriously. There is a general belief that to be successful a new ISA must lay greater emphasis on stocks than any have done in the past, though for the time being precise formulae for these have not been considered. Of particular significance is the fact that the EEC has shown itself willing to enter fully into the discussions which have been taking place in the preparatory committee which is developing the framework within which it will be attempted to negotiate the new Agreement.

"Well before delegates assemble in Geneva in May the preparatory committee which has been established, and which has already held its first meeting, will presumably, together with the ISO Secretariat, have prepared a draft to be used as the basic framework upon which the delegates to the UNCTAD Conference will attempt to build a new Agreement. It may be recalled that a draft Agreement was drawn up and taken to Geneva in 1977. Once there, however, it was largely ignored by delegates and the two sessions of the UNCTAD Conference which were held that year were partly concerned with drafting instead of being able to concentrate entirely upon negotiating matters. This led eventually to hasty drafting in the final days of the Conference. It is hard to escape the conclusion that with more time for careful consideration it might have been possible to have avoided some of the problems which have beset the 1977 ISA; national representatives are no doubt conscious of this and will try to ensure that their drafting at the London meetings is as complete as possible."

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[1] *Public Ledger's Commodity Week*, December 24, 1982.
[2] *Sugar Review*, 1982, (1629), 235-236.

Measuring concentration boundary layers around crystals with holographic interferometry

By L. J. KUIJVENHOVEN and I. J. RISSEEUW
(Delft University of Technology, Laboratory for Process Equipment, Leeghwaterstraat 44, 2628 CA Delft, Holland)

Introduction

In crystallization the mass transfer from the bulk of the solution to the crystal surface is conventionally written as:

$$\frac{dm}{dt} = k_d A (\Delta c)^n \qquad (1)$$

in which the mass transfer coefficient k_d accounts for both diffusion and convection and may be obtained from usual mass transfer correlations (Sherwood relations):

$$Sh = a + b\, Re^c\, Sc^d \qquad (2)$$

or

$$Sh = b\, Re^c\, Sc^d \qquad (3)$$

Many Sherwood relations are to be found in the literature[1-10], but most are related to the higher Reynolds numbers ($Re \gg 1$) and have been derived from the results of fluidized bed experiments. As the relative velocity between falling sugar crystals and the mother liquor is very low[11], whereas the viscosity is high, in normal practice sugar crystallization takes place in the region $Re \ll 1$, and extrapolation of relationships from the literature might be very misleading. However, the mass transfer coefficient in Equation 1 can also be written as:

$$k_d = \frac{D}{\delta} \qquad (4)$$

and can be calculated if the coefficient of diffusion *(D)* and the concentration boundary layer (δ) are known, whence it is possible to calculate the total mass transfer, since the value of n in Equation 1 is generally accepted to 1[12-18]. However, few value of δ have been published[19, 20], and these have not been measured but have been calculated from growth or dissolution experiments. With holographic interferometry it is possible to measure values of δ directly under different conditions.

L. J. Kuijvenhoven

I. J. Risseeuw

Holographic interferometry

Holographic interferometry compares beams of laser light, which have passed through a measuring cell at two different times. The wave-front of the light at $t = t_0$ is stored on a holographic plate. After developing this plate the original wave-front can be reconstructed at any time by a reference beam. If at time $t = t_1$ a crystal is put into the solution in the measuring cell the crystal will grow or dissolve if that solution is supersaturated or undersaturated, respectively, and a concentration boundary layer will be formed (see Fig. 1). This layer will

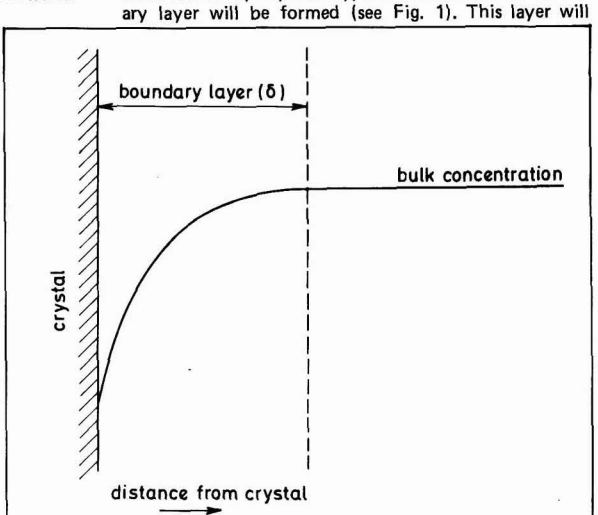

Fig. 1. Concentration profile around a crystal under growth conditions

1 Schliephake & Austmeyer: *Zucker*, 1976, **29**, 293.
2 Kharin & Zharkov: *Teor. Osnovy Khim. Tekhnol.*, 1975, **9**, (3), 443; translation in *Theor. Found. Chem. Eng.*, 405.
3 Giorgi *et al.*: *Sucr. Franç.*, 1974, **115**, 305.
4 Rahman & Streat: *Chem. Eng. Sci.*, 1981, **36**, 301.
5 Tournié *et al.*: *Chem. Eng. Sci.* 1979, **34**, 1247.
6 Karpinski: *ibid.*, 1980, **35**, 2321.
7 Koloini *et al.*: *ibid.*, 1977, **32**, 637.
8 Nelson & Galloway: *ibid.*, 1975, **30**, 1.
9 Rowe: *ibid.*, 7.
10 Laguerie & Angelino: *ibid.*, 1525.
11 Kuijvenhoven: *Sucr. Belge*, 1982, **101**, 167.
12 Kuijvenhoven & de Jong; in: "Industrial Crystallization '81", Eds. de Jong & Jancic (North Holland Publishing Company, Amsterdam), 1982, 253.
13 Bennett: *Chem. Eng. Prog. Symp. Ser.*, 1969, **65**, (95), 34.
14 Mantovani *et al.*: *Zuckerind.*, 1970, **95**, 123.
15 VanHook: *ibid.* 1973, **98**, 499.
16 Smythe: *Sugar Tech. Rev.*, 1971, **1**, 191.
17 Hartel *et al.*: *AIChE Symp. Ser.* 1980, **76**, (193), 65.
18 Golovin & Gerasimenko: *Proc. 10th Congr. ISSCT*, 1959, 248.
19 Zagrodzki & Krysicki: in "Industrial Crystallization '78", Eds. de Jong & Jancic (North Holland Publishing Company, Amsterdam) 1979, 195.
20 VanHook: Private communication (February 1982).

cause an index of refraction gradient. If now the reconstructed wave-front, without a crystal in the cell, is compared with the actual wave-front, interference will occur and fringes appear whenever the following condition is satisfied:

$$\Delta n = [(2k + 1)\lambda]/2d \qquad (5)$$

in which Δn is the difference in refractive index, d the optical length, over which the index of refraction is different, λ the wavelength of the light and k is an integer, representing the order of the fringe.

reference beam to make the holograms. After the object beam passes through the measuring cell an imaging lens projects an image of the cell into a plane beyond the holographic plate. In this manner the reconstructed hologram may be photographed with a 35-mm camera focused on the image plane. After processing the film measurements are made by enlarging the pictures to a suitable size.

Working procedure

A rectangular cell measuring 2 x 2 x 2 cm was filled with a supersaturated solution at room temperature and

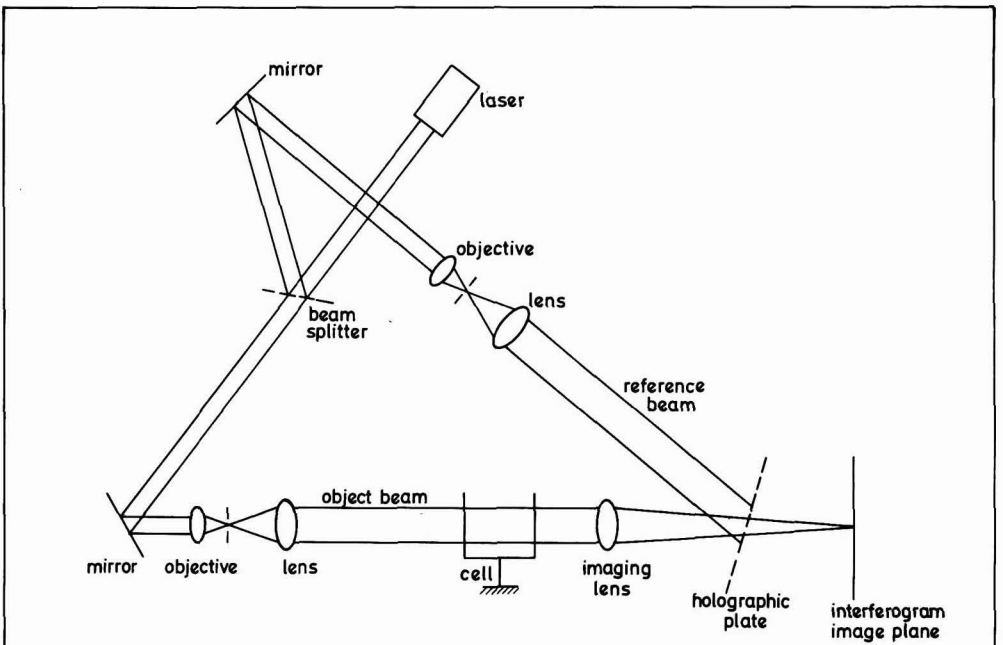

Fig. 2. Schematic diagram of the measurement apparatus

The location of the interference fringes is determined by the change in the index of refraction. Figure 1 shows that the change in concentration decreases as the distance from the crystal surface increases; so also the distance between two successive fringes will increase. An outline description of this technique of holographic interferometry can be found in the book by Vest[21].

Holographic interferometry has been used successfully to measure liquid diffusion coefficients[22, 23] and to describe factors affecting crystal growth[24–28]; in the latter case only qualitative effects are mentioned but no values of boundary layers are given. The aim of this paper is to introduce the technique of holographic interferometry to sugar crystallization and to give some preliminary results of the boundary layer thickness around sugar crystals.

EXPERIMENTS

Apparatus

A schematic diagram of the apparatus is shown in Figure 2. A He-Ne laser beam is split into an object and a

at time $t = t_0$ a hologram was made to obtain and store the cell condition at this time. After developing, the holographic plate was placed back into its position and a crystal was put into the solution. As this crystal causes a concentration gradient, interference fringes can be registered on the photographic film in the camera and change with increasing time as diffusion takes place from the bulk of the solution to the crystal surface.

Fringes can now be found in a layer (the diffusion layer) around the crystal where the concentration is different from the bulk concentration. No fringes will be found at a distance greater than δ from the crystal surface.

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21 Vest: "Holographic interferometry" (Wiley, New York) 1979.
22 Gabelman-Gray & Fenichel: *Appl. Opt.*, 1979, **18**, 343.
23 Bedarida *et al.;* in: "Application of holography and optical data processing," Ed. Marom (Pergamon, Oxford) 1977.
24 Petrovsky *et al.: J. Crystal Growth*, 1982, **56**, 7.
25 Bedarida *et al.: Amer. J. Phys.*, 1980, **48**, 413.
26 Ginzburg *et al.: Soviet Physics – Crystallography*, 1973, **17**, 889.
27 Mischgofsky: *J. Crystal Growth*, 1978, **43**, 549.
28 Idem: *Proc. Soc. Photo-Opt. Inst. Eng.*, 1980, **236**, 86.

Results and discussion

A crystal with an a-axis length of 1.84 mm was glued to a rod with a diameter of 0.5 mm. At time $t = t_1$ this crystal was put into the supersaturated solution (20°C, S = 1.4) and a picture of the interferogram was taken.

Table I. Diffusion layer thickness as a function of time after submersing the crystal

Figure	Time, min	Max. crystal length, μm	Diffusion layer thickness, μm
3a	0.5	1840	60
3b	5	1880	150
3c	10	1900	150
3d	25	1970	150
3e	60	2030	150

This was repeated at intervals during one hour (see Table I) and these pictures are shown in Figures 3a – 3e. In these figures the crystal and also the rod are clearly visible. The black bulb on the top side of the crystal is a blob of glue, while the white spot on the lower side is a fault in the hologram and should be ignored. From these figures it can be concluded that within about 5 minutes the concentration boundary layer has reached its maximum size which is about 150 μm at the lower side of the crystal. At the topside this value is much higher, caused by the fact that convective transport develops around the crystal: as molecules are built into the crystal lattice the solution becomes less dense and this is intensified, moreover, by the liberated heat of crystallization. This effect of rising liquid is very clearly to be seen in Figure 3c, where the interference fringes form a droplet-shaped pattern at the left side above the crystal. This convective transport effect has also been reported by Bedarida *et al.*[25] and by VanHook[29] and Powers[30].

1000 μm, whereas the true boundary layer is about one sixth of these values. The directly measured values are thus of the same order of magnitude as the calculated ones and it may be concluded that the technique of holographic interferometry can be used to study boundary layers around crystals and that this will give more insight into the fundamentals of crystal growth.

Notation

A	crystal surface	m^2
a,b,c,d,e	constants in (2) and (3)	–
c	concentration	kg sugar/kg water
c^*	saturation concentration	kg sugar/kg water
Δc	concentration driving force	kg sugar/kg solution
D	diffusion coefficient	$m^2.s^{-1}$
d	length	m
k_d	mass transfer coefficient	$m.s^{-1}$
k	integer	–
L	characteristic length	m
n	exponent in (1)	–
Δn	difference in index of refraction	–
Re	Reynolds number ($= \rho v L/\eta$)	–
S	supersaturation coefficient ($= c/c^*$)	–
Sc	Schmidt number ($= \eta/\rho D$)	–
Sh	Sherwood number ($= k_d L/D$)	–
t	time	s
v	velocity	$m.s^{-1}$
δ	boundary layer thickness	m
η	dynamic viscosity	Pa.s
λ	wavelength	m
ρ	density	$kg.m^{-3}$

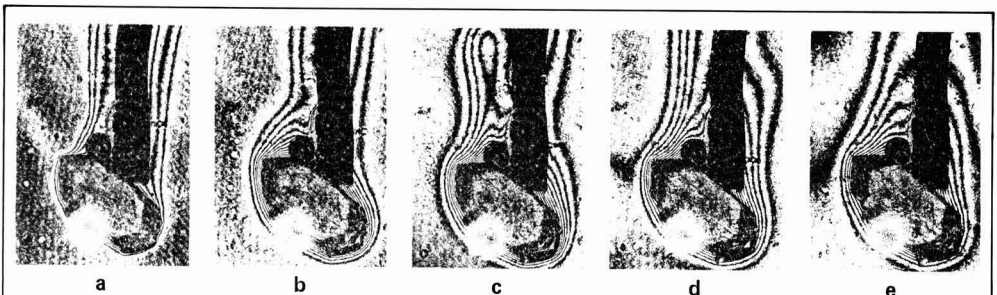


Fig. 3. Fringes around a crystal glued to a rod at 20°C, S = 1.4 and at different times after submersing the crystal (a): 0.5 min; (b): 5 min; (c): 10 min; (d): 25 min; (e): 60 min

It can also be seen in Figures 3a – 3e that the crystal is growing; the length of the a-axis has increased from 1840 to 2030 μm (see Table I).

The value of δ (= 150 μm) is high compared with calculated values reported by Zagrodzki[19]: 37 μm for a stationary crystal of 80 mg, submersed in a solution with a supersaturation coefficient S = 1.06 at 20°C.

However the dynamic viscosity (η) of the solution increases considerably with concentration and at 20°C $\eta(S = 1.4) \approx 5\ \eta(S = 1.06)$[31]. So the calculated value of δ should be multiplied by a factor 5 resulting in δ = 185 μm before a comparison may be made. VanHook[20, 29] gave values of δ ranging from 100 –

Acknowledgement

The authors are very grateful to Prof. H. Fenichel, Department of Physics, University of Cincinnati, and to Prof. H. J. Frankena and co-workers, Department of Physics, University of Delft, who introduced us to the theory of holographic interferometry, made it possible for us to do the experiments in their laboratory and assisted in the experimental part of this study.

29 *I.S.J.*, 1980, **82**, 331.
30 *Sugar Tech. Rev.*, 1970, **1**, 85.
31 Kadlec *et al.: Sucr. Belge*, 1981, **100**, 45.

Measuring concentration boundary layers around crystals

Summary

In crystallization the concentration boundary layer around crystals plays an important role. However, values recorded in the few papers published concerning this layer are not really measured but are calculated from growth or dissolution experiments. A technique called holographic interferometry is described by which direct measurements of concentration boundary layers can be performed, and some preliminary results are presented.

Mesure, par interférométrie holographique, de la concentration dans les couches-limites autour des cristaux

La concentration dans les couches-limites autour des cristaux joue un rôle important dans la cristallisation. Cependant les valeurs mentionnées dans les quelques publications concernant ces couches ne sont pas vraiment mesurées, mais sont calculées aux dépens d'expériences de croissance ou de dissolution. On décrit une technique appelée interférométrie holographique qui permet des mesures directes de concentration dans les couches-limites et on présente quelques résultats préliminaires.

Messung der Konzentration von Grenzschichten um Kristalle mit holographischer Interferometrie

Bei der Kristallisation spielt die Konzentration in der Grenzschicht um die Kristalle eine wichtige Rolle. Jedoch sind die in einigen Arbeiten veröffentlichten Werte hinsichtlich dieser Schicht nicht wirklich gemessen, sondern aus Wachstums- und Auflöseversuchen berechnet worden. Eine holographische Interferometrie genannte Technik wird beschrieben, mit der direkt die Grenzschichtkonzentration gemessen werden kann; einige vorläufige Ergebnisse werden mitgeteilt.

Medición de capas de concentración a los límites acerca de cristales por interferometría holográfica

En cristalización la capa de concentración a los límites acerca de cristales hace un papel importante. Sin embargo, valores registrado en los pocos informes publicados que tratan de esta capa no han sido medidos en verdad sino se han calculado de experimentos de desarrollo o dissolución de cristales. Se describe una técnica, denominada interferometría holográfica, por que es posible hacer medidas directas de capas de concentración a los límites acerca de cristales y algunos resultados preliminares se presentan.

The Canesorb carbon/bone char system at Atlantic Sugar

By WILLIAM F. BARTON and WILLIAM J. KNEBEL

PART II

Initial operational problems on process implementation

After a near normal completion of the initial adsorption cycle, the spent adsorbent mixture was discharged to the kiln for its first reactivation. After this, a number of operational problems became apparent, and were attributed primarily to the mutual interaction of the two adsorbent components during handling. Specifically, the virgin Canesorb carbon was undergoing a particle rounding-off effect (i.e. removal of edges and corners from particles of the new material) and the service char possessed a high level of dense fines which could not be readily removed from the adsorption system. The following occurrences that were observed during the initial operating phases of the new adsorption system were indicative of the nature of these problems.

Excessive levels of air-borne dust were evident in the adsorbent handling system, primarily at those points (i.e. kiln room and fill floor) where handling took place in an open environment. Accumulations of dust and fines within the adsorbent media were deposited onto the cistern blankets and resulted in liquor flow-rate reduction during the adsorptive cycles. Extended sweetening-off times and excessive volumes of sweet-water also resulted while the ineffective sweetening-off operations, in turn, gave high residual sucrose levels (e.g. 200-500 ppm) on the washed spent adsorbent mixture and caused a number of char fires in the pre-dryer section of the kiln.

Several sources of dust and fines were eliminated from the adsorption system by (1) settling the freshly reactivated adsorbent with hot water, (2) back-washing the cisterns with water-to-sewer, (3) blowing-out excess water, and (4) back-filling the cisterns with settling liquor when starting the cistern adsorption cycle. After approximately three turn-arounds of the new adsorbent inventory and using the above practices, the problems disappeared. Improvement of dust collection in all areas where adsorbent transfers were effected and an increase in the screening of the adsorbent from the kiln resulted in the elimination of the remaining dust and fines problems. With the dust removal accomplished, the problems in the areas of liquor flow reduction, sweetening-off, and kiln pre-dryer fires were eliminated.

Concurrently with the above, a number of other process improvement steps were adopted by Atlantic Sugar, and effectively eliminated the aforementioned operational difficulties. These new practices included: (1) improvements in liquor settling by use of new procedures and mechanical devices, (2) use of a two-stage sweetening-off process, and (3) blockage of excess pre-dryer capacity and of access to pre-dryer sections with damaged louvres.

During the operating period in which the cisterns were settled on water, the effluent pH levels were somewhat lower than those from service char and those observed during the trial runs. This was resolved when water settling was discontinued and increased amounts of

dead-burned magnesite were added to the freshly reactivated adsorbent from the kiln.

On evaluation of the existing adsorbent composition and volume following the initial operational phases of the new adsorption system, several observations were noteworthy. The adsorbent composition of the carbon component in the mixture was lower (i.e. 18-19% w/w) than that anticipated on completion of the initial fill. This could be attributed, in part, to an erroneously assumed Canesorb carbon packing density when formulating the mixture. In addition, the rounding-off of virgin particles contributed significantly to the reduced level of carbon in the mixture. Overall, an inventory shrinkage of approximately two cistern volumes occurred during the initial five months of char house operations. Thus, higher-than expected Canesorb carbon make-up rates were required at the outset of the full-plant implementation.

Performance characteristics during refinery operation

Aside from some initial difficulties, performance of the new adsorption system during the first 5 months of operation was generally in accord with that expected from the initial studies. For an average adsorption cycle service extension factor of 1.6, the Canesorb carbon/bone char system gave an average colour and turbidity removal of 83.4% from clarified white sugar liquors during the period from February to June 1980. Tables II and III list the operating and performance characteristics of the service bone char and CS/BC systems during the period to December 1981. The performance, although somewhat less than expected from the trials, occurred in spite of unusually higher than anticipated colour and turbidity loadings on the adsorbent media. This is illustrated in Figure 17 which indicates that, during some adsorption cycles, colour and turbidity (i.e. adsorbate) loadings were up to four times that usually placed on straight service char. With these high adsorbate loadings, the Canesorb carbon activity properties diminished toward their current operating levels. A slightly improved adsorbate removal performance (i.e. 82.3%) in the processing of clarified remelt liquors was also observed with the CS/BC system during the period (Table III).

As expected, de-ashing by the Canesorb carbon/bone char system was less than that afforded by straight service char (14% *vs.* approximately 25% by weight).

The make-up requirements for Canesorb carbon were significantly higher than the original projections for the reasons previously stated (Table V). As shown for the operating period, the average carbon make-up rate was 4.6 wt.%. On the other hand, the virgin bone char (equivalent) make-up rate was the anticipated 1.4 wt.%.

The average fuel usage index for the CS/BC system was slightly higher than that for straight char at 1.45 lb of No. 2 fuel oil per cubic foot of adsorbent mixture against 1.31 lb for service char. The higher value for the

Table II. Operating characteristics of the adsorption cycles for service bone char and Canesorb carbon systems

Process/Sugar liquors	Service bone char system (May-December 1979)		Canesorb carbon system (February-December 1980)		Canesorb carbon system (January-December 1981)	
	On-stream time, hr	Dosage on melt[1], lb adsorbent/100 lb melt	On-stream time, hr	Dosage on melt, lb adsorbent/100 lb melt	On stream time, hr	Dosage on melt, lb adsorbent/100 lb melt
Clarified white sugar liquors[2]	50 ± 5	15.5 ± 1.8	84 ± 12	10.2 ± 1.7	82 ± 15	10.0 ± 1.9
Clarified remelt liquors	5 ± 1		8 ± 2		8 ± 2	
Soft sugar liquors (second-pass)	10 ± 2		16 ± 4		18 ± 6	
Soft sugar liquors (first-pass)	10 ± 2		16 ± 4		18 ± 6	
Process hot water for sweetening-off	15 ± 3		18 ± 2		18 ± 2	
Process hot water for water wash	15 ± 3		16 ± 4		16 ± 4	

[1] "Dosage on melt" is the adsorbent burn rate related to the melt processing rate of raw sugar; it includes the actual service adsorbents and run-back materials during the start-up and shutdowns.
[2] The clarified white sugar liquors refers to the actual influent materials (i.e. melt liquors blended with 3-8% remelt liquors by weight) entering the char cisterns.

Table III. Colour and turbidity[1, 2] of the various char house liquors

Operating period	Clarified white sugar liquors			Clarified remelt liquors			Soft sugar liquors		
	Feed liquor[3]	New liquor	Removal, %	Feed liquor	Effluent liquor	Removal, %	Feed liquor	Y-liquor[4]	Removal, %
May – December 1979	502 ± 86	122 ± 20	75.7 ± 2.7	2,790 ± 790	506 ± 79	81.8 ± 5.8	10,020 ± 2,410	1,810 ± 740	81.9 ± 5.3
February – June 1980	561 ± 104	93 ± 20	83.4 ± 1.8	3,170 ± 1,390	560 ± 54	82.3 ± 5.8	8,210 ± 2,160	1,920 ± 540	76.6 ± 9.0
July – December 1980	567 ± 126	116 ± 35	79.5 ± 2.7	2,890 ± 850	529 ± 94	81.7 ± 6.1	11,270 ± 2,930	2,530 ± 750	77.6 ± 9.2
January – June 1981	560 ± 122	151 ± 41	73.1 ± 3.2	3,900 ± 910	356 ± 45	90.9 ± 2.4	11,460 ± 5,210	2,260 ± 1,180	80.3 ± 6.0
July – December 1981	548 ± 103[5]	127 ± 30[6]	76.8 ± 2.9	2,530 ± 1,210	320 ± 40	87.4 ± 4.6	14,390 ± 5,930	2,420 ± 860	83.2 ± 6.7

[1] All colour and turbidity values are expressed in terms of ICUMSA units as determined from measurements at a wavelength of 420 nm.
[2] The above colour and turbidity values have been normalized for the solids levels processed per operating week.
[3] The clarified white sugar liquors refer to the actual influent materials (i.e., melt liquors blended with 3-8 % remelt liquors by weight) entering the char cisterns.
[4] The soft sugar feed liquors are subjected to two consecutive passes through the char cisterns in yielding the Y-liquors.
[5] The clarified white sugar feed liquors possessed colour levels of 457 ± 56 ICUMSA units and turbidity levels of 91 ± 24 ICUMSA units during this operating period. It is noteworthy that the colour contributed approximately 84% of the total colour plus turbidity for this operating period.
[6] The new white liquor effluents possessed colour levels of 104 ± 23 ICUMSA units and turbidity levels of 23 ± 11 ICUMSA units during this operating period. The colour contributed approximately 82% of total colour plus turbidity levels for this operating period.

dual adsorbent system is attributed directly to the greater number of start-ups and shut-downs of the kiln which averaged 2.4 per week against an average of 1.5 per week during bone char operations. Excessive times for sweetening-off a few uniquely behaving cisterns were the major cause of interruptions to the kilning operations.

Sweetening-off times for the CS/BC cisterns were generally 1.3 to 1.5 times those for straight char cisterns (Table VII). Adopting a two-step flow rate scheme (i.e., water flow-rates of 80 $ft.^3hr^{-1}$ during the initial sweetening-off from 60°+ to 10°Brix and 40 $ft.^3hr^{-1}$ during the remainder of the sweetening-off cycle) extended the sweetening-off times but also reduced significantly the sweet-water generated from each cistern. The volume of sweet-water from each cistern of the mixture is now comparable to that which was obtained with straight char.

(iii) Pressure fluctuations from past operations caused three cisterns to crack and required their elimination from service. Examination of the remaining cisterns showed similar defects in their structures.

(iv) Open-belt conveying systems for handling of dry and wet adsorbent were prone to spillages on the floor and, as a result, contributed to the dust problem.

(v) Insufficient height of the dry adsorbent belts above the filter heads did not permit the use of proper settling devices.

(vi) The fluid distribution systems to the heads of the filters were poorly balanced hydraulically and contributed to liquor flow restrictions.

(vii) The cleanliness of char handling areas, not only did not meet good manufacturing practice, but also contributed to the refinery's unaccountable loss of adsorbent.

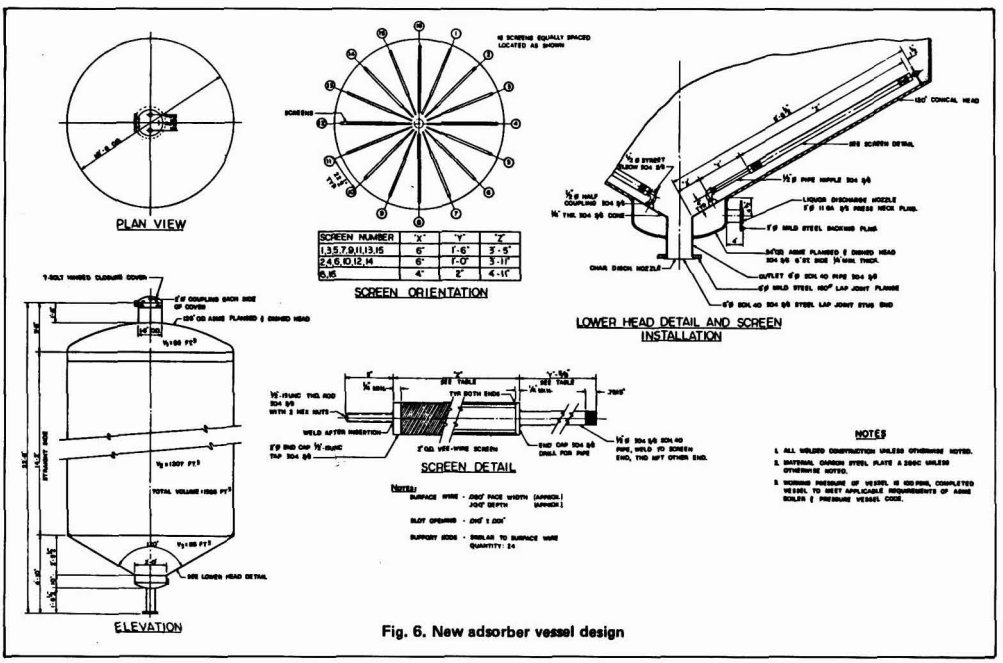


Fig. 6. New adsorber vessel design

New mechanical systems implementation

In June/July 1980, Atlantic Sugar implemented a number of new mechanical features into their existing char house facility. The 1915-vintage cast-iron cistern and char handling equipment was replaced with modern facilities which were more appropriate to the current and future refinery operations.

The incentives for Atlantic Sugar to implement the new mechanical systems were as follows:

(i) Pressure limitations on the cast-iron cisterns restricted the flow requirements required to maintain or to increase the melt capacity.

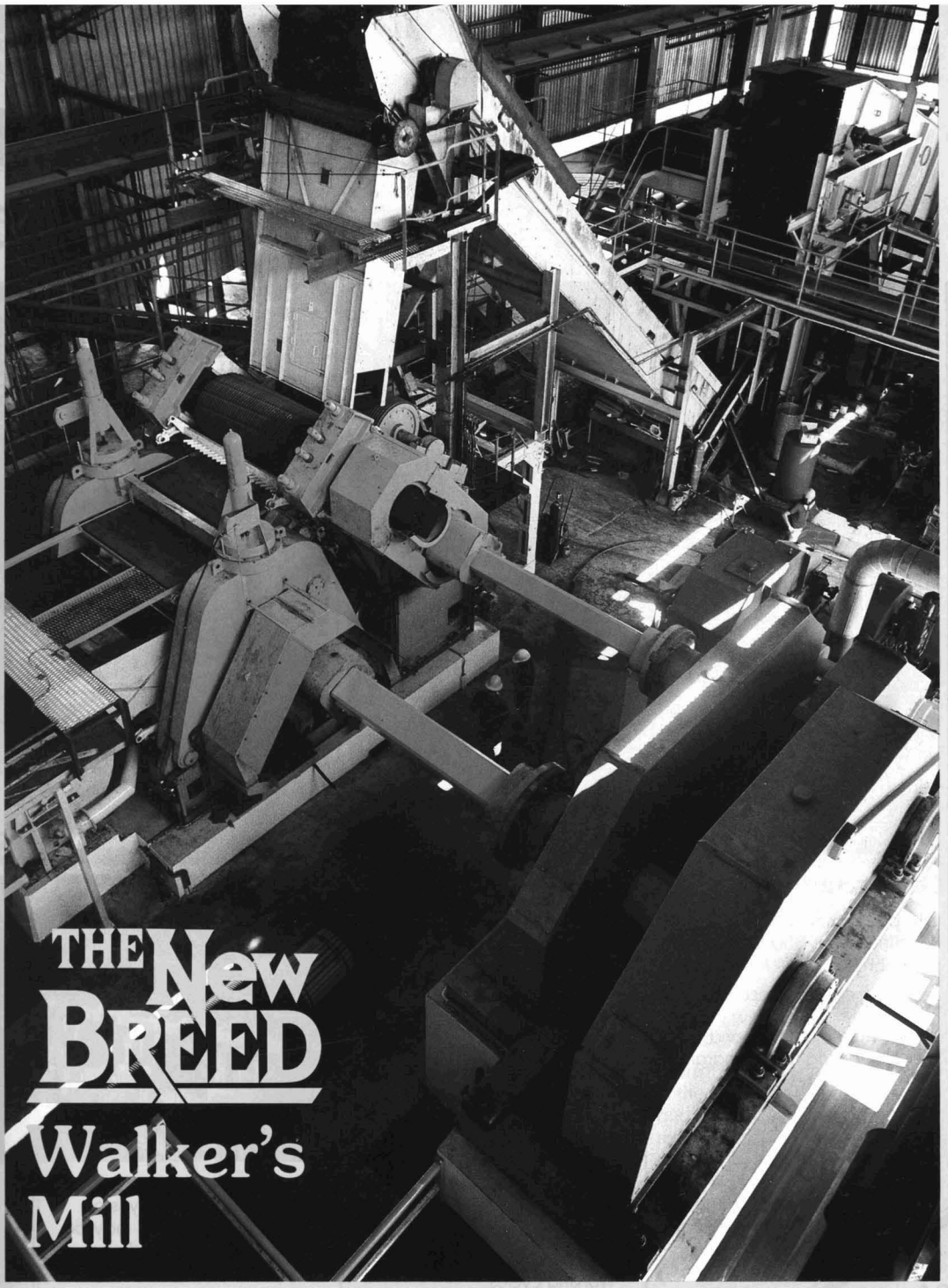
(ii) Restricted pressure as applied to the cisterns necessitated the placement of the liquor gallery below the bottom of the cisterns to maintain liquor flow rates. However, this increased cistern channelling and resulted in lower-than-standard decolorization performance as well as extended sweetening-off times and high volumes of sweet-water.

Accordingly, Atlantic Sugar proceeded to modify the char house in the following manner:

(a) The original cast iron cisterns were removed and replaced with new carbon steel vessels having approximately the same size and volume. Figure 6 is a schematic drawing of the new adsorption vessel design. The carbon steel units were designed for operating pressures up to 100 psig. The underdrain system consisted of vee-bar screens which eliminated the old blankets and packing procedures. The new cisterns were designed for hydraulic discharge at the bottom and were made to be easily maintained, neat and clean at the head level.

(b) The dry adsorbent conveyance of freshly regenerated adsorbent from the storage bin to the adsorber vessels was accomplished with totally-enclosed vibrating conveyors. All adsorbent transfer points and adsorber fill points were equipped for pick-up and collection of dust and fine particulates.

(c) Liquor and water supply headers for feeding of all



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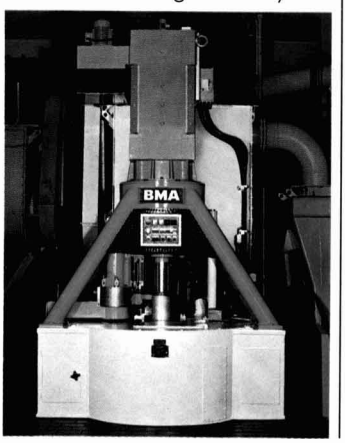

Either pole-changing asynchronous motors or thyristor-controlled d.c. motors may be used to drive the centrifugals.

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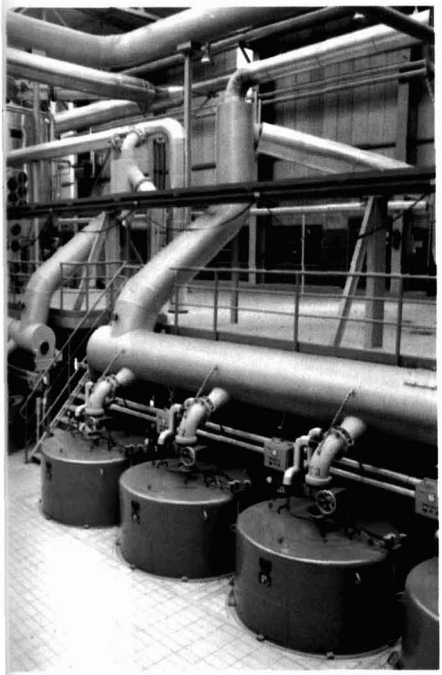

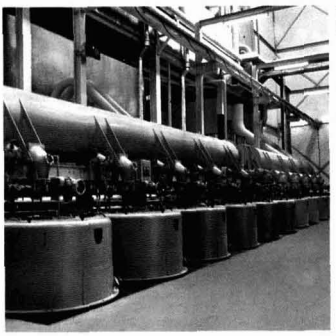

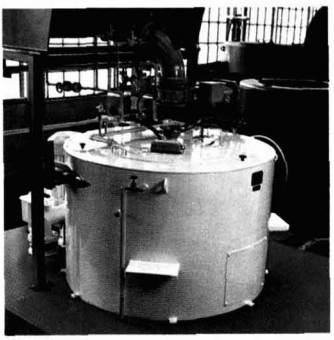

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such materials to the adsorbers were run immediately above the rows of the adsorbers with the transference of the fluids from the header to each adsorber made possible by flexible connexions. Instrumentation was added to each pumping system that was associated with an adsorber header to maintain the appropriate pressures in that header.

(d) More appropriate settling devices were fabricated for ratio-controlled filling of the adsorber vessels with the adsorbent mixture and liquor. These devices were fabricated to fit tightly at the top of the settling cistern and were hooked to the dust collection system. A tight fit at all connecting points was required to eliminate the dust and vapours from the filter-head floor.

hydraulically withdrawn, and the adsorbent is choke-fed through a short hopper to the transport system to the kiln. A schematic illustration of the char flow arrangement is presented in Figure 7.

(f) The liquor gallery was relocated to the filter-head area; this ensures that a minimum of channelling occurs in the cisterns. The gallery was likewise designed to be totally enclosed to minimize heat and vapours in the area. The system was equipped with flow control, a sight-glass for effluent evaluation without drawing a sample, and a simple tap to facilitate sampling with no spillage on the floor.

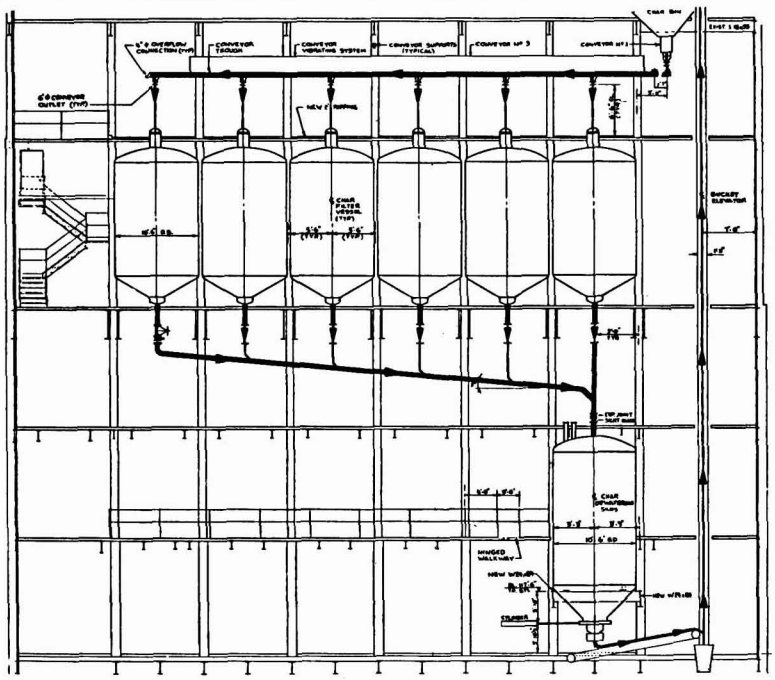

Fig. 7. The new char transfer system

(e) The new cisterns were arranged in four rows each containing six cisterns. Each of the cisterns in a row was connected to a common hydraulic discharge pipe and isolated from that pipe by valves. Each hydraulic discharge pipe was, in turn, connected to a dewatering vessel which had a working volume approximately 20% larger than an adsorber vessel and which was located at a lower level. Washed spent adsorbent is now sluiced from the adsorber (pressure) vessel and is transported down the common header pipe into the dewatering vessel. During this time, the dewatering vessel is closed at the bottom and provided with a "heel" of hot water prior to sluicing of the adsorbent within the pressure vessel. Following the sluicing step, low-pressure air is applied to the dewatering vessel and excess water is blown out over a period of approximately 3-4 hours. Then, when the adsorbent, now at approximately 21% moisture (dry basis), is required at the kiln, the vessel's bottom drainage member combination is

(g) A quality control laboratory was placed next to the liquor gallery to expedite analytical process control measurements.

(h) This arrangement not only eliminates the negative aspects of the old system, but also reduces the char house labour requirements by two men per shift. These reductions were made possible since no-one is now required to dump spent adsorbent by hand from the cisterns. The kiln operators now sluice the cisterns, de-water the adsorbent and transfer spent adsorbent to the kiln. Further, with filter heads and liquor gallery now at the same level, only one operator is now required instead of two.

All of these changes in the char house were accomplished while production operations were maintained at their normal levels for the remainder of 1980.

The operational and performance characteristics of the CS/BC system during the above operating period (i.e. July – December 1980) were as summarized in Tables II – IX.

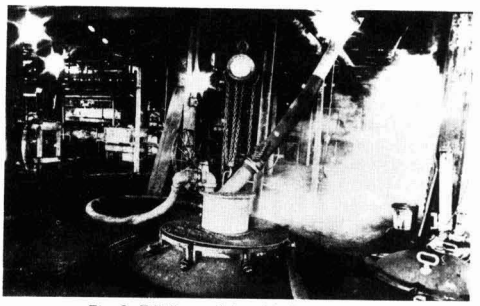

Fig. 8. Fill floor of the old char system

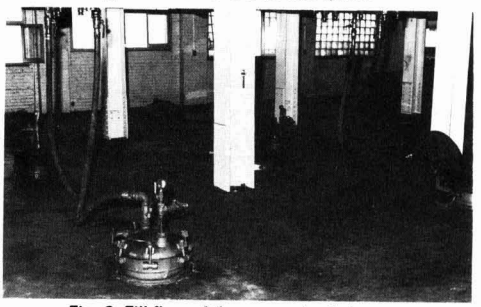

Fig. 9. Fill floor of the new mechanical system

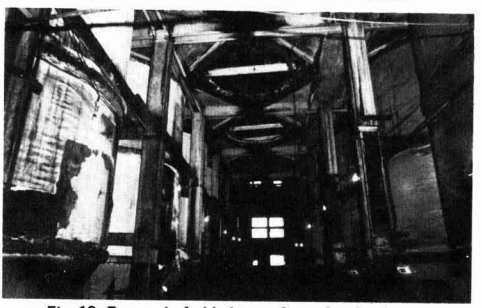

Fig. 10. Removal of old cisterns from the char house

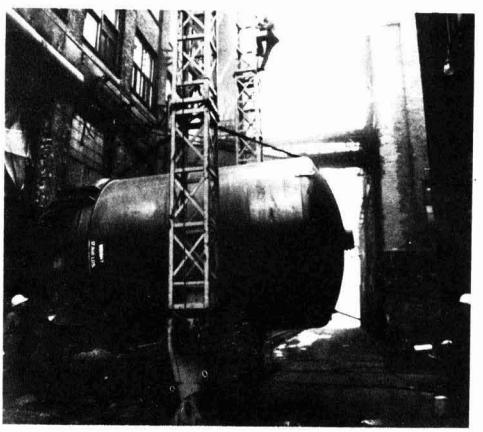

Fig. 11. Installation of new adsorber vessels within the char house

Fig. 12. Securing a blanket for the underdrain system of the old cistern

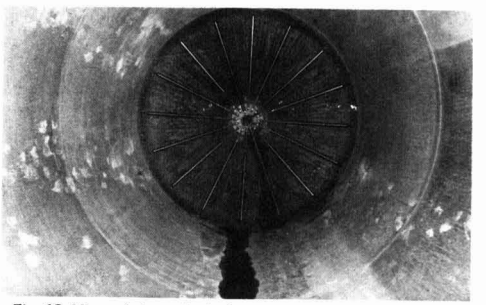

Fig. 13. View of the underdrain system for the new adsorbers

Fig. 14. Transfer of spent adsorbent from the old cisterns

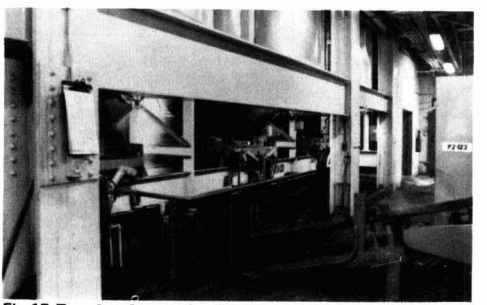

Fig. 15. Transfer of spent adsorbent from the new dewatering vessels

(To be continued)

Paraguay alcohol program[1]. – A program identical with that of Brazil's Proalcool is to be established in Paraguay following an agreement between the two countries whereby Brazil will provide distillery equipment and technology in respect of cane growing, erection of distilleries and also conversion of vehicles to alcohol fuel.

[1] *Brasil Açuc.*, 1982, **90**, 5.

Gypsum and other pulp pressing aids

By M. SHORE, J. A. ADAMS, N. W. BROUGHTON,
N. BUMSTEAD and G. C. JONES
(British Sugar plc, Research Laboratories, Norwich)

PART II

If there is a synergistic effect when using the two additives together, this may be associated with the lowering of pH by the acid. The results indicate that the increase in pressed pulp dry substance is greater if gypsum is added to a diffusion system at about pH_{20} 5.5 than if the system is at pH_{20} 6 or above. Thus, the pressed pulp increased by 3.3 units from 20.5% to 23.8% mean dry substance when gypsum was added to the acidified system, but only by 1.2 units from 18.9 to 20.1% mean dry substance when gypsum was added to the unacidified system. These markedly different results suggest that different mechanisms were involved in the effect of gypsum addition on pressed pulp dry substance at the two different pH values.

It was noticed that, some two hours after making any change from conditions (a), the quantity of wet pulp being produced exceeded the capacity of the presses and overflowed to dryer feed, although the slice rate had not been increased significantly. This observation indicates a volume increase in the wet pulp as a result of the changed conditions. There was a concurrent excess of pulp being fed to the dryers, necessitating discharge of the surplus, but whether this indicated a volume increase in the pressed pulp too or reflected the presence of the wet pulp in the dryer feed is not known. A similar effect on wet pulp volume, as a result of raising diffusion pH, has previously been observed in factory studies and proved in laboratory experiments[5].

Effect of point of gypsum addition

Gypsum slurry was usually added to diffusion supply water at King's Lynn factory. A brief trial was carried out in which the addition point was moved to exhausted cossettes just after drainage. The rate of slurry addition to supply water was 16 litres.min^{-1}, and the rate of addition to wet pulp was adjusted to be the same.

The average of the dry substances of 20-minute pressed pulp composites collected from each press some 70 minutes after change-over of addition point was identical with that for a similar set of composites collected just before the change-over: both were 24.0% dry substances, with standard deviation 1.2% dry substance. Although these results are only tentative, because the new equilibrium may not have been established, they suggest that either addition point could be used at the factory for the same effect.

The extent of gypsum dissolving

The gypsum slurry added at 16 litres.min^{-1} to supply water at King's Lynn contained about 35 g total calcium/litre from analysis whereas laboratory experiments had established that the solubility of gypsum in water over the range 20-80°C was only about 0.6 g calcium/litre. About 98% of the gypsum in the suspension would thus have been undissolved when it was added to the process. For gypsum to influence pulp pressing it is presumably necessary for calcium in it to pass into solution from the solid, as it is unlikely that interactions take place between pulp and calcium still held by binding forces in the solid.

The extent to which the gypsum was likely to dissolve after the slurry had been added to process was studied in some laboratory experiments which simulated the addition of gypsum slurry to supply water at King's Lynn. These demonstrated that about 80% of the calcium added as gypsum slurry to supply water at a rate equivalent to 74 kg/100 tonnes beet sliced might be expected to have dissolved within a minute, and 94% within three minutes. The rate of dissolving in these experiments suggested that virtually all of the small proportion of added gypsum likely still to be undissolved when the supply water came into contact with the exhausted pulp in the diffuser would dissolve in the last one or two compartments of the drum.

Attempts were made to confirm these deductions on the plant by measuring the calcium contents of filtered and unfiltered samples of supply water as it entered the diffuser, at times when gypsum slurry was being added at 16 litres.min^{-1} and when it was not. The undissolved calcium content of supply water without added gypsum was found to fluctuate too much for an exact figure to be established for the proportion of gypsum which had dissolved at that position, but the data indicate that at least 75% of the gypsum was then in solution.

It is considered likely from these findings that virtually all of the added gypsum became dissolved in the water end of the diffuser at King's Lynn factory. This might not necessarily be so in a different installation. The laboratory experiments had shown that gypsum takes several minutes to dissolve completely in a large excess of water, and, therefore, the retention times in the different parts of the plant, and, in particular, in the pipe between the slurry addition point and the supply water entry point into the diffuser, will influence the extent of dissolving.

Variation of pressed pulp dry substance with gypsum addition rate

The addition rate of gypsum to supply water was halved to investigate the effect which this had on press pressed pulp dry substance. The original rate was 16 litres slurry per minute, equivalent to 17 kg calcium or 74 kg gypsum/100 tonnes beet sliced, and the new rate for the same slurry was adjusted to be 8 litres/minute.

Three 20-minute composites of pressed pulp were collected for each press over a 24-hour period at the original addition rate. The rate was then halved, and, after several hours, four similar composites were made for each press over the next 24 hours. The mean pulp dry substances from each press for the original and the reduced rates of slurry addition are shown in Table VIII. They were obtained by drying replicate portions of each composite for 16 hours at 110°C. During the period of the test all other diffusion parameters were unchanged.

Halving the gypsum addition rate to 37 kg/100 tonnes beet sliced had no effect on pressed pulp dry substance. Press motor currents and speeds increased slightly, perhaps indicative of a small volume increase in the wet pulp with the lower addition rate.

There are at least two possible explanations of why the pressed pulp dry substance was unaffected by so

marked a change in gypsum addition. First, there may have been no increase in dissolved calcium at the higher rate, but this was discounted because measurements of the calcium contents of several samples of supply water which had been filtered immediately on collection indicated that at least 75% of the extra calcium was in solution before the supply water came into contact with the exhausted cossettes. Alternatively, the maximum interaction of calcium with exhausted pulp may have been exceeded even at 37 kg gypsum/100 tonnes beet sliced. Some evidence tending to support this hypothesis is discussed later in this paper.

Table VIII. Gypsum addition rate and pressed pulp dry substance (January 13-15, 1982)

Press No.	Gypsum slurry addition rate (litres.min^{-1})					
	16			8		
	Pressed pulp D.S., % Mean	s.d.	Mean press motor current, amp	Pressed pulp D.S., % Mean	s.d.	Mean press motor current, amp
1	24.6	0.2	65.4	24.6	0.3	68.8
2	23.5	0.2	61.2	23.4	0.2	62.8
3	23.3	0.3	65.5	23.1	0.3	67.2
4	23.7	0.3	64.0	23.7	0.4	65.9
			Mean press speed, rpm			Mean press speed, rpm
5	24.9	0.5	2.7	24.3	1.0	3.6
6	23.7	2.0	2.7	23.5	0.8	3.6
Mean	24.0			23.8		

Calcium chloride

Trials were carried out to compare the effect of calcium chloride as a pressing aid with that of gypsum. About 14 m^3 of stock solution were prepared with about 3 tonnes of industrial flake calcium chloride by dissolving it in water as for gypsum. According to the supplier, this grade of calcium chloride typically contains 77.7% $CaCl_2$ and 20% water. Most of the impurity is sodium chloride. The stock solution was found by atomic absorption spectroscopy to contain 6.1% w/v calcium. This solution was added in place of gypsum slurry to supply water at 8 litres/minute, giving an addition rate of 14 kg calcium/100 tonnes beet sliced. Normal sterile diffusion conditions with midbay acidification were maintained during these experiments.

Table IX. Gypsum and calcium chloride as pressing aids

Addition			Pressed pulp dry substance, %		Mean pH_{20}		
Compound	Position	Ca rate, kg/100 tonnes beet	Mean	s.d.	Midbay juice	PPW	DSW
Gypsum	Supply water	16.6	24.0	0.5	5.6	5.6	5.7
Calcium chloride	Supply water	14.0	24.4	0.1	5.4	5.4	5.4

20-minute composite samples of pulp from each press were collected about 6 hours after the start of calcium chloride addition. They were of mean 24.5% dry substance. The value given in Table IX is the mean for similar composites taken 18 hours later; it will be seen that the dry substance had not changed in this period. These values are compared in Table IX with the mean dry substance of three sets of composite samples of pulp from each press when gypsum slurry was being added at 16 litres.min^{-1} a few days earlier. The table also includes mean pH_{20} values from hourly measurements by the factory laboratory after the attainment of equilibrium in each experiment. The slice rate was virtually identical in the two trial periods.

The addition of calcium chloride instead of gypsum to supply water at similar rates of calcium addition had virtually no effect on the pressed pulp dry substance. This result was in accordance with expectation, as previous work[7, 8, 17] has shown that the anion is not preferentially absorbed by the pulp, unlike the cation.

When the addition point of the calcium chloride solution was changed to the exhausted cossettes after draining, the volume of wet pulp exceeded the capacity of the presses and the excess overflowed to dryer feed. As a result, the latter soon exceeded dryer capacity and the factory had to discharge pressed pulp. The experiment was soon discontinued, and addition to supply water resumed, whereupon these adverse effects ceased. The slice rate and pH conditions had remained virtually constant throughout this period. Analysis of pressed pulp composites indicated that the dry substance for addition to wet pulp was, if anything, slightly higher than for addition to supply water, but the other effects made this irrelevant. There had been no parallel effects when the point of gypsum addition had been similarly changed.

Calcium chloride costs about £490/tonne of calcium, whether bought as solid or solution. Gypsum, however, is only about £215/tonne calcium. The results reported here suggest that either gives the same pressed pulp dry substance per unit weight of added calcium, as expected. Gypsum is thus considerably cheaper to use in terms of cost of calcium for a given effect on dry substance.

This advantage is increased because, as discussed below, gypsum produces less extra molasses than calcium chloride.

Moreover, it would seem from the results reported above that calcium chloride may have an adverse effect on pulp volume in some applications, although no explanation for this phenomenon can yet be given. At a factory where there was insufficient press or dryer capacity to accommodate the excess, this effect could lead to slice rate reduction. It also results in a speeding-up of the variable-speed presses, in an attempt to handle the increased feed, and this lowers the dry substance of the pressed pulp from those presses; a similar effect was noted earlier in the experiments reported above.

Aluminium sulphate

Trials were carried out to compare the effect of aluminium sulphate as a pressing aid with that of gypsum. The aim was an aluminium addition rate comparable, in terms of chemical equivalents, to that of calcium, i.e. 9 kg aluminium for each 20 kg calcium. The gypsum tank and addition system were used for these trials, significant gypsum residues being removed first. 3.3 tonnes of industrial aluminium sulphate were dissolved in water to give about 13.5 m^3 solution. The aluminium content of the material used at King's Lynn was found to be 8.6% w/w by atomic absorption spectroscopy. This conformed with a typical composition of 17.2% Al_2O_3 according to the supplier. The stock solution thus contained about 2.1% w/v aluminium and it was added to supply water in place of gypsum slurry at 17.0 litres.min^{-1}, to give an addition rate of about 10 kg aluminium/100 tonnes beet sliced. Normal sterile diffusion operations with midbay acidification were main-

[17] Asselbergs *et al.*: *Compt. Rend. 12e. Comm. Int. Tech. Sucr.*, 1963, 264-283.

tained during these experiments.

The main impurity in aluminium sulphate is iron, but the proportion is sufficiently low that use of this compound as a pressing aid would be quite unlikely to raise the iron content of dried molassed pulp above the statutory limit[9,11].

20-minute composites of pressed pulp were collected for each press after 3 hours. The mean dry substance is compared in Table X with that for addition of gypsum slurry to supply water a few days later. These latter data were also used in Table IX. It is considered valid to use results for gypsum that were from a period not immediately adjacent to the aluminium sulphate trials: the many measurements of pressed pulp dry substance that were made over the 55-day period when gypsum was added to supply water at King's Lynn factory showed remarkably little variation. The table also includes mean pH_{20} values from factory laboratory measurements during each experiment. The slice rate was identical in the two periods.

Table X. Gypsum and aluminium sulphate as pressing aids

Addition				Pressed pulp dry substance, %	Mean pH_{20}		
Compound	Position	Rate (/100 tonnes beet)			Midbay juice	PPW	DSW
		kg cation	keq cation				
Gypsum	Supply Water	16.6	0.83	24.0	5.6	5.6	5.7
Alumin. Sulphate	Supply Water	10.1	1.12	23.9	5.5	4.8	4.3

The addition of aluminium sulphate instead of gypsum to supply water did not result in a change in pressed pulp dry substance even though the aluminium was added at a slightly higher rate in terms of chemical equivalents. There was a marked lowering of the pH of supply and pulp press waters.

The addition point was changed to exhausted cossettes immediately after draining, and the addition rate halved. After 4 hours, mean pressed pulp dry substance was 23.3%. The press water pH_{20} was 5.0. These observations indicated that the addition position had virtually no effect on pressed pulp dry substance, and that the rate could be halved without adverse effect; similar observations had already been made with gypsum.

Within a short time of changing the addition point, similar effects were apparent owing to increased wet pulp volume as had been observed for calcium chloride addition to wet pulp. These effects persisted throughout the trials with aluminium sulphate, which lasted for 19 hours. As soon as the gypsum slurry addition to supply water was resumed instead, the effects ceased. The slice rate had remained steady since before the start of the aluminium sulphate trials. The effect was marked, but might not have been so easily observed at a factory which was not already slicing to the capacity of the press and drying stations.

Throughout the period when aluminium sulphate was being added, dried molassed pulp was much darker than normal. A similar intensified darkening has been noticed in laboratory oven drying of exhausted cossettes treated with aluminium solutions.

The lowering of pH at the water-end would undoubtedly increase corrosion. The stock solution of about 21 g aluminium/litre was about $pH_{20}4$, and a solution of the aluminium sulphate in deionized water containing only 80 mg aluminium/litre, comparable to the concentration in supply water in the experiment reported in Table X, was $pH_{20}4.1$. When this latter solution was adjusted to pH_{20} 5.0 or above by addition of sodium carbonate, aluminium determinations on the filtered solution showed that virtually all the dissolved aluminium had been precipitated.

The grade of aluminium sulphate used at King's Lynn costs about £132/tonne or about £13/keq aluminium. The grade of gypsum used is about £50/tonne or £4.30/keq calcium. It is thus much more expensive to use aluminium sulphate in place of gypsum, as the results reported here indicate that, if aluminium sulphate replaces gypsum on the basis of equal kilo-equivalents of the cation/100 tonnes beet sliced, pressed pulp dry substance is not affected. This substantial price advantage in favour of gypsum is very unlikely to be eroded by the relative effects of the two additives on extra molasses production, as discussed below.

The cost of using aluminium sulphate might be appreciably increased relative to that of using gypsum because of the observed effects of a lowering of the water-end pH and an increased volume of wet pulp. The former would increase corrosion. The disadvantages of the latter in terms of possible slice rate reduction in order to be able to press all the pulp and lower pressed pulp dry substance because of an increase in speed of the variable-speed presses have been referred to above.

PRESSING AIDS AND THEIR DISTRIBUTION BETWEEN JUICE AND PULP

The significance of ionic distribution

If all the ions added to process when a pressing aid is used were to leave the process in the pulp, the most cost-effective additive could, as a first approach, be established from a comparison of the costs of the quantities of different ones needed to effect the same increase in pressed pulp dry substance.

This approach could be refined to allow for any adverse effects of particular compounds on pulp volume, as discussed above, but such factors as fuel saving and change in diffusion loss would be the same for all.

That the added ions do not behave in this simple way has been established in several studies[7,8,17]. As a result of using pressing aids like calcium chloride, cations and anions pass to raw juice. Various changes take place during subsequent processing, and the net effect is to increase the amount of non-sugars passing to molasses, and thus the sugar lost to molasses. This must be taken into account in a true assessment of the relative economics of using different pressing aids.

Investigational approach

A previous factory study[8] by these laboratories showed that more than 90% of calcium, added as calcium chloride at a rate of about 22.6 kg (1.1 keq) calcium/100 tonnes beet sliced, was present in the pulp. At the same time, the potassium content of thin juice was deduced from pulp analyses to increase by about 0.05 g/100 g sugar, equivalent to about 0.2 keq potassium/100 tonnes beet sliced. Changes in juice composition were, however, generally undetectable against the prevailing fluctuation in base levels of the various ions.

The stability of conditions at King's Lynn conferred by the operating procedures described above prompted a repeat of these studies using composite juice and pulp samples collected during steady-state conditions with and without various pressing aids. Samples were analysed for sodium, potassium, magnesium, calcium, aluminium, chloride and sulphate contents as appropriate.

Gypsum and other pulp pressing aids

The results indicate that the cationic composition of raw juice was reasonably consistent over a two-week period on various occasions when no pressing aid was being added. It is therefore considered that observed differences in juice composition with and without pressing aids on consecutive days are reliable indications of the ionic distribution occasioned by use of such compounds. This view has been supported by calculations which have indicated that the sum of the measured ionic changes is in good agreement with the quantity of pressing aid added.

Distribution of ions for gypsum addition

Analyses of composite samples were made for various steady-state conditions as follows:

(a) sterile diffusion with standard midbay acidification and gypsum addition to supply water at 74 kg/100 tonnes beet sliced,

(b) sterile diffusion,

(c) sterile diffusion with standard midbay acidification.

Tables XI and XII below are derived from results for the studies made on January 4/5, 1982, using calculated mass balance factors.

Table XI. Ionic balances with gypsum at 74 kg/100 tonnes beet sliced (January 4/5, 1982)

Sample	Ionic content (meq/100g)					Ionic content (keq/100 tonnes beet sliced)				
	Ca	Mg	K	Na	SO_4	Ca	Mg	K	Na	SO_4
Fresh cossettes	3.10	1.98	4.42	1.06	0.36	3.10	1.98	4.42	1.06	0.36
Supply water	1.55	0.37	0.97	0.32	N.D.	1.05	0.25	0.66	0.22	N.D.
IN						4.15	2.23	5.08	1.28	
Pressed Pulp	15.10	2.94	2.72	0.77	2.57	3.43	0.67	0.62	0.18	0.58
Press water	1.25	0.57	1.67	0.46	N.D.	0.45	0.21	0.60	0.17	N.D.
Raw Juice	0.74	1.25	3.45	0.80	1.25	0.81	1.36	3.76	0.87	1.36
OUT						4.69	2.24	4.98	1.22	
OUT/IN (%)						113	100	98	95	

Table XII. Ionic balances (no added gypsum, January 4, 1982)

Sample	Ionic content (meq/100g)					Ionic content (keq/100 tonnes beet sliced)				
	Ca	Mg	K	Na	SO_4	Ca	Mg	K	Na	SO_4
Fresh cossettes	3.28	1.88	4.09	0.90	0.30	3.28	1.88	4.09	0.90	0.30
Supply water	0.34	0.12	0.57	0.23	N.D.	0.26	0.09	0.43	0.17	N.D.
IN						3.54	1.97	4.52	1.07	
Pressed Pulp	9.74	2.66	3.64	0.94	0.85	2.71	0.74	1.01	0.26	0.24
Press Water	0.19	0.19	1.06	0.33	N.D.	0.08	0.08	0.42	0.13	N.D.
Raw juice	0.82	1.20	3.20	0.60	0.66	0.89	1.30	3.45	0.65	0.71
OUT						3.68	2.12	4.88	1.04	
OUT/IN (%)						104	108	108	97	

N.D. = Not determined

Comparison of the calcium contents of diffusion supply water in Tables XI and XII shows an increase of 0.79 keq calcium/100 tonnes beet sliced when gypsum was added. This is 92% recovery of the addition rate of 74 kg gypsum (i.e. 0.85 keq calcium) /100 tonnes beet sliced.

The ionic content of pressed pulp can be considered to be divided between the solid and aqueous phases. If it is assumed that the composition of the latter is the same as that of press water, then, from the ionic contents of pressed pulp and press water, the ionic content of the pulp part of pressed pulp can be derived. This has been done in Table XIII, for added gypsum and no added gypsum conditions, using the data in Tables XI and XII.

calcium in the pressed pulp was associated with the pulp fraction rather than with the water fraction of the pressed pulp.

It is interesting to note that the results for no addition of gypsum indicate that some 77% of the potassium and 73% of the sodium in pressed pulp were associated with the pulp part. When gypsum was used, the desorption of potassium and sodium caused these proportions to be reduced to 53% and 56% respectively of the amounts then in pressed pulp. The close parallels in these independent results for potassium and sodium, two ions

Table XIII. Changes in ionic concentrations in pressed pulp with use of gypsum (January 4/5, 1982)

Cation	Cation content (keq/100 tonnes beet sliced)							
	without gypsum			with gypsum				
	Pressed pulp (C_p)	Press water (C_w)	Pressed pulp solids (C_f)	Pressed pulp (C_p)	Press water (C_w)	Pressed pulp solids (C_f)	Change in content in pressed pulp	Change in content in pressed pulp solids
Ca	2.71	0.08	2.67	3.43	0.45	3.21	+ 0.72	+ 0.54
Mg	0.74	0.08	0.70	0.67	0.21	0.57	- 0.07	- 0.13
K	1.01	0.42	0.78	0.62	0.60	0.33	- 0.39	- 0.45
Na	0.26	0.13	0.19	0.18	0.17	0.10	- 0.08	- 0.09

Thus, columns 4 and 7 of Table XIII have been calculated using the equation:

$$C_f = C_p - 0.01 \frac{Y}{P} (100 - D_p) C_w$$

where C_f is the cation content of the pulp part of pressed pulp (keq/100 tonnes beet sliced),

C_p that of pressed pulp (keq/100 tonnes beet sliced),

C_w that of press water (keq/100 tonnes beet sliced),

Y is the yield of pressed pulp (% on beet sliced),

P is the quantity of pulp press water (% on beet sliced) and

D_p is the dry substance of pressed pulp (%).

The final column of Table XIII shows the difference between the two values of C_f so obtained, one for added gypsum, the other for no addition, and thus indicates the change in the cationic composition of the pulp part of pressed pulp as a result of using gypsum.

The increase in calcium content of pressed pulp corresponded to 85% uptake of added calcium. The absorption of calcium was accompanied by desorption of potassium, and to a lesser extent, magnesium and sodium, in confirmation of previous findings in factory studies[8]. Changes in ammonium content, which have been shown to be involved in the water-end chemistry when calcium is added[7,18], were not studied in these investigations.

The results indicate that about 75% of the additional

which might be expected to behave alike in ionic bonding and thus in extraction and desorption from pulp, add weight to the general reliability of the findings.

Table XIV. Changes in ionic content of juice and pulp with use of gypsum (January 4/5, 1982)

Ion	Change in ionic content (keq/100 tonnes beet sliced)	
	Raw juice	Pressed pulp
Mg	+ 0.06	- 0.07
K	+ 0.31	- 0.39
Na	+ 0.22	- 0.08
	+ 0.59	- 0.54
Ca	- 0.08	+ 0.72
Total	+ 0.51	+ 0.18
SO_4	+ 0.65	+ 0.34

[18] Carruthers *et al.: Paper presented to the 9th Tech. Conf. British Sugar Corp.*, 1956.

The changes in the quantities of individual cations in raw juice have been calculated from Tables XI and XII for comparison with the changes in the amounts in pressed pulp and with the increase in sulphate content. The results are given in Table XIV.

The decrease in the quantities of potassium and magnesium ions in pressed pulp were matched by the increases in the amounts of these ions in raw juice, but the balance was poor for sodium. The increase in raw juice of 0.65 keq sulphate/100 tonnes beet sliced was in reasonable accord with the increase in cation content, as would be expected on the grounds of electrical neutrality.

The gypsum addition rate was equivalent to 0.85 keq sulphate/100 tonnes beet sliced. The measured sulphate increases in pressed pulp and raw juice corresponded to 40% and 76% respectively of the added amount, giving a total recovery of 116% of the added sulphate.

Deductions made from the pulp analyses for the experiments, with and without added gypsum, on January 22, 1982, were in good agreement with the findings above for the earlier experiments, despite the deterioration in beet quality in the interim. Table XV below has been obtained from the later results in a manner analogous to the derivation of Table XIII.

Evidence about the distribution of the sulphate from gypsum could not be obtained in these later experiments. Midbay acidification with dilute sulphuric acid had been discontinued when gypsum addition was stopped, so that measured increases in sulphate reflected both sources of this ion.

The uptake of calcium by pressed pulp was examined further using analytical data from steady-state conditions over a period of a few days (Jan 14-18, 1982) when gypsum was added at rates of 0, 8.5 and 17.0 kg calcium/100 tonnes beet sliced. The results, with those for desorption of potassium, are given in Table XVI.

Table XVI. Calcium absorption and potassium desorption by pressed pulp

Gypsum addition rate (kg Ca/100 tonnes beet sliced	Pressed pulp dry substance (%)	K in pressed pulp (meq/100g)	Ca in pressed pulp (meq/100g)	Ca in PPW (meq/100g)	Ca in solids in pressed pulp (meq/100g pressed pulp)
0	20.8	3.88	10.61	0.44	10.26
8.5	23.8	3.12	13.94	1.09	13.11
17.0	24.3	2.98	14.56	1.10	13.73

As this table shows, the calcium content of pressed pulp rose by 3.33 meq/100g pressed pulp when the added calcium was increased from 0 to 8.5 kg/100 tonnes beet sliced, but only by a further 0.62 meq/100 g pressed pulp when the addition was increased from 8.5 to 17 kg calcium/100 tonnes beet sliced. The corresponding calculated increases in the calcium in solids in pressed pulp were 2.85 meq and 0.62 meq/100 g pressed pulp, and potassium desorption was 0.76 and 0.14 keq/100 tonnes pressed pulp, respectively.

Uptake of calcium by the pulp was much less for the second, and equal, increment in gypsum addition. This evidence, although not conclusive, suggests that the reason why increasing the addition of gypsum from 8.5 to 17 kg calcium/100 tonnes beet sliced had virtually no effect on pressed pulp dry substance, as reported above, was because the capacity of the pulp to take up calcium had virtually been reached at the lower addition rate. The matter is being studied in the laboratory, where more precise ionic balances can be achieved than are possible with factory samples.

Table XV. Changes in ionic concentrations in pressed pulp with use of gypsum (January 22, 1982)

Cation	Cation content (keq/100 tonnes beet sliced)							
	Without gypsum			With gypsum			Change in content in pressed pulp	Change in content in pressed pulp solids
	Pressed pulp (C_p)	Press water (C_w)	Pressed pulp (C_f)	Pressed pulp (C_p)	Press water (C_w)	Pressed pulp (C_f)		
Ca	2.93	0.29	2.78	3.41	0.48	3.16	+0.48	+0.38
Mg	0.69	0.12	0.63	0.66	0.20	0.55	−0.03	−0.08
K	0.88	0.52	0.62	0.50	0.40	0.29	−0.38	−0.33
Na	0.27	0.14	0.20	0.16	0.15	0.08	−0.11	−0.12

The concentrations of the individual cations in pressed pulp and press water, both with and without gypsum, are in good general agreement with those recorded in Table XIII for the earlier experiments.

These results again show that absorption of calcium by pressed pulp when gypsum was used was accompanied by desorption of magnesium, potassium and sodium. The quantities of these ions desorbed are in excellent agreement with those in Table XIII.

On the basis of the evidence presented in Tables XIV and XV, the addition of 0.85 keq calcium as a pressing aid was accompanied at King's Lynn factory by the desorption into juice of about 0.4 keq potassium, 0.1 keq sodium and 0.05 keq magnesium.

79% of the additional calcium in the pressed pulp was associated with the pulp fraction, in good agreement with the earlier finding. Once again, about 70-75% of the potassium and sodium in the pulp was associated with the pulp fraction when gypsum was not in use, and this decreased to about 50-55% when gypsum was used.

(To be continued)

SUGAR CANE AGRONOMY

Soil studies in Réunion. Anon. *Ann. Rpt. Inst. Rech. Agron. Trop.* (Réunion), 1980, 11-16 *(French).* Mention is made of investigations on soil pH and electrochemistry. In a plot in which the pH ranged from 4.95 to 7.05, slight differences in the growth of R 570 cane were found. However, varietal trials conducted elsewhere on the island have shown that yields of this cane exceed 100 tonnes.ha^{-1} irrespective of pH, whereas those of other varieties (Triton, RP 367/70 and RP 353/70) are below 100 tonnes.ha^{-1} when the pH of the groundwater is below 5.5. It is pointed out that pH is undoubtedly not the only factor to be taken into account.

Irrigation in Réunion. Anon. *Ann. Rpt. Inst. Rech. Agron. Trop.* (Réunion), 1980, 41-44 *(French).* – Among various investigations on aspects of irrigation, the only one for which results have been obtained is that in which the effect of cessation of irrigation at given times before harvest was determined. Results showed that the only case where cane and sugar yield and sugar content were greater than in the control (no stoppage of irrigation) was where irrigation ceased 4½ months before harvest; discontinuation 3 and 1½ months before harvest gave poorer results than the control. However, the parameters measured in the experiment are considered inadequate for the cause of the effects to be established, although it is suggested that they could be attributed to underestimation of the soil contribution and/or stoppage of cane growth with drop in temperature (causing a reduction in water consumption). Discontinuation of irrigation 4½ months before harvest reduced normal total water usage by 25%.

Effect of doses of nitrogen, phosphorus and potash on yield and quality of sugar cane. V. S. Kadian, S. N. L. Srivastava and V. R. Singh. *Indian Sugar,* 1981, **31,** 405-408. – N-P-K trials are reported, in which all three nutrients increased cane yield and had varying effects on sugar content and yield. P significantly affected the action of N by increasing yield still further than when N was applied on its own.

On the calibration of equipment and correct application of herbicides. Anon. *La Ind. Azuc.,* 1981, 272-275 *(Spanish).* – Recommendations of the INTA Experiment Station at Famaillá, Tucumán, Argentina, for calibration of spraying equipment, and for post-emergence weed control in plant and ratoon cane in the region are described and tabulated, respectively.

Energetic agriculture and the production of food – estimation of the costs of cultivation of sugar cane alone or intercropped or rotated with other crops – case study. A. C. Lombardi and C. Brugnaro. *Brasil Açuc.,* 1982, **98,** 351-362 *(Portuguese).* – Tables are presented in which are given the costs of growing cane, alone or in combination with peanuts, rice, beans, maize or soya, in 9 regions in São Paulo and 3 in Minas Gerais, determining the improvement or reduction of profit, relative to cane alone, of the additional crop(s).

Effects of application of vinasse in ratoon crops of sugar cane. A. F. Sobral, D. A. Cordeiro and M. A. C. dos Santos. *Brasil Açuc.,* 1981, **98,** 368-374 *(Portuguese).* In two experiments, vinasse from cane juice and molasses fermentations, respectively, were applied to ratoon crops growing in two soils. Yields with the former vinasse (receiving up to 400 m^3.ha^{-1}) were lower than the control crop receiving 80-80-120 kg.ha^{-1} of N-P_2O_5-K_2O. By contrast, yields with vinasse from molasses, which contained twice the nutrient content of that from juice, were higher than the control for applications of 50 and 100 m^3.ha^{-1} and lower for higher rates of application. Juice pol was not significantly affected by vinasse from juice but was reduced by that from molasses. Both types of vinasse increased soil pH slightly and also exchangeable K^+ and cation exchange capacity; these increases were not related to the amount of vinasse applied but to the interval between application and soil sampling.

Nitrogen complementation of vinasse. II. Forms of application to TE soil. L. C. F. da Silva, O. Alonso, J. Orlando and E. Zambello. *Brasil Açuc.,* 1981, **98,** 375-381 *(Portuguese).* – Nitrogen supplements of 45 and 90 kg.ha^{-1} in the form of urea were either added to vinasse in its tank or applied to the soil during tillage, the vinasse treatment being 100 m^3.ha^{-1}. The second method of application was more efficient and the economic level ranged from 76 to 92 kg N per ha, depending on the relative prices of cane and urea. The different treatments did not affect the pol % cane.

Studies on the crop rotation pattern and irrigation system in Hsingying district. D. S. Cheng, K. Y. Yan and Y. T. Chang. *Rpt. Taiwan Sugar Research Inst.,* 1981, (93), 11-19 *(Chinese).* – Details are given of a study carried out to evaluate three 3-year rotation patterns and the irrigation requirements of each. Rice and cane were the main crops, and they were combined with miscellaneous crops such as corn, soybean, corn ear shoot and vegetable soybean.

Effects of phosphatized fertilization on plant cane. J. Orlando and E. Zambello. *Tech. Bull.* (GEPLACEA), 1981, (18), 6 pp. – P fertilization trials carried out at four locations in Brazil are reported. Results showed that there was a significant response to P where the cane was growing on a latosol but not where the soil was a podsol, the positive reaction being particularly marked where the amount of P applied was one-third of the maximum that the soil could absorb. On the latosols it was possible to adjust the Mitscherlich equation for calculation of economical dosage rates in accordance with the price relationship between yield of cane and weight of P applied. The type of soil affected cane yield, but none of the treatments influenced cane pol or juice reducing sugars.

Energy inventory for TSC's sugar cane production. C. C. Wang. *Taiwan Sugar,* 1981, **28,** 188-191. – Examination of the energy consumption in cane agriculture in Taiwan has shown that the level was higher than estimates for Barbados, Brazil and Louisiana; this was chiefly attributed to the greater amount of N applied. Reference is made to trials on application of fertilizer tablets[1] as a possible means of reducing leaching of N, although it is considered that judicious use of pig manure as N source would be the best means of reducing fertilizer costs.

[1] Wang *et al.: I.S.J.,* 1981, **83,** 173.

CANE PESTS AND DISEASES

Sources of resistance to sugar cane smut *(Ustilago scitaminea* **Syd.) among the different species of** *Saccharum.* K. C. Alexander and M. M. Rao. *Sugarcane Pathologists' Newsletter,* 1981, (27), 7-12. – The reactions of 297 genotypes from *Saccharum officinarum* (115), *S. spontaneum* (158), *S. barberi* (8), *S. sinense* (2) and *S. robustum* (14) to smut, induced by dipping three-budded cuttings in a smut teliospore suspension for 30 minutes before planting, were determined. The results are tabulated, showing 85 of *S. officinarum,* 110 of *S. spontaneum,* 1 of *S. sinense* and 1 of *S. robustum* genotypes to be resistant. All but one of the remainder were classed as susceptible.

Resistance to smut *(Ustilago scitaminea* **Syd.) in the hybrids/varieties of sugar cane.** K. C. Alexander and M. M. Rao. *Sugarcane Pathologists' Newsletter,* 1981, (27), 13-17. – Results of smut resistance trials are reported. Most of the 233 hybrids were represented by commercial varieties; of these, the H series from Hawaii was the worst as regards susceptibility to the disease – out of a total of 92, only 3 were resistant, 4 moderately resistant and 6 moderately susceptible, while 18 were susceptible and 61 highly susceptible.

Studies on variation in the smut disease organism *(Ustilago scitaminea* **Syd.) of sugar cane.** K. C. Alexander. *Sugarcane Pathologists' Newsletter,* 1981, (27), 18-20. Smut teliospore collections were made from different varieties growing in India as well as from different *Saccharum* species. Their morphology was determined and possible pathogenic variations established by inoculation of tester varieties. Results showed that morphology did not vary sufficiently to indicate specialization, while the reaction of Co 527 cane to one collection of spores was so different from its known field response (susceptible in contrast to moderately resistant) as to indicate a difference in race from the other collections.

The status of the sugar cane smut disease in Mexico and smut resistance screening. S. Flores C. *Sugarcane Pathologists' Newsletter,* 1981, (27), 21-24. – The status of smut in Mexico, where it was first found in January 1980, is reported and details are given of measures adopted and planned to curb the disease. The results of screening tests on 50 varieties at Tower Hill, Belize, are presented, showing 22 to be highly susceptible, 7 susceptible, 6 moderately resistant and 15 resistant.

Effect of wilt- and red rot-induced disease stress on quality deterioration of sugar cane. O. Singh and K. S. Waraitch. *Sugarcane Pathologists' Newsletter,* 1981, (27), 25-30. – The changes in composition of leaf tissue and cane juice resulting from wilt (caused by *Fusarium moniliforme* var. *subglutinans)* and red rot (caused by *Colletotrichum falcatum)* infection were studied. Both diseases caused an increase in the rate of tissue dehydration, a reduction in leaf protein and chlorophyll content and a fall in nitrate reductase activity. The sucrose content, purity and protein content in juice decreased, while reducing sugars, gums, titratable acidity, flavonoids and soluble salts increased. Red rot caused greater deterioration than wilt.

A note on rust in Papua-New Guinea. B. T. Egan. *Sugarcane Pathologists' Newsletter,* 1981, (27), 30-31. – Although *Puccinia kuehnii* was the pathogen responsible for rust on Ragnar and Q 87 cane, as well as on indigenous noble canes and clones of *Saccharum edule* and *S. robustum,* no rust due to *P. melanocephala* was found in Papua-New Guinea during a short visit made in 1981, nor has it ever been reported from there.

A possible hyperparasite of sugar cane rust: *Cladosporium uredinicola* **Speg.** C. C. Ryan and J. A. Wilson. *Sugarcane Pathologists' Newsletter,* 1981, (27), 31. – A dark grey fungal growth found on pustules of *Puccinia melanocephala* in Queensland was identified as *C. uredinicola.* Microscopic examination of the pustules showed that the uredospores were darker than normal and the internal structure appeared to be disorganized. On the basis of the findings and references to parasitization of other *Puccinia* species by the fungus, it is suggested that it is a hyperparasite of *P. melanocephala.*

Red rot on rust-infected sugar cane leaf blades in Florida. J. L. Dean. *Sugarcane Pathologists' Newsletter,* 1981, (27), 32-34. – While the red rot fungus, *Physalospora tucumanensis,* commonly produces midrib lesions on cane leaves, such lesions are relatively rare in the Florida cane area, unlike Louisiana; on the other hand, the fungus rarely attacks leaf blade tissues. However, leaf blade lesions bearing fruiting structures typical of *Colletotrichum falcatum,* the imperfect stage of the red rot fungus, have been found on cane leaves infected with rust. Fungus associated with red rot and leaf blade-attacking *C. falcatum* were isolated from two noble canes that had developed the disease in their standing stalks. Comparison of the isolates showed that both sporulated sparsely on oatmeal agar under fluorescent lighting, but did so abundantly under long-wave U.V. light; there was no difference between them as regards spore production per unit surface area. Pathogenicity tests gave inconclusive results, although typical red rot symptoms developed around sites inoculated with either isolate.

A system for recording data about the sugar cane rust/host interactions. L. H. Purdy and J. L. Dean. *Sugarcane Pathologists' Newsletter,* 1981, (27), 35-40. – See *I.S.J.,* 1982, **84**, 46.

An outbreak of yellow spot disease in Guyana. R. Bhim. *Sugarcane Pathologists' Newsletter,* 1981, (27), 46-47. Yellow spot was discovered on D 76/61 cane in Guyana in September 1980, since when other varieties have proved susceptible, including B 41227, which is grown on 43% of the total cane area. The disease is prevalent in areas of high rainfall.

Leaf scald resistance ratings of a group of *Saccharum* **and** *Ripidium* **clones.** C. C. Ryan, B. J. Croft and D. M. Hogarth. *Sugarcane Pathologists' Newsletter,* 1981, (27), 47-50. – The leaf scald ratings of a group of *Saccharum officinarum, S. robustum, S. edule, S. spontaneum* clones and two clones of *Ripidium* spp. in the 1976 ISSCT Germplasm Collection from Indonesia have been determined and are tabulated.

CANE BREEDING AND VARIETIES

Comparative varietal trial on saline soil. M. Lotutale. *Sukari* (Zaire), 1981, **1**, (1), 19-23 *(French).* — Varietal trials, up to a 2nd ratoon crop, are reported in which five varieties (CP 63588, S 17, B 60267, Co 1740 and CB 4077) were grown on saline soil in the area of Kiliba sugar factory, N:Co 376 being used as standard. While Co 1740 and CP 63588 were the nearest in performance to N:Co 376, Co 1740 arrows at 10 months, while CP 63588 flowers too early and is susceptible to smut.

Florida's 1981 sugar cane variety census. B. Glaz. *Sugar y Azúcar,* 1981, **76**, (12), 37-38, 40. — The annual variety census for the 1981-82 harvest season in Florida is presented. The number of varieties increased by 19 over the previous season's figures, but most of the 64 were grown on only very small areas. While CP 63-588 continued to be the most widely grown variety for plant and ratoon crops taken together, its chief popularity was as a ratoon cane, while CP 70-1133 is replacing it as the most popular variety for planting. Of the six varieties that have shown a fall in area, five (including CP 63-588) are susceptible to smut or rust.

Varietal buffering in sugar cane. A. Q. Khan. *Indian Sugar,* 1981, **31**, 409-411. — Buffering or productivity stability is shown by some cane varieties in both predictable and unpredictable environments. In a predictable environment (e.g. climate, soil types, day length and controllable variables such as fertilization, sowing dates and harvesting method), a high level of genotype x environment interaction is desirable so as to ensure a maximum yield or financial return, whereas in an unpredictable environment (e.g. in- and between-season fluctuations in amounts and distribution of rainfall and prevailing temperatures), a low level of interaction is desirable so as to ensure maximum uniformity of performance over a number of locations and seasons. The form of buffering of importance for sugar cane is individual buffering, i.e. as an individual characteristic of the genotype. Studies have shown that it is a feature of specific genotypes and of heterozygosity and can be achieved by utilizing specific combining ability. Tillering as a factor promoting stability in cane is discussed, and the need to test for tillering capacity in breeding programs is emphasized, since it is this ability which will allow varieties to adapt themselves to varying environmental conditions and compensate for loss of tillers.

Effect of freshness and pre-treatment on the germination of seed cuttings of sugar cane variety ROC 1. J. B. Chen, C. C. Lo, P. C. Yang and F. W. Ho. *Rpt. Taiwan Sugar Research Inst.,* 1981, (93), 1-10 *(Chinese).* — While ROC 1 is a newly released variety of excellent yield, high sucrose content and very early maturity, its germination rate appears to be slower. Experiments were therefore conducted in a growth chamber to improve germination. Results showed that soaking cuttings in 2% lime solution, 0.28% KOH, 0.3% $MgSO_4$ or water for 24 hours significantly increased germination at 22° or 28°C by comparison with the control. No significant difference was observed between the four treatments, although KOH solution gave a slightly better effect at 22°C. Freshness of the seed stalks is one of the main factors affecting germination, and it was found that the longer the seed stalks were exposed in the field, the slower was the germination rate; exposure for 3-5 days before planting delayed the achievement of 50% germination by 2-4 days by comparison with the results of 1-day exposure. On the other hand, soaking the seed stalks in water for 24 hours after 3-5 days' exposure caused very rapid and uniform germination 8-11 days after planting, but had no effect on germination when the seed stalks were soaked immediately after collecting from the field. The slower germination of ROC 1 may be attributable to a high sucrose content and low rate of sucrose inversion.

Design and statistical analysis of experiments on the selection of optimum culture medium in sugar cane tissue culture technique. T. M. Wang. *Tech. Bull.,* (GEPLACEA), 1981, (20), 19 pp. — See *I.S.J.,* 1981, **83**, 275.

Relative value of sugar cane. J. Miocque. *Tech. Bull.* (GEPLACEA), 1981, (18), 5 pp. — Cane improvement programs, such as Planalsucar in Brazil, require a formula permitting comparative evaluation of data on new cane varieties, taking into account richness, extractable product (sugar or alcohol), agricultural yield and primary costs (those of harvesting, transportation and processing expressed as a fixed coefficient per tonne of cane and designated the "economic factor" F). A formula has been developed which takes the form VR = t/ha (Pol % — F), where VR = economic relative value, t/ha = tonnes of sugar cane per ha, and Pol % = kg of pol per tonne of cane. Use of the formula is demonstrated in the case of two varieties of different degrees of richness, showing how much greater the financial yield is in the case of the richer cane. The formula is used by Copersucar in the statistical analysis of clone selection tests.

The analysis of sugar cane experiments. A. Martínez G. and F. Cienfuegos I. *Tech. Bull.* (GEPLACEA), 1981, (18), 7 pp. — Two methods developed for statistical evaluation of cane varietal trials have been combined, since neither, when used on its own, is complete. The method of Rojas[1] is based on the actual value of the crop, while that of Martínez[2] is based on the evaluation of the net income. Application of the combined technique is demonstrated by an example involving five varieties in the Mex series and N:Co 310.

Cane sugar production and varietal research in China. T. L. Chu. *Sugar y Azúcar,* 1982, **77**, (2), 56-57. — A survey is presented of cane varieties grown in China, where three provinces (Kwangtung, Kwangsi and Fukien) accounted for almost 80% of the cane sugar produced in the country in 1980-81. Details are given of cane sugar production (a total of 2,392,800 tonnes of white sugar) in these and six other provinces in 1980-81, and of the cane varieties grown on 1% or more of the total cane area in Kwangtung. Information is also given on the parentage of cane varieties developed in Kwangsi province. Although smut has been reported in three provinces since the early 1960's, no apparent effort has been made to control the disease, to which the leading variety (F 134) is susceptible.

[1] *Proc. 9th Congr. ISSCT,* 1956, 418-428.
[2] *Proc. 14th Congr. ISSCT,* 1971, 1069-1071.

SUGAR BEET AGRONOMY

Control of grasses and weeds. Anon. *Die Zuckerrübe,* 1982, **31**, 70-72 *(German).* — Recommendations are given on chemical weed control.

Beet cultivation on heavy soils. W. Garburg. *Die Zuckerrübe,* 1982, **31**, 92, 94-95 *(German).* — Chemical weed control in beet crops on heavy soils is discussed.

Potassium — major nutrient and quality-determining component of beet. U. Beiss. *Die Zuckerrübe,* 1982, **31**, 79-83 *(German).* — K uptake and distribution in the beet, its effect on yield and quality, and the effect of various factors on its contents are discussed.

Weed control on light soils. F. Maykuhs. *Die Zuckerrübe,* 1982, **31**, 97-98 *(German).* — Herbicide application on light soils is discussed, and the particular problems posed by certain grasses are examined.

The current position of chemicals application in Hungarian sugar beet agriculture. A. Angeli. *Cukoripar,* 1981, **34**, 81-84; 1982, **35**, 1-4 *(Hungarian).* — An account is given of fertilizer and herbicide application in Hungarian beet fields.

The possibility of eradicating creeping thistle in sugar beet. K. Posch. *Cukoripar,* 1982, **35**, 5-7 *(Hungarian).* Three-year trials are reported in which up to 98% eradication of creeping thistle *(Cirsium arvense)* was achieved with Lontrel (a Dow product) + Betanal at 0.4-0.6 litre + 5.0 litres per ha. Lontrel also proved effective in control of *Polygonum lapathifolium* and *P. persicaria.* It is recommended to apply the herbicide only once the beets have 4-6 leaves.

Investigation of changes in sugar beet during storage. X. Establishment of polyphenol oxidase and pectolytic enzyme activity. P. Meresz, K. Hangyal and R. Lasztity. *Cukoripar,* 1982, **35**, 24-28 *(Hungarian).* — Investigations showed that the title enzymes behaved similarly in the beet and that their activity was governed primarily by growth conditions and physiological state of the beet before storage as well as by genetic factors. Hence, the enzymes in question are different in behaviour from e.g. invertase, which is more readily affected by storage conditions.

Effect of herbicides on weed growth, root yield and quality of sugar beet *(Beta vulgaris* **L.).** R. S. Chauhan, M. P. Motiwale and R. N. Singh. *Indian Sugar,* 1981, **31**, 465-468. — Two-year herbicide trials are reported in which Alachlor, Nortron and Pyrazon at 2, 2 and 3 $kg.ha^{-1}$, respectively, gave 92-94% control and increased yield of beets to a level comparable to that with manual weeding. Treatment also resulted in a saving of about 23 $kg.ha^{-1}$ N (otherwise taken up by the weeds). The root yield in untreated fields was about half that in treated fields.

Sugar beet sowing in 1982. A. Vigoureux and R. Vanstallen. *Le Betteravier,* 1982, **16**, (162), 16-18 *(French).* — Advice is given on seedbed preparation, seed spacing, choice of drills and use of micro-granulators as well as on the drilling operation itself.

Betanal E low volume: a revolution overall. I. Jewry. *Agrospray,* 1982, (5), 2-4. — Advice is given on application of Betanal E herbicide at low dosage rates, with mention of results obtained in control of specific weeds. It is stated that a high spraying pressure is not as important as has been thought in association with low-volume application.

Mixtures and programs for weed control in sugar beet across Europe. S. Horne. *Agrospray,* 1982, (5), 5-9. Herbicide mixtures and weed control programs suitable for beet crops in various Western European countries are described, and information is given on specific weeds involved.

Morphological characteristics and quality-determining properties of sugar beet as criteria of topping quality. A. Westing. *Zuckerind.,* 1982, **107**, 216-223 *(German).* Trials showed that even where there were no gaps in the beet row, it was still not possible to effect optimum topping because of marked fluctuation in the shape of the beets above ground, despite proper adjustment of the topper. Plant population had the greatest effect on topping — increase in plant density was accompanied by increase in over-topping; on the other hand, variety and N fertilization effects on beet morphology and on losses caused by over- and under-topping were insignificant. Beet size affected the processing quality — that of the crowns from beets of low plant density was somewhat higher than with high plant density.

Improving beet quality. M. Loilier. *Sucr. Franç.,* 1982, **123**, 119-126 *(French).* — Beet varietal trials carried out in 1981, nitrogen trials conducted on a field scale in 1980 and an experiment on treatment of stored beet with a fungicide are reported. Comparison of beet untreated and treated with Rovral T.S. showed that the daily sugar losses were greater in the first 15 days in the case of the treated beet, but were lower than in the untreated beet during the subsequent 60 days. Some beets were found to be infected with *Rhizoctonia violacea;* however, in the case of the treated beet, the disease remained stationary, whereas it caused marked deterioration in the untreated beet.

Effect of pesticides used in beet cultivation on the biological activity of the soil. II. C. Bellinck and J. Mayaudon. *Publ. Trim. Inst. Belge Amél. Betterave,* 1981, **49**, 89-95 *(French, Dutch).* — Eleven formulations of herbicides and pesticides were applied to a beet field and the biological activity of the soil determined by radiorespirometry in terms of p.moles of $^{14}CO_2$ obtained per $min.g^{-1}$ (as a result of decarboxylation of glutamic acid). Results are given in table and graph form, and recommendations are made on the basis of these.

Sugar beet harvesting problems. W. C. von Kessel. *Die Zuckerrübe,* 1982, **31**, 114-116, 118-119 *(German).* Various aspects of beet harvesting which need consideration at the time are discussed, including the question of whether to harvest the leaves for use as animal fodder, harvester adjustment for optimum topping, the reconciliation of costs of harvester use with the returns from the factory, and minimization of dirt tare. Mention is made of salient features of particular harvesters.

BEET SUGAR MANUFACTURE

Automation of the pan station at the Breda sugar factory of CSM. P. W. van der Poel, J. H. Bun, C. C. Bleyenberg and N. H. M. de Visser. *Zuckerind.*, 1982, **107**, 113-117 *(German).* — Information is given on the automatic control of the 7-pan station at Breda factory (in Holland), where a mini-computer system was preferred to a fixed-wire logic scheme with analogue control and to a microprocessor system because of flexibility and the possibility of programming of the control loops in dialogue with the computer. Main parameters measured are viscosity (for which a viscosity/consistency transmitter is used), absolute pressure, heating vapour bleed and massecuite level. Supersaturation is controlled on the basis of viscosity up to a crystal content of 25%; above this level, supersaturation is affected by changes in consistency with increasing crystal content, so that the viscosity/consistency transmitter ceases to "measure" supersaturation but monitors crystal content instead. Between 5 and 25% crystal content, the curve of the target value is automatically corrected by the computer. The system has permitted a fuel oil saving of 0.2-0.3% on beet and a 10% increase in sugar output (to 7200 tonnes per week).

Calculation of the separation factor of continuous centrifugals for sugar massecuites. A. A. Dobik, M. I. Il'in and S. V. Danilin. *Izv. Vuzov, Pishch. Tekh.*, 1981, (5), 54-56 *(Russian).* — Using mathematical functions pertaining to gyratory mechanics, the authors develop equations for calculation of optimum centrifugal force at which throughput for a basket of given structural material is maximum.

Means of increasing the efficiency of beet diffusers and development of plant of high unit capacity. V. M. Lysyanskii *et al. Izv. Vuzov, Pishch. Tekh.*, 1981, (5), 62-66 *(Russian).* — Information is given on a Soviet-designed prescalder which operates on a counter-current basis and in tests has permitted an increase in diffuser throughput, a reduction in juice draft and a fall in pulp sugar.

Determination of settling time in sugar juice clarifiers. L. G. Rodriguez, P. M. Fabregat, A. V. Gukalov and A. P. Nikolaev. *Izv. Vuzov, Pishch. Tekh.*, 1981, (5), 110-111 *(Russian).* — By means of a mathematical function which is constant for each type of clarifier and defines the ratio of true to theoretical settling time but is independent of juice properties, the authors compare the performances of a number of clarifiers in terms of utilization of the available settling surface area.

A static model of the energy system of a sugar factory using the black box method. E. Sarka and P. Kadlec. *Listy Cukr.*, 1982, **98**, 37-41 *(Czech).* — The concept of the electronic "black box" is explained, and application of it to determination of electricity generation and energy consumption per unit processed beet is described in the case of a Czechoslovakian beet sugar factory with refinery section. The method does not require knowledge of the specific energy processes. The dependence of the energy factors on factory throughput is described by approximation equations; data evaluation requires only well-kept records and a pocket calculator.

Coal as fuel in the sugar industry. M. Pouillaude. *Sucr. Franç.*, 1982, **123**, 91-98 *(French).* — Oil is the fuel consumed by most French sugar factories, with coke as a poor second, while very little coal is used. The fuel situation has been examined in order to see if it would be practical for the sugar industry to return to large-scale use of coal in view of uncertainties regarding availability and costs of crude oil. However, it has been found that there are a number of major arguments against the use of coal, including transport problems, the difficulty of finding ample space for coal storage and dust separation at sugar factories, atmospheric pollution (bearing in mind that half of the factories are located near towns) and the costs of furnace conversion — furnaces operate for only some 2000 hours per year in sugar factories, so that it would take a long time to cover the conversion costs, while the long downtime between campaigns would increase the maintenance costs, which are already higher for a coal-fired than for an oil-fired furnace. It would be better to replace fuel oil with electricity produced by nuclear power stations or with the product of coal gasification.

Increasing the extraction efficiency of rotary diffusers. N. V. Pogorelova and V. M. Lysyanskii. *Izv. Vuzov, Pishch. Tekh.*, 1981, (6), 100-102 *(Russian).* — The time taken for complete denaturing of beet tissue (originally 25% of the entire extraction time) was drastically reduced in a rotary diffuser by modifying the system of juice withdrawal from the head section for cossette prescalding. By providing 120% of the juice (on beet) as diffusion juice and 80% as circulation juice, the new system permitted an increase in the quantity of prescalding juice of higher temperature while maintaining juice draft at the same level as before. As a result, denaturing was completed in the 1st/2nd or 3rd/4th compartments at two factories (the earlier denaturing resulting from a special prescalder) by comparison with the 8th compartment in the original diffuser.

The lime salts content in 1st carbonatation juice as a function of lime usage in defecation. N. I. Gavrina, A. R. Sapronov, D. V. Ozerov and N. E. Karaulov. *Sakhar. Prom.*, 1982, (2), 14-15 *(Russian).* — The effect of lime usage on 1st carbonatation juice Ca salts and colour was investigated in the range 0.45-2.3% CaO on juice. Optimum conditions for calcium carbonate adsorptivity were created by separation of preliming muds and liming with 0.6-0.7% CaO, although this would depend on the quality of the beets being processed.

Massecuite boiling temperature. Yu. D. Kot, A. N. Savich, A. F. Kravchuk, Z. I. Beregovaya and A. V. Vlasenko. *Sakhar. Prom.*, 1982, (2), 16-19 *(Russian).* — Massecuite boiling data for supersaturation coefficients of 1.03, 1.06 and 1.09 show that the crystallization rate increased with temperature rise from 75° to 90°C only at a supersaturation greater than 1.06, so that it is better to restrict the temperature to 75-80°C. However, choice of temperature must take into account not only purity and supersaturation but also viscosity, and the inter-relationship is shown in graph form. The recommendation is to boil at a temperature corresponding to minimum viscosity.

Some features of low-grade sugar affination in centrifugals. N. I. Odorod'ko, A. P. Kozyavkin and V. A. Maistruk. *Sakhar. Prom.*, 1982, (2), 19-20 *(Russian).* Because of difficulties experienced at a number of Soviet sugar factories in affination of low-grade sugar, a number of recommendations are made, whereby affined sugar quality can be raised and molasses purity rise prevented.

Molasses formation. I. N. Kaganov. *Sakhar. Prom.*, 1982, (2), 21-22 *(Russian).* — Molasses formation is described in simplified form by a mathematical approach based on the physico-mechanical parameters involved and their retarding effect on sugar crystallization.

Graphical evaluation of the performance of the pulp treatment plant of a sugar factory. D. E. Sinat-Radchenko. *Sakhar. Prom.*, 1982, (2), 22-24 *(Russian).* — A nomogram is presented for calculation of the various parameters concerned in beet pulp pressing as a means of establishing optimum conditions.

The rate of bulk growth of sucrose crystals. M. Traore, V. I. Tuzhilkin and A. R. Sapronov. *Sakhar. Prom.*, 1982, (2), 24-25 *(Russian).* — Investigations of crystallization are often carried out under conditions that differ from those of normal pan boiling. Studies are described which were carried out in a closed circuit with natural circulation, thus providing conditions analogous to the factory process. The crystallization process is described with the aid of graphs showing the crystallization rate as a function of supersaturation and boiling point elevation at constant pressure.

The effect of moisture and temperature on heat conduction and diffusivity in the sugar beet. A. V. Sadych, I. A. Oleinik and I. G. Bazhal. *Sakhar. Prom.*, 1982, (2), 26-28 *(Russian).* — Investigations are reported on determination of the relationship between heat conduction and heat diffusivity on the one hand and temperature (in the range 20-80°C) and moisture content (in the range 72-78%) on the other. The results are given in graph form, and formulae developed for calculation of the two heat parameters as a contribution to establishing optimum prescalding and diffusion conditions.

Foam — a secondary source of bacterial infection in flume-wash water at sugar factories. A. G. Kirichenko, B. I. Goncharenko and V. E. Tarasenko. *Sakhar. Prom.*, 1982, (2), 28-30 *(Russian).* — Foam that forms in flume-wash water accumulates a considerable quantity of organic matter which acts as substrate for microbial development at favourable temperatures. Various methods were tested for reduction of foam and hence bacterial populations. Results are tabulated and illustrated by petri dish cultures before and after treatment. These showed that by far the most effective (92% reduction of bacterial count) was liming to pH 12.2-12.5 followed by gassing with CO_2, allowing the impurities to be adsorbed by the resultant $CaCO_3$, while the CO_2 itself had an inhibitory effect on the micro-organisms. Flotation reduced the bacterial counts by 84%, while liming with or without addition of anti-foam agent had a 67% effect. The results clearly showed how the foam contained more microbes than the original water.

Entropy and exergy of wet carbonatation gas. G. Kimenov and G. Wyltschev. *Zuckerind.*, 1982, **107**, 205-209 *(German).* — The entropy of wet CO_2 is used as basis for the calculation of the gas exergy, allowing for specific exergies of its components (CO_2, N_2, O_2 and water vapour) and exergy losses occurring during mixing. Mollier diagrams are presented for enthalpy-water-entropy based on entropy at 1 bar pressure and 0°C, and for enthalpy-water-exergy based on exergy at 1 bar pressure and 20°C. The diagrams may be used for calculation purposes with sufficient accuracy for normal factory carbonatation.

Large-scale trial on biological waste water treatment at Wierthe factory of Braunschweiger Zucker-AG. L. Lütge and H. Wunsch. *Zuckerind.*, 1982, **107**, 210-213 *(German).* Full-scale tests are reported in which 75,000 m^3 of waste water (about 40% of the total) from the 1980-81 campaign was treated with activated sludge during 140 days from April 9. Specially designed Fuchs ejector-type aerators were used and proved highly efficient, with little maintenance required. After initial teething troubles (including an initial inadequate concentration of activated sludge which was rectified by introduction of some pig manure), the plant operated satisfactorily, reducing the BOD_5 from about 5000 mg.litre^{-1} to below 30 mg.litre^{-1} at a power consumption of 1.38 kWh per kg BOD.

Sugar factory juice purification with calcium sucro-carbonate. J. Grabka. *Sucr. Belge*, 1982, **101**, 43-48 *(French).* — Comparative tests were conducted on raw juice treatment with sucro-carbonate (obtained as a dense, gelatinous product by gassing a mixture of lime and sugar with CO_2) and milk-of-lime, respectively. Results demonstrated that sucro-carbonate was more efficient in eliminating impurities as shown by 2nd carbonatation juice purity.

Design and operating characteristics of a new beet quality measuring system. J. Hobbis, J. Kysilka and M. Holle. *Sucr. Belge*, 1982, **101**, 49-59. — Details are given of a rapid beet analysis system developed by American Crystal Sugar Co. which incorporates three major units: (1) a CTI-301 Data Entry Station (DES), a microprocessor-based unit into which the sample identification number is keyed; the DES is interfaced to the electronic tare scales and to the logic of the sample washing/drying system, and sends the relevant data to a line computer in the analytical console for calculation of dirt tare; (2) a CTI-101 digestion-filtration unit incorporating a "wheel" which carries, at its circumference, 20 blenders arranged so that each can pour into one of the the filter holders which drain into beakers below. As the table rotates the samples are fed into the blenders and are suitably treated at various points so as to yield the required analytical data; aluminium sulphate is used as clarifying agent. The unit also includes a control cabinet for the digestion-filtration operations and the sampling and timing functions of the CTI-201 analytical console (3), which houses the analytical equipment, power systems and line computer. The system processes three samples per minute.

Microbiological processes and their control within the sugar industry. D. Matteuzzi and G. Vaccari. *Ind. Sacc. Ital.*, 1982, **75**, 16-26 *(Italian).* — A review, with 72 references, is presented of the literature on bacterial processes occurring during beet processing, including fermentation in diffusion, the formation of gums, sugar losses, means of combating infection and analytical methods for determining the degree of microbial infection and hence when to add disinfectant (particularly in diffusion).

SUGAR REFINING

Colour development and separation in refined pan house operation. D. J. Bardwell, H. R. Delaney and D. T. Hawkins. *Proc. 40th Meeting Sugar Ind. Technol.*, 1981, 208-241. — The generation of colour in stored syrups was found to be governed by temperature, time and aeration; correlations for temperature and time were obtained from 1st order reaction kinetics, supporting the theory that colour formation in short-term storage is a molecular rearrangement initiated by carbonyl groups present in colorant molecules. The effect of centrifugal wash water on refined sugar colour was also investigated. Correlations obtained permitted prediction of washed sugar colour for all grades of white sugar from massecuite colour content and wash water quantity. The effect of wash water was found to follow an exponential pattern; the equations developed demonstrate the limit to which colour can be reduced by wash water alone.

A progress report on the use of new precoat technology for sugar clarification and decolorization. A. Tavares and R. Kunin. *Proc. 40th Meeting Sugar Ind. Technol.*, 1981, 242-250. — Although the use of ion exchange resins and adsorbents has been increasing in the world's refining industries, recent events have dictated that the processes should be examined in regard to capital investment, energy consumption and environmental pollution. Studies with cane sugar syrups and corn sweeteners have shown that new precoat formulations based on powdered ion exchange resins and powdered active carbon can be used to advantage on a disposable, non-regenerable basis for syrup clarification and decolorization. Pilot-plant and full-scale tests are reported in which the Graver Ecodex precoat technology has proved effective. The trials are continuing. (See also Kunin & Tavares: *I.S.J.*, 1982, **84**, 118.)

Experience in processing cane raw sugar at sugar factories in the Soviet Union. A. P. Khotsinskaya and A. I. Shapiro. *Sakhar. Prom.*, 1982, (1), 14-18 *(Russian).* — An account is given of the history of cane sugar refining in the USSR, and information is given on processes and means used to achieve optimum results.

We improve the system for raw sugar processing. L. S. Alekseeva. *Sakhar. Prom.*, 1982, (1), 18-21 *(Russian).* Details are given of modifications to the entire refining process at Gorodeya factory, and performance data are tabulated.

Some features of the sugar refinery of Central El Palmar. F. Z. Cordovez. *Sugar J.*, 1981, **44**, (7), 17-19. — See *I.S.J.*, 1982, **84**, 307.

Trends in the manufacture of raw sugar which are affecting the technology of sugar refining. M. C. Bennett. *Sugar y Azúcar*, 1982, **77**, (1), 35, 38-39, 42. — See *I.S.J. Supplement*, 1978, **80**, 7.

V.H.P. raws — some pertinent facts for producer and refiner. J. B. Alexander. *Sugar y Azúcar*, 1982, **77**, (1), 42-43, 45, 48-49. — See *I.S.J.*, 1982, **84**, 308.

Some characteristics of refining beet raw sugar. H. Eichhorn. *Sugar y Azúcar*, 1982, **77**, (1), 49, 52-53. See *I.S.J.*, 1982, **84**, 135-139.

New sucrose recovery station for mud and lint at the Colonial Sugar refinery. R. L. Knecht and J. D. McCulla. *Sugar J.*, 1982, **44**, (8), 7-12. — See *I.S.J.*, 1982, **84**, 308.

Simulation of the effect of hydrodynamic conditions and air temperature during drying of sugar cubes. O. Mikus, J. Nemec and N. Marek. *Listy Cukr.*, 1982, **98**, 32-37 *(Czech).* — Computer processing of data obtained from a model of cube sugar drying gave the minimum time for complete drying in hot air as 7 minutes, while optimum air flow rate was 0.5 $m.sec^{-1}$.

An experimental study of the effect of certain parameters of the (wet sugar) mixture on the quality of pressed cubes. P. Betak and O. Mikus. *Listy Cukr.*, 1982, **98**, 56-61 *(Czech).* — The effects of cube sugar porosity and granulometry and of wet sugar moisture content and mixing time on the mechanical strength of the moist cube and the dissolving time and abrasion of the dry cube were investigated, and the optimum applied pressure determined. For good-quality cubes, the porosity under permissible pressure conditions should be in the range 23-33%.

Dextrans in raw sugar: the refiner's viewpoint. R. Priester. *Bol. Técn.* (GEPLACEA), 1981, (19), 2 pp *(Spanish).* See *I.S.J.*, 1982, **84**, 122.

Raw sugar polarization. D. M. Humm. *Tech. Bull.* (GEPLACEA), 1981, (20), 10 pp. — See *I.S.J.*, 1979, **81**, 135.

Ash in the refining process. W. R. Tuson. *Tech. Bull.* (GEPLACEA), 1981, (20), 5 pp. — See *I.S.J.*, 1979, **81**, 135.

Colour. G. Sansaricq. *Tech. Bull.* (GEPLACEA), 1981, (20), 3 pp. — See *I.S.J.*, 1979, **81**, 135.

Mixing bone char with granular carbon. F. G. Carpenter. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 5 pp. — The various properties of bone char and granular active carbon are examined with regard to the possibility of mixing them for liquor decolorization and ash removal. Regeneration of a mixture of the two adsorbents is of major importance, and the best compromise conditions are considered to be a temperature as high as possible without undue overburning of the char, and a time that is sufficient for carbon regeneration but allows some pore blockage. As regards hardness, the carbon should be softer than the bone char since it will be the more under-regenerated, while the mixture should contain more carbon than is required for use since it will wear away faster. Mixtures are being used at several refineries.

Science and the art of low-purity cane sugar crystallization. E. J. Culp. *Paper presented at 1st Meeting, Sugar Processing Research Inc.*, 1982, 15 pp. — The biggest source of loss in a refinery is final molasses which, in the case of cane sugar, is typically of 40 purity. However, while there is considerable potential for increased yields through reductions in purity, little research has been

carried out on crystallization of low-purity sugar. The relationship between theory and practice is set out for crystallization where the invert sugar content is 35% of the non-sucrose solids. Two well-known formulae developed by Tate & Lyle for prediction of molasses purity are presented, and the melassigenic effect of invert sugar demonstrated by curves of sucrose:non-sugars *vs. g* (invert:non-sugars). Both curves show a minimum for *g* at about the same point corresponding to 35% invert; the slope on one side of this minimum corresponds to the salting-out effect of invert, while that on the other side shows the melassigenic effect of higher invert concentrations. It has been found that cane sugar solutions have molecular water:sucrose ratios which progressively increase with fall in purity; however, the relationship of concentration to temperature does not change much with purity provided concentration is expressed in terms of the number of water molecules per molecule of total sugars (sucrose equivalent). This ratio is designated N_T, and a value of 4.5 has been found to approximate to a supersaturation coefficient of 1.3, at which crystallization rate has proved to be maximum in refining. The hydration structure of sucrose molecules in aqueous solution is explained and crystallization efficiency discussed in terms of the behaviour of the sucrose molecule. Viscosity is briefly mentioned, and answers are given to eight questions regarding crystallization based on the results of the investigation.

Minor constituents of sugar and filtration. C. M. Elgal. *Paper presented at 1st Meeting, Sugar Processing Research Inc.,* 1982, 14 pp. – A review is presented of minor constituents of raw sugar that affect filtration, and the effect of starch and dextran on viscosity discussed on the basis of experimental results; while starch, at the levels normally found, had an insignificant effect on viscosity and caused little decrease in permeability, dextran may double or treble syrup viscosity and cause as much as 50% fall in the rate of production in a refinery. However, solid granules of starch may cause plugging of a filter and eventual stoppage of permeation, so that its removal is desirable. The use of a centrifuge for this purpose was tested on 65% sugar solution containing 1% starch. Results showed that starch can be separated by this means, but refiners consider it uneconomical on an industrial scale.

Performance of powder resin in conjunction with the Talofloc process. B. C. Goodacre. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 30 pp. – While conventional resin decolorization of refinery liquors uses the deep bed technique, powder resin such as Ecodex-R can be used as thin precoat layers; the fibrous part of the Ecodex system ensures sufficient permeability to the liquor, while the fine particles of resin have a larger surface area per unit weight than normal deep-bed resins and thus permit an increase in the decolorization rate. Comparative tests were conducted on decolorization of a liquor clarified by the Talofloc method and one clarified by phosphatation, using Amberlite 401S deep-bed resin and Ecodex-R. Results showed that the advantage of the much greater surface area per unit bed volume of the Ecodex-R was lost because of the need to use it as a relatively thin bed, so that residence time and linear flow rate was typically only about 10% of the values for the other resin, with consequent adverse effects on performance. If several beds of the powder resin were operated in series, the performance would improve; however, in practice, bed permeability decreases with time, which limits the extent to which the beds can be used in series. Effective regeneration of the powder resin was possible, and performance did not appear to deteriorate over two cycles when the Talofloc-treated liquor was decolorized. Since the average performance of deep-bed resins over a normal life (150 cycles) is very much worse than their performance in the first cycle, it is likely that powder resin would need to be regenerated only a few times before it became competitive with the other resins, but the exact break-even point is governed by such factors as plant requirements, hot water availability, quality requirements, etc.

A progress report on the use of Ecosorb precoat technology for cane sugar syrup clarification and decolorization. A. Tavares and R. Kunin. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 11 pp. – The decolorizing properties of Ecosorb C and Ecosorb R precoats, based on powdered active carbon and anion exchange resin in Cl^- form, respectively, were investigated in tests on clarified liquors. Comparison with conventional deep-bed resin treatment and with kieselguhr treatment showed that the precoats were more efficient and cost-effective.

Regeneration of a mixture of bone char/granular carbon in vertical retort kilns. D. J. Sulick. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 9 pp. – Tests are reported in which vertical retort kilns were used successfully to regenerate a bone char/granular carbon blend; subsequent performance of the blend demonstrated its regenerability. The kilns required no mechanical changes for the regeneration, and very low dust levels were observed during mechanical handling of the mixture, with carbon makeup rates of about 3%. The blend provided no fire hazard under conditions deliberately created for outbreak of fire.

Double char filtration of washed sugar liquor. D. P. Demone. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 13 pp. – Under the previous system at the Baltimore refinery of Amstar Corporation, 91% of the *A*-liquor by weight was in the form of washed sugar liquor, of which 36% (absolute) was filtered while the rest was sent directly to the *A*-liquor tank; the remaining 9% of the *A*-liquor was filtered remelt liquor. A new system has been introduced in which all of the 91% as washed sugar liquor is filtered before the *A*-liquor tank; initial results indicate an overall liquor decolorization efficiency of 89% by comparison with 85% previously, although the long-term outlook for char quality is uncertain.

An overview on the liquid sugar manufacturing operation at Ponce Candy Industries Corporation in Ponce, Puerto Rico. R. Pou. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 7 pp. – An account is given of operations in the production of water-white liquid sugar from raw sugar of 98-98.5 pol without affination.

Microprocessor-controlled packaging of soft sugars. F. V. Rathje. *Paper presented at 41st Meeting, Sugar Ind. Technol.,* 1982, 18 pp. – The new automatic system for packaging of soft sugars in polyethylene bags at B.C. Sugar in Canada is described and advantages over the previous system are discussed. The scheme is used for production of 1- or 2-kg packages at the rate of 22 or 18 per min, respectively; yellow sugar is packaged in both sizes, while brown sugar is packaged in only the smaller size.

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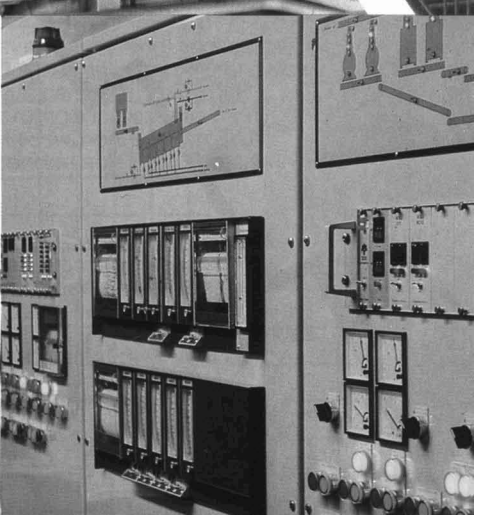

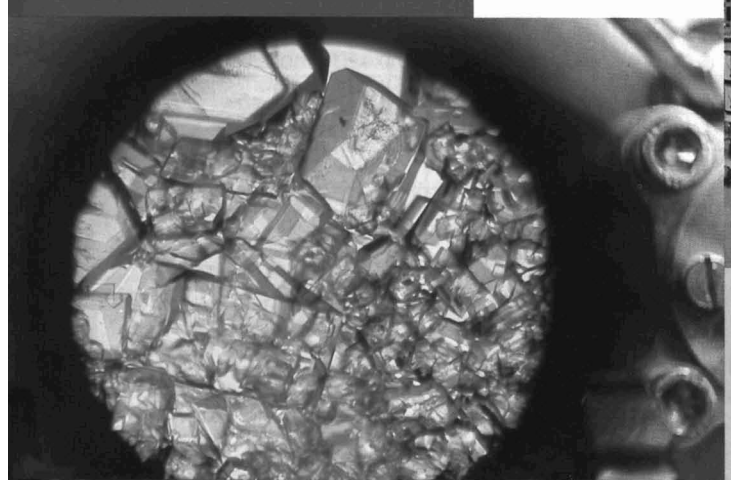

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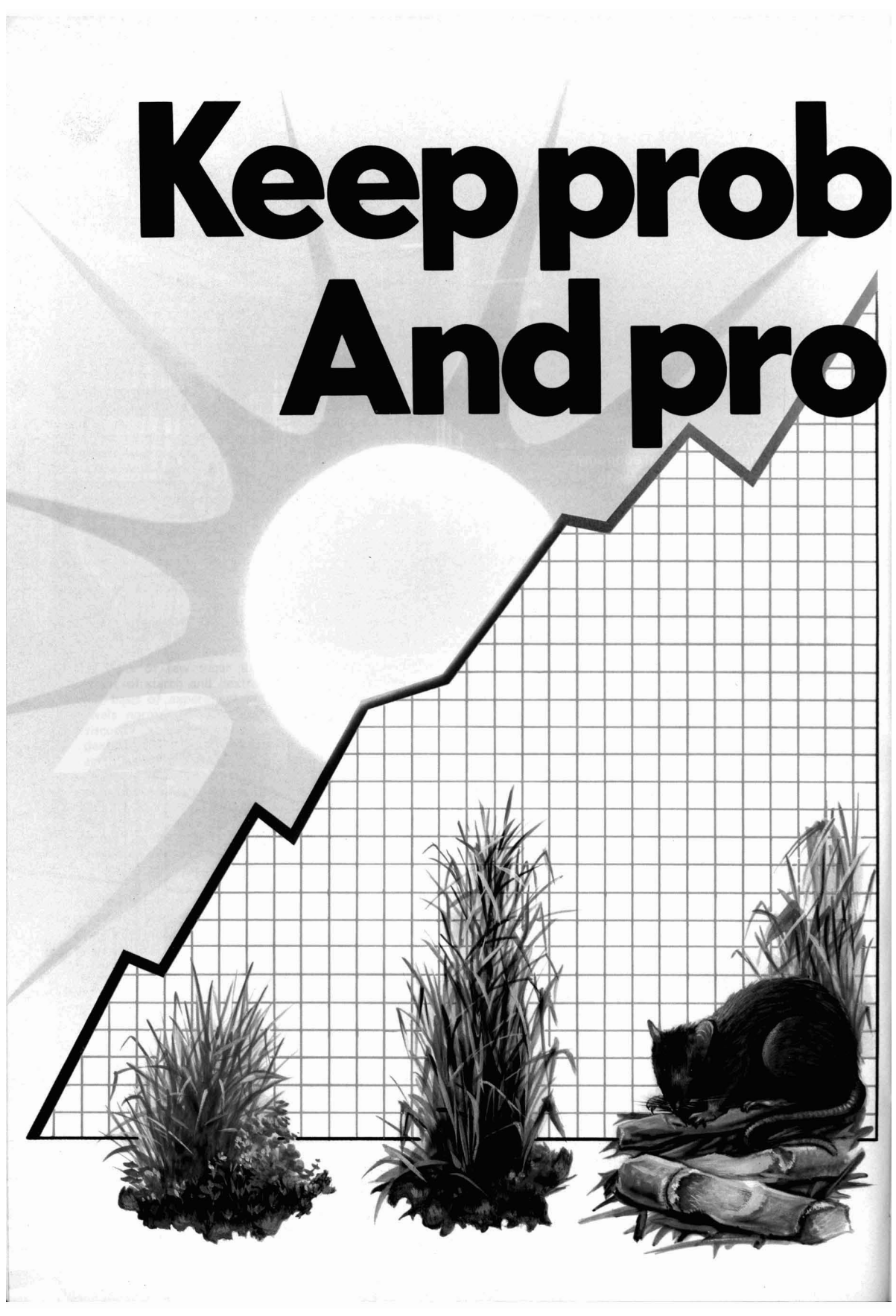
DK-1001 Copenhagen K
Denmark
Phone: 45 1 54 61 30
Telex: 31 436 ddseng dk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LABORATORY STUDIES

Separation of carbohydrates and polyols by a radially compressed high-performance liquid chromatographic silica column modified with tetraethylenepentamine (TEPA). D. L. Hendrix, R. E. Lee and J. G. Baust. *J. Chromatogr.*, 1981, **210**, (1), 45-53; through *S.I.A.*, 1982, **44**, Abs. 82-125. — Carbohydrates and polyols can be separated by HPLC on a silica column modified with TEPA. In order to find the optimum conditions for compound separation and baseline stability, the effects of various acetonitrile:water ratios in the solvent, concentrations of TEPA in the solvent, pH and flow rates were tested. Capacity factors and resolutions of 22 compounds under stated conditions are tabulated. Advantages of the method include room temperature operation, low operating pressure, simplicity, high resolution, relatively long column life and high linear sample capacity.

Improved column efficiency in chromatographic analysis of sugars on cation exchange resins by use of water-triethylamine eluents. L. A. T. Verhaar and B. F. M. Kuster. *J. Chromatogr.*, 1981, **210**, (2), 279-290; through *S.I.A.*, 1982, **44**, Abs. 82-129. — An improvement in the chromatographic separation of sugars and sugar alcohols on cation exchangers (Ca^{++}) with water as eluent is presented. Addition of 0.001M triethylamine to the eluent catalyses the mutarotation of reducing sugars, and results in reduced peak widths. Complete resolution is obtained in 3½ min for glucose, mannose and fructose or for sucrose, glucose and fructose, and in 9 min for glucose, mannose, fructose, mannitol and glucitol. A nearly complete resolution of lactose, glucose and galactose is achieved in 3 min. The influence of the triethylamine content, column temperature and eluent flow rate was studied. Procedures are given for column preparation, activation and regeneration.

Brix determination in cane juice using the automatic refractometer, the Abbé refractometer and the digital densimeter. J. A. Weber. *Tech. Bull.* (GEPLACEA), 1981, (18), 4 pp. — Comparative tests are reported in which an Abbé continuous refractometer, a Schmidt & Haensch Refractomat-L automatic refractometer and a DMA-45 digital densimeter were used for Brix determination of sugar solutions and cane juices. Results showed that the electronic densimeter was the most accurate (± 0.01°Bx), followed by the automatic instrument (± 0.03°Bx) and the Abbé refractometer (± 0.05°Bx).

The physico-chemical properties of reversible colloids in sugar manufacture. A. R. Sapronov, E. B. Ishchenko, V. A. Loseva and O. N. Bedenko. *Izv. Vuzov, Pishch. Tekh.*, 1981, (5), 36-39 *(Russian)*. — Investigations of colloids isolated from refinery boiling house products showed that most of them were separated as constituents of raw and wash syrup, the small amount found in sugar being mainly concentrated in the film surrounding the crystal. As to be expected, the concentrations in each product rose with the order of the strike in the 6-boiling system. Specific gravity, relative refractive index and hydrophilic coefficient were established by use of formulae and substitution of measured values.

Technology and chemical control of the sugar industry. Anon. *Mem. Anual Est. Exp. Agro-Ind. Obispo Colombres* (Tucumán, Argentina), 1980, 127-136 *(Spanish)*. — The effect of borax, with and without NaOH, on polarization of cane juice has been studied as has a colorimetric method of sugar analysis in juice which requires prior elimination of reducing sugars with 0.2M NaOH for 3 min at 100°C followed by reaction of the sucrose with 12M HCl and 0.066 mM indole at 100°C and measurement of the absorbancy after 1 minute. Good agreement has been found with the Jackson & Gillis No. IV method. Studies have been made of the chemical composition and clarification of juice from different cane varieties, while a different study has demonstrated that starch is to be found throughout practically the whole length of the cane stalk, but especially around the nodes and in the upper half of the stalk in the case of immature cane. Wax extracted from filter cake has been purified and data from analysis of two different samples are tabulated. Also tabulated are analytical data on the composition of vinasse.

Conditions under which 5-hydroxymethylfurfural is formed in sugar syrups. G. A. Ermolaeva and L. A. Sapronova. *Sakhar. Prom.*, 1982, (2), 31-32 *(Russian)*. Hydroxymethylfurfural (HMF) may be formed as an invert sugar degradation product following sucrose hydrolysis or during storage of white sugar or beet thick juice. Laboratory investigations are reported in which 0.1 mole.litre^{-1} solutions of fructose and glucose and 0.05 mole.litre^{-1} sucrose were heated for 120 min at 120°C and pH 1.4. The main source of HMF was found to be the fructose, which is less stable than glucose. At pH 3-5 HMF formation was slight, while there was little increase with pH increase above 5, whereas at pH < 2.5 the increase in concentration was almost in proportion to H^+. Average formation was 0.32 g HMF per g degraded fructose.

High-performance liquid chromatography in sugar analysis. K. F. Ivie. *Sugar y Azúcar*, 1982, **77**, (2), 44, 48, 52-53. — A basic HPLC system is described, and application of the technique to rapid analysis of corn syrup, HFCS, sucrose syrup, sugars and ethanol and determination of galactose in glucose demonstrated with the aid of chromatograms.

Topography of the chemical composition of the sugar beet root. VI. Topo-chemistry and processing quality of sugar beet under the effect of different nitrogen doses. J. Zahradnicek *et al. Listy Cukr.*, 1982, **98**, 62-66 *(Czech)*. — Investigations were conducted on the distribution of sucrose, reducing sugars, α-amino-N and ash in beet at harvest and after prolonged storage as a function of N fertilization. Comparison between beets lifted from fields to which 100 kg.ha^{-1} N and 210 kg.ha^{-1} N had been applied showed that the distribution of the sucrose, ash and amino-N were unaffected by the dosage rate, whereas both distribution and content of glucose and fructose were affected; in all cases, the contents of the two sugars rose with the higher N dosage rate, particularly after storage. The greatest changes occurred in the epicotyl and the beet tail. Both sugar content and storage properties were adversely affected by the higher N dosage rate.

Laboratory studies

Formation of non-sucrose compounds in sugar cane in storage during the post-harvest period. A. P. Gupta and N. Nigam. *Maharashtra Sugar,* 1982, **7**, (3), 51-54, 56. Co 1148 cane was cut and left in the field, and samples were analysed after 24, 48, 72 and 96 hours. The organic acids, gums and dextran were determined and the results compared with those for fresh cane crushed 2 hours after harvesting. The tabulated data clearly showed that the contents of all three components rose with increasing time after harvest.

Analyses. R. Detavernier, J. P. Ducatillon and J. Roger, *Sucr. Franç.,* 1982, **123**, 153-157 *(French).* – Comparison of high-pressure liquid chromatography, gas-liquid chromatography and enzymatic analysis for determination of sucrose in beet and cane molasses showed that in all cases GLC gave higher values than enzymatic analysis, while in all but two out of twelve cases the HPLC values were slightly higher than the GLC values. Polarimeter readings were lower than the enzymatic values in eight cases. The major disadvantage of HPLC is the need for pre-treatment of samples in order to eliminate numerous substances that interfere. The melassigenic coefficients of 25 non-sugars were determined and compared, where possible, with values found by Silin. On the basis of the findings it is considered that only enzymatic determination of sucrose and determination of the dry solids content will give valid results for molasses containing polarizing non-sugars. A new beet analytical system conceived by IRIS is based on measurement of pol, and analysis for sucrose, glucose, sodium and potassium as well as α-amino-N. Results of preliminary tests showed that use of the "blue number" method did not always give values identical to those given by the ICUMSA ninhydrin method for α-amino-N since it included traces of ammonium salts which could possibly enter factory juices. Comparison between the new system and one embodying polarimetry, flame photometric determination of Na and K (common to both systems) and the "blue number" method showed that, in the case of healthy beet, the two methods gave approximately the same values for pol, Na, K and α-amino-N, whereas there was marked difference between the two systems as regards pol and α-amino-N in the case of frozen and subsequently thawed beet. Polarimetry was compared with enzymatic determination of sucrose in raw juice and molasses during the 1981/82 campaign; average results for a number of factories are plotted as % (pol-sucrose)/pol and show a maximum difference of 3.7 for raw juice and > 5 for molasses, particularly in the case of frosted beet. At nine sugar factories there were 14 cases of evaporator tube corrosion reported, while a survey of evaporator scale formation showed that, although the Ca and Si contents in juice were slightly lower than in the previous year, more of the two elements was deposited.

Detection of floc-producing sugars by a protein dye-binding method. J. A. Liuzzo and C. M. Wong. *J. Agric. Food Chem.,* 1982, **30**, 340-341. – Since trace quantities of protein have been found to be a major contributor to floc formation in carbonated beverages, the aim was to develop a protein dye-binding technique for rapid quantitative determination of protein in suspected sugars. Because the amount of protein in refined sugar is extremely small, separation presents a problem; however, of a number of methods tried, the most suitable was a modification of the Sevag method[1]. Full details are given of this and of the protein dye-binding procedure involving Amido Black. The method was standardized for variables of reagent concentration, time, colour and volume. Results showed a significant correlation between protein levels found by this method and by Kjeldahl nitrogen determination. Floc-positive sugars showed protein concentrations in the range 0.3-0.4% while floc-negative sugars contained 0.004-0.006% protein.

Flavour chemistry of sucrose. W. C. Monte and J. A. Maga. *Sugar Tech. Rev.,* 1982, **8**, 181-204. – The chemistry of beet and cane sugar flavour and colouring compounds is reviewed, with descriptions of the sensory properties of compounds associated with sucrose caramelization and of the various types of reactions leading to formation of colorants and flavour compounds, including acidic degradation, alkaline degradation (the Lobry de Bruyn-van Ekenstein transformation), sucrose-amine (browning) reactions and the condensation reaction between the amino group of amino-acids and the carbonyl group of reducing sugars which is the initial step in the browning reaction, the Amadori rearrangement and Strecker degradation. Typical classes of heterocyclic flavour compounds formed during browning are shown.

Importance and realization of defined wavelengths in saccharimetry. K. Zander and H. Melle. *Sugar Tech. Rev.,* 1982, **8**, 205-255. – The comparability of polarimetric measurements depends on knowledge of the optical centre of gravity of the light source which, however, is not easily determined spectroscopically or interferometrically (in many instances it is impossible to determine, particularly in the case of light sources of high luminance with a strong background). The problem of a defined wavelength of the light source arose with the introduction of modern circular polarimeters but did not apply to quartz-wedge instruments. With an erratic wavelength, the measured value is not influenced by differences in the rotatory dispersion between the sugar sample and quartz but is affected by the rotatory dispersion of the sugar itself. At a change of wavelength of ± 0.02 nm there is already an error of ± 0.01°S in the measurement. For precise measurements used to calibrate quartz control plates, the wavelength must be known to within a few 10^{-3} nm in order to ensure an accuracy of ± 0.001° (angular). The problems that arise in determination of reference wavelengths for saccharimeters are discussed, starting with an explanation of the International Sugar Scale and changes that have been made in the measurements on which it is based. A difference between the reference wavelength established by the National Bureau of Standards (NBS) in the USA to confirm the new 100°S point and that determined by the Physikalisch-Technische Bundesanstalt (PTB) in West Germany is attributed to differences in the measuring methods used; that of the NBS used a dye laser locked to the emission lines of a mercury hollow cathode lamp, while the PTB used the lines of a normal mercury spectral lamp and determined the wavelength of the light from the rotatory dispersion of a calibrated long quartz block. The two methods are compared and discussed. In a direct comparison, no differences were found between the results. A description is given of the highly precise, low-cost method developed by the PTB to determine the optical centre of gravity for precision polarimetry. Measuring errors caused by displacement of the wavelength with circular polarimeters can be largely

[1] Staub: "Removal of proteins. Methods in carbohydrate chemistry", Ed. Whistler (Academic Press, New York), 1965, Vol. 5.

avoided by using spectral lamps and interference filters. The instrument-specific influences affecting the measuring accuracy of photo-electric quartz-wedge saccharimeters are examined, and the accuracy of both quartz-wedge and circular polarimeters in measuring the pol of coloured solutions is discussed.

The surface reaction in the growth of crystals in supersaturated liquids. V. Maurandi. *Ind. Sacc. Ital.*, 1982, **75**, 5-15 *(Italian)*. – After a brief review of the classical views on the surface reaction mechanism in two-dimensional nucleation, the author discusses a number of theories and models developed over the last 30 years, and describes experiments on sucrose crystallization that have been carried out between 1959 and 1981, using both pure and impure solutions (including molasses). Agreement between practical results and theoretical calculations is shown to very good at intermediate temperatures, where the kinetics are sufficiently linear at high supersaturations, whereas at low supersaturations the kinetic pattern is parabolic. However, at $\geqslant 0^{\circ}C$ VanHook has also observed linearity in the kinetics at low supersaturations. Experiments have confirmed that linear dislocations as well as screw dislocations create the auto-conservative growth centres first described by Frank[1]. As regards sucrose, the most suitable theory on the mechanism of crystal growth involves a combination of volume and surface action. Both surface reaction and transport play an important part at intermediate temperatures, whereas the surface reaction predominates at low temperatures and transport at high temperatures.

Determination of nitrite in molasses residues. L. D. Il'ina and N. G. Sitnik. *Khlebopek. Konditer. Prom.*, 1981, (2), 39-41; through *Anal. Abs.*, 1982, **42**, 4F25. – The method involves treatment of the diluted sample with a mixture of sulphanilic acid and 1-naphthylamine (prepared separately in acetic acid and mixed immediately before use); the absorbance of the brownish-red colour produced is measured at 520 nm and referred to a calibration graph. The method allows detection of NO_2^- at a concentration of 1-5 ppm, and is fast (10-15 min) and reproducible. The relative error is ± 7%. The control of NO_2^- concentration in the alcohol-molasses industry should eliminate the toxic effect of NO_2^- on the yeast used for fermentation.

Contribution to knowledge of the behaviour of amino-acids during sugar extraction. I. Gas chromatographic investigations on sugar factory products concerning free amino-acids and amino-acids liberated by acid hydrolysis. E. Reinefeld, K. M. Bliesener and J. Schulze. *Zuckerind.*, 1982, **107**, 283-292 *(German)*. – The literature (108 references) is surveyed concerning: amino-acids in beet and juices; their fate during diffusion and subsequent processing; their effect, via the Maillard reaction, on colour formation; differences in the amino-acid content in fresh and deteriorated beet; the effect of $Ca(OH)_2$ on amino-acid formation and degradation; amino-acid liberation by acid hydrolysis of raw juice, thin juice, thick juice, molasses and pulp; and suitable conditions for sample storage so as to avoid changes in the amino-acid composition. Details are given of a gas-liquid chromatographic method for determination of amino-acids in beet juice and molasses in their N-trifluoroacetyl-*n*-butyl ether form after preliminary separation by cation exchange with Amberlite CG-120 I resin in H^+ form.

The fractionation of cane molasses with liquid ammonia. J. H. Payne. *Zuckerind.*, 1982, **107**, 293-295. – Treatment of six portions of molasses totalling 600 g with 3 litres of ammonia yielded a soluble fraction containing 78% of the molasses solids and 96% of the sucrose. The insoluble fraction contained 57% of the ash and 42% of the original K. Undried molasses gave essentially the same results as dried molasses. Further treatment of the soluble fraction with methyl cellosolve gave a recovery of 62% of the sucrose in the form of crystals of 88 purity. Treatment of the residue by cation and anion exchange removed an average of 86% of the ash component; concentration of the eluate by evaporation to a thick syrup followed by seeding with powdered sucrose yielded a small number of fine sucrose crystals precipitated on the walls of the container, but there was insufficient material for separation and analysis.

The effect of magnesium cation exchange on molasses viscosity. S. P. Vycherova, M. I. Barabanov and A. A. Ivanyuk. *Sakhar. Prom.*, 1982, (3), 31-33 *(Russian)*. Comparative measurements were made of viscosity between 40° and 80°C of normal molasses and of molasses in which K^+, Na^+ and Ca^{++} had been replaced with Mg^+ ions. In the presence of Mg there was marked increase in the viscosity up to 60°C by comparison with normal molasses, but at $> 60^{\circ}C$ the two types of molasses had identical structural and mechanical properties, so that cation exchange with resin in Mg^+ form causes no difficulties in boiling and crystallization.

Modern chromatographic methods for the analysis of carbohydrate mixtures. K. M. Brobst and H. D. Scobell. *Starch/Stärke*, 1982, **34**, 117-121. – Three chromatographic methods for the analysis of sugar mixtures are reviewed: high-performance liquid chromatography and the improvements brought about in separation of tri-, tetra- and higher sugars by passage through an ion exchange resin in Ag^+ form; gas-liquid chromatography for separation of sugars as their trimethylsilyl derivatives; and GLC of trimethylsilyl derivatives of sugar oximes, a method which has the major advantage of reducing the number of tautomeric forms given by reducing sugars.

An improved productivity and stability test for immobilized enzymes with reference to glucose isomerase. R. van Tilburg and J. A. Roels. *Starch/Stärke*, 1982, **34**, 134-140. – Since commercial preparations of immobilized glucose isomerase have a long productivity half-life, e.g. 50-60 days, at normal operating temperature, laboratory assay of the productivity and stability of the product is rather time-consuming. A rapid test is described which is carried out within 7 days at 70°C and is based on the known temperature dependence of the deactivation rate of the preparation, its activity and the equilibrium constant of glucose conversion to fructose. The method has proved valid for predicting the behaviour of the product at 60°C. The effect of particle size on the initial flow rate, half-life and productivity is discussed.

Micro-organisms in liquid sugar. L. Fassatiova and J. Smolik. *Listy Cukr.*, 1982, **98**, 83-88 *(Czech)*. – Major factors contributing to bacterial activity in liquid sugar are discussed. Microbiological standards for production, storage and transport of liquid sugar in Czechoslovakia and for liquid and granulated refined sugar in other countries are indicated. Among recommendations for bacteriological control of liquid sugar storage is determination of the total number of mesophiles, yeasts and moulds.

[1] *Disc. Far. Soc.*, 1949, **5**, 67.

BY-PRODUCTS

Studies on the effect of depithing on pulps from Sudanese sugar cane bagasse: comparison with similar studies on Brazilian and Egyptian bagasse. M. M. S. El-Morsy and B. Y. Riad. *Fibre. Sci. Technol.*, 1980, **13**, (2), 119-123; through *S.I.A.*, 1982, **44**, Abs. 82-259. – Tests on the effects of depithing (see El-Morsy & El-Gohbasy[1] were carried out on Sudanase bagasse. Best results were obtained by removal of 5% pith before prehydrolysis, as with the Brazilian bagasse, but pulp yield and quality were not as high as with the Egyptian bagasse.

Perspectives of the treatment of vinasse with environmental and economic benefits. C. A. B. Dias. *Bol. Técn.* (GEPLACEA), 1981, (19), 26 pp *(Spanish)*. – Alternative methods for disposal of vinasse include anaerobic fermentation to produce methane, aerobic fermentation for producing single-cell protein to be used as animal fodder, application to the fields as a fertilizer before or after concentration, and concentration for use as animal fodder or for use as a fuel, the ash being used as fertilizer. These various alternatives are discussed and an energy and cost analysis is presented on an anaerobic fermentation installation.

Sugar cane juice as cattle feed: comparisons with molasses in the presence or absence of protein supplement. M. Sánchez and T. R. Preston. *Bol. Técn.* (GEPLACEA), 1981, (19), 8 pp *(Spanish)*. – Feeding trials with fattening cattle over a 75-day period compared live weight gains from cane juice containing 0.5% urea and molasses containing 2.5% urea, with and without 1 kg per day of sunflower flour. Live weight gain increased from 800 to 1300 g per day with juice and from 252 to 525 g per day with molasses; the better performance with juice is attributed to its lower mineral content which made it more acceptable to the animals than the molasses.

The sugar industry as an energy source. F. J. Vicini. *Tech. Bull.* (GEPLACEA), 1981, (20), 8 pp. – In a discussion of the practical aspects of producing energy from cane, the author considers that production of ethanol as a substitute for motor fuel would be uneconomical under Dominican Republic conditions and that it would be better to concentrate on exporting sugar and molasses and use the money from the sales to cover the costs of gasoline and other imported fuels. In addition, sugar factories have a large potential for electricity generation provided the calorific value of bagasse is maximized and appropriate equipment installed; reference is made to a project under way at Cristóbal Colón factory.

The Indian paper industry – a case for bagasse. G. K. Viswanath, V. S. Rao, J. S. Ram and T. K. R. Setty. *Maharashtra Sugar*, 1982, **7**, (3), 13, 15, 17-19, 21-23. The advantages of paper manufacture from bagasse are discussed and the technology is outlined.

Bagasse and paper making – selection of equipment. R. Ramaswamy, A. C. Gupta and –. Pravin. *Maharashtra Sugar*, 1982, **7**, (3), 25-28, 30-31, 33-35. – Processes involved in the manufacture of pulp and paper from bagasse are described.

Manufacture of pulp based on surplus bagasse and other agricultural residues. M. K. Patil. *Maharashtra Sugar*, 1982, **7**, (3), 49-50. – It is suggested that sugar factories would find it financially more beneficial to manufacture pulp from bagasse rather than sell the bagasse to paper mills, and the economics are worked out to show a substantial net profit before tax.

Methane fermentation. J. P. Lescure and P. Bourlet. *Sucr. Franç.*, 1982, **123**, 127-131 *(French)*. – Pilot plant experiments are reported in which beet pulp was subjected to anaerobic fermentation in a two-stage process, each stage being conducted in a separate vat; the first stage involved hydrolysis of the water-diluted pulp, acidification and initial methane formation with accumulation of propionic acid, while the second stage consisted of substrate exhaustion. Each vat had a total capacity of 32 m^3, separated into a 25-m^3 digester section, a 5-m^3 decanting section and a 2-m^3 reserve gas space. The gases were collected by a funnel-shaped diaphragm and directed to a small central bell. The dilution water rose to the edge of the diaphragm along a baffle plate and thence flowed into the decanter section. Homogeneity of the fermentation mixture was ensured by a twin-screw mixer. Results showed that 14.6 tonnes of pulp dry solids yielded 3.2 m^3 of methane and 2.6 m^3 of CO_2, from which it is calculated that two vats, each of 25,000 m^3 capacity could treat all the pulp from 6000 tonnes of beet per day to yield at least 570,000 therms/day, representing 59.5 tonnes of fuel, or 10 kg per tonne of beet. Fermentation reduced the mud content (largely $CaCO_3$) considerably, but the COD of the treated pulp was high at 1500-2000 $mg.litre^{-1}$, although this could be drastically reduced by increasing the initial pulp solids content from 10% to 20%. Malodorous butyric and valeric acids were produced as well as H_2S.

Recent developments in pulp drying. A. Bausier. *Sugar Tech. Rev.*, 1982, **8**, 149-179. – Conventional beet pulp drying in a drum is discussed, wherein it is pointed out that the energy consumed per kg of dry pulp is greater than that required for manufacture of 1 kg of white sugar which sells at four times the price of pulp. The heat balance of a pulp dryer is set out in detail and means of improving it are indicated, including recycling of the dryer flue gases, use of boiler flue gases and operation of low-temperature dryers, using hot water or dryer flue gas, as pre- or after-dryer or in parallel with a conventional drum dryer. Results obtained with RT low-temperature dryers in Belgium and France are reported; these show that there is need for modifications to the dryers in order to increase efficiency, while the investment is much greater than for conventional dryers of the same capacity. Advantages include the higher quality of the dried product, lack of restriction on the limit to which the pulp dry solids content could be increased (by contrast with the conventional dryer in which increase in dry solids is acccompanied by higher losses in nutritive value), and the possibility of using the dryer for products other than pulp outside the campaign.

[1] *I.S.J.*, 1983, **85**, 30.

PATENTS

UNITED KINGDOM

Beet harvesters. National Research Development Corporation, of London SW1, England. **1,603,098.** November 19, 1977; November 18, 1981.

Juice evaporation. Süddeutsche Zucker-AG, of Mannheim 1, Germany. (A) **1,603,678.** (B) **1,603,679.** May 31, 1978; November 25, 1981.

(A) Raw juice is purified (and treated to hydrolyse completely its glutamine and asparagine content) and at least part of the thin juice obtained is cooled by heat exchange, followed by flash evaporation in one or more stages to concentrate and cool it further. The cooled juice is then reheated using condensate or vapour produced elsewhere in the process and then heated further by heat exchange with fresh thin juice in the step above. The reheated juice is then introduced into a multiple-effect evaporator in which it is concentrated to a thick juice the density of which is monitored by a pulse generator and density meter. Vapour from the final effect is compressed and selectively passed to one of the earlier effects, depending on the density of the thick juice. Part of the thin juice may be recycled through the cooling, flash evaporation and reheating stages.

(B) Raw juice is purified and the thin juice passed through a multiple-effect evaporator to produce thick juice and vapour. Vapour from the final effect is compressed and selectively returned to one of the effects of the evaporator depending on the density of the thick juice, which is measured by means of a pulse generator and density meter.

Juice evaporation and sugar boiling. Buttes Gas & Oil Co., of Oakland, CA, USA. **1,604,105.** May 5, 1978; December 2, 1981. — Juice is concentrated in two stages, the first comprising a thermocompression evaporation and the second a direct evaporation, after which it is crystallized in pans supplied with vapour which originates from the second stage of evaporation. Excess vapour beyond the requirements for boiling are used for heating in other process steps. At least part of the pan vapour is cooled by heat exchange with a refrigerant and the latter then compressed so that its temperature rises to 95°C, when it is used for other process heating purposes.

US patents are published when applications have been granted and the number of the specification is that of the granted patent. In our abstracts we include two dates which are those of the original application and of the granting of the patent. This used to be the case with UK patents but from early 1979 a new system was instituted.
Now, within a short while of an application being made, the specification is published and a serial number assigned to the application. Thereafter, the application may be withdrawn, rejected or granted but no new number is assigned in the last case. Applications before early 1979 have continued to be processed on the earlier basis and the abstract above is the last under this system. The new system started with Application No. 2,000,001 and we will for the future be publishing abstracts of applications which we believe to be of interest to our readers. Where we include three dates these are, respectively, those of the original application, publication of the specification, and granting of the patent. Where only two dates are given, the patent application is still pending. We will at intervals list such pending patent applications which, in the meantime, have been rejected or withdrawn and those which have been granted. Applications which have been withdrawn or rejected before publication of our abstract is arranged will not be included.

Production of molasses pulp from sugar beet for use as animal food. Zuckerfabrik Franken GmbH, of Ochsenfurt, Germany. **2,002,216.** July 7, 1978; February 21, 1979; January 13, 1982. — Beet pulp is mechanically pressed, mixed with molasses (of more than 50% dry substance) and again pressed. This gives a diluted molasses which has its dry substance content increased by concentration or mixing with further concentrated molasses. It is again mixed with the pressed pulp and the sequence of pressing, concentrating and mixing repeated at least once. Material to improve the pulp pressability [$CaCl_2$,$Al_2(SO_4)_3$ and/or silicic acid] is added to the pulp at least before the last pressing stage (as well as substances to improve its food value (protein-rich material such as yeasts, urea, etc.)]. The final product has a dry substance of $> 30\%$ and can be preserved with or without acid addition without drying.

Continuous vacuum pan. Huletts Sugar Ltd., of Mount Edgecombe, Natal, South Africa. **2,003,741.** September 5, 1978; March 21, 1979.

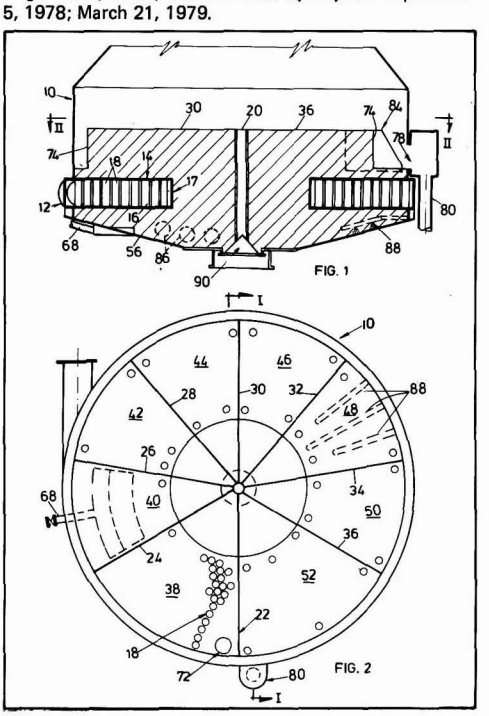


FIG. 1

FIG. 2

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

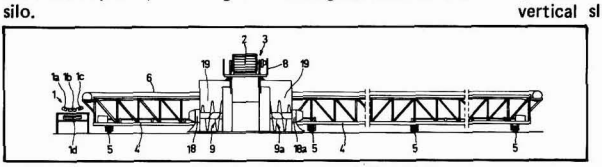
The pan 10 is provided with a calandria 12 having upper and lower annular tube plates 14, 16 closed by cylindrical wall 17 and provided with tubes 18. A series of vertical plates 22-36 between the centre of the pan and the outer wall form a series of compartments 38-52 each of which is provided with a molasses feed distributor 68 and steam blow pipes 88 to assist circulation. An inlet pipe 72 is provided for seed slurry in the first compartment 22 and the compartments are connected by an overflow weir 74 in each plate which may be provided with a gate 84. Alternatively, apertures 86 may be provided near the bottom of alternate plates.

Plate 22 has no means of overflow from compartment 52 into compartment 38; instead, massecuite overflows into outlet 78 and pipe 80. A valve 90 is provided which is only opened when the entire contents of the pan are to be emptied for cleaning.

Animal feed blocks. ICI Australia Ltd., of Melbourne, Vict., Australia. **2,007,076.** November 1, 1978; May 16, 1979; April 15, 1982. – Animal feed blocks are made by heating a water-bearing medium (e.g. molasses) to 20°-90°C, adding 5-30% on total block ingredients of active MgO and 3-50% of dicalcium phosphate, blending for a sufficient time at $< 90°C$ to give a uniform mixture, optionally adding other nutrients or medicaments, and moulding at 45°-110°C until the mixture solidifies.

Beet reclamation from a silo. Soc. Nouvelle des Etbts. A. Maguin, of La Fère, France. **2,007,620.** September 1, 1978; May 23, 1979; February 17, 1982.

A transverse conveyor 1 is supported at intervals by sets of rollers 1a, 1b, 1c and is thereby troughed to retain beet roots while the return belt is supported by flat roller 1d. Transversely from conveyor 1 is a gantry 4, supported on rollers 5 so that it can move parallel with conveyor 1, covering the rectangular area of the silo.



Mounted on the gantry is a framework 8 which can move along the length of the gantry and which carries screws 9, 9a rotated by hydraulic motors 18, 18a which collect beet roots within the housings 19 where they are received by elevator 3 and delivered onto trough conveyor 6 which carries them to conveyor 1.

Cane mill. USM Corporation, of Farmington, CT, USA. **2,007,996.** October 18, 1978; May 31, 1979; February 24, 1982. – See US Patent 4,168,660[1].

Fondant sugar manufacture. Ingredient Technology Corporation, of New York, NY, USA. **2,008,920.** November 14, 1978; June 13, 1979; May 26, 1982. Pulverized sugar is agglomerated by entraining it in a flowing gas (heated air) stream and spraying into it a liquid binder (an invert syrup) whereby agglomeration and drying occur during the pneumatic transport of the sugar and the product is an instant dry fondant sugar.

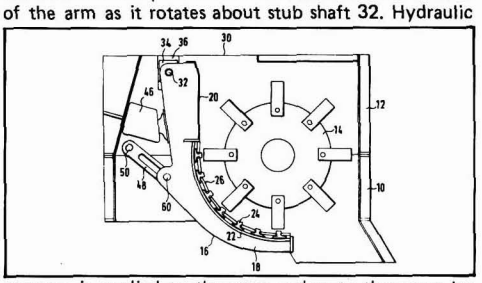
Sugar crystallization. Ingredient Technology Corporation, of New York, NY, USA. **2,010,325.** December 7, 1978; June 27, 1979; June 30, 1982. – A supersaturated syrup containing at least 75% (at least 85%) solids, of which at least 85% is sucrose, is sprayed at a temperature $> 250°F$ (260°-290°F) in the form of droplets of 50-500 μm into a (vertical) gas (air) stream having a temperature $< 200°F$ (70°-90°F) (and a velocity of at least 4000 $ft.min^{-1}$) whereby droplets of syrup crystallize and the solid particles are removed by pneumatic transport in the gas stream. The gas stream may be provided with entrained seed crystals of sugar not exceeding 3% of the total solids of the crystallized sugar.

Preconditioning sugar tablets. Chambon Ltd., of London W.6, England. **2,101,903.** December 7, 1978; July 4, 1979; April 21, 1982. – Moulded sugar tablets suffer a considerable thermal shock when they enter a drying oven at e.g. 70°-80°C, and condensation can occur on their surfaces if their temperature is below the dewpoint of the atmosphere inside the oven. To avoid this, the tablets are preconditioned by passing them under an infra-red heater where the radiation, of 3-6 μm wavelength, raises the temperature of the tablets to 65°-80°C during 2-3 seconds, the moisture content forming a cloud of steam-saturated air around each tablet. This cloud forms a barrier against the infra-red radiation and prevents rapid drying of the tablets which then enter the oven at a temperature above the dew-point of the oven atmosphere, so avoiding risk of condensation.

Cane shredder. Fives-Cail Babcock, of Paris, France. **2,011,275.** November 15, 1978; July 11, 1979; May 26, 1982.

The rotor 14 of the shredder acts against an anvil formed by rails 24 held by clamps 26 in the form of sheet metal strips bolted to the plate 22 which comprises a section of a cylinder. Plate 22 and flat plate 20 are welded to arms 18. The edges of the clamps are in direct contact with the sides of the rails so as to form a continuous surface which does not allow lodging of material under the clamps. At the upper end of the outer arms is stub shaft 32 mounted in bearings 34 arranged in vertical slideways fixed to the upper frame 12. Each bearing rests on a wedge provided with an adjustment screw so that the position of the bearing may be varied.

A pin 60 fixed to the arm moves within a slot in link 48 which pivots about a shaft 50. This is held by a support mounted adjustably on the frame of the shredder; movement of the pin 60 within the slot limits movement of the arm as it rotates about stub shaft 32. Hydraulic



pressure is applied to the arms and so to the apron by means of pneumatic jacks 46; these are connected to a reservoir of much greater volume, whereby the load is slightly affected by displacement of the apron by a varying cane blanket thickness. A variable-section throttle element is also interposed in the pneumatic circuit to avoid too high a return speed for the apron after passage of an uncrushable article.

[1] *I.S.J.*, 1981, **83**, 254.

BREVITIES

Bangladesh distillery contracts[1]. — Two alcohol distilleries are to be built by Abay S.A. for Jadz Distilleries Ltd. and Rangpur Distilleries and Chemical Ltd., respectively. To be located in the north-west of the country, the plants represent an investment of more than $2,000,000 each. They will be similar and will produce B.P. grade rectified alcohol using cane molasses as raw material. Construction is expected to be completed by mid-1983.

New sugar factory in El Salvador[2]. — A large sugar factory, Central Azucarera Chaparrastique, was to function for the first time in the eastern part of El Salvador in the 1982 season. The mill has the capacity to crush the cane grown on 3150 hectares but only 1050 hectares have been planted, owing to lack of credits for farmers. Nevertheless sufficient sugar should be produced in the country to satisfy domestic needs with a small surplus which can either be stored for future export or as an insurance against a shortfall in 1983, or exported if the cost of warehousing imposes too high a financial strain on the sugar authority INAZUCAR.

South African sugar crop recovery. — With summer rains in November, the drought in South Africa[3] was broken and the crop has recovered to the extent that sugar production is now expected to reach some 2,160,000 tonnes, 6% higher than 1981/82.

Thailand sugar expansion project[4]. — The French government has agreed in principle to give financial aid worth some $90 million for a major expansion project at the state-owned sugar factory at Supanburi. The project will allow an increase in milling capacity from 3500 to 10,000 tonnes of cane per day. The factory, which has been operating for the past 30 years, will get 30% of the aid in the form of a soft loan at an interest rate of 3½%; this is for a term of 30 years with a grace period of the first ten. The balance of the aid will be in the form of export credits.

Mexico drought[5]. — Sugar production in Mexico for the crop year ending October 1983 is likely to be much smaller than the original forecast of 3,100,000 tonnes according to a spokesman for the National Sugar Industry Commission. Severe drought in San Luis Potosí and in part of Vera Cruz and Sinaloa is expected to have repercussions on output which "with luck, might be between 2.7 and 2.8 million tonnes". This compares with 2.7 million tonnes produced in 1981/82, when imports of 400,000 tonnes were required. In a field report issued in October, the US Agricultural Counsellor in Mexico City forecast production at 2.7 million tonnes and consumption at 3.6 million; he considered Mexico would raise imports to 1.0 million tonnes, raw value, in 1982/83.

India crop prospects for 1982/83[6]. — The sugar cane crop for the 1981/82 season amounted to 200 million tonnes, 20 million tonnes more than the official estimate. This may mean that some of the cane for the 1982/83 crop was crushed in the earlier season and this would reduce the amount available for the new season. A decline in sugar production is also expected for a number of other reasons: severe drought has prevailed in almost all states except Uttar Pradesh, and there the crop has been damaged by floods. The prolonged 1981/82 season affected cane plantings and these are expected to be 25-30% lower also because farmers' enthusiasm has been dampened by unremunerative cane prices. The farmers cannot afford fertilizers and the large quantities of sugar available for domestic consumption have reduced sugar prices. Production of sugar is therefore expected to fall to 7.0-7.5 million tonnes in 1982/83 and to 6.0 tonnes, raw value, in 1983/84.

Silver Engineering Works Inc. move. — Silver Engineering Works Inc. has announced its relocation to new and larger manufacturing and office facilities at 14800 East Moncrieff Place, Aurora, Colorado. The 100,000 sq. ft. plant is situated on a 16-acre site with its own rail siding and within seven minutes of Denver's International Airport.

Corrigendum. — In our December 1982 issue we published[7] an abstract of a paper "Studies on the use of flocculating agents during sugar cane juice clarification. XII. Settling studies with Magnafloc LT 26 and Magnafloc LT 27" which was presented to the 45th Congress of the Sugar Technologists Association of India by S. Bose and L. Singh. We regret that the results reported were misinterpreted in our abstract. We should have reported that, of the flocculants examined, the best performance in terms of settling rate and final mud volume was given by Magnafloc LT26, followed by Magnafloc LT27, both being better than that of Separan AP30. We apologise to the authors and to the makers of the Magnafloc materials, Allied Colloids Ltd., of Bradford, England.

Western Australia sugar scheme. — The state government has decided to go ahead with its plans to develop a sugar industry in the Ord River irrigation area, and has appointed a consortium comprising Booker Agriculture International Ltd. of the UK, Hanyang Corporation of South Korea and Wesfarmers Cooperative of Australia to examine the best ways of producing about 160,000 tonnes of sugar a year, from 1985/86 onwards. The $A 200 million plan calls for 12,000 hectares of cane and production would amount to about 20% of domestic consumption but only about 5% of total Australian output. Western Australia is to apply for and expects to receive the necessary licences to sell Ord River sugar both at home and abroad, and the project is expected to require no government funding. The scheme has met considerable opposition from the established sugar interests of Queensland and New South Wales.

EEC sugar regulations effect on Italy[8]. — In 1981/82 Italy produced 522,000 tonnes, raw value, of C- or non-quota sugar, of which 271,000 tonnes was blocked under the Community's sugar stockpile scheme. It has been known for some time that Italy's sugar production in 1982/83 would be considerably smaller owing to a 21.3% reduction in the beet area coupled with unfavourable weather conditions affecting both root weight and sugar content. Production is expected to be about 1.4 million tonnes or 36.5% below that of 1981. In spite of its large 1981/82 production, however, Italy will be obliged to import sugar from the other members of the EEC and, at the same time, because of EEC rules, export the remainder of its C-sugar to countries outside the Community.

Locust swarm in Swaziland[9]. — In a recent combined locust control operation mounted by the South African Dept. of Agriculture in cooperation with the Swaziland Ministry of Agriculture and Cooperatives, together with staff of the Simunye Estate, a 100-hectare swarm of red locusts *(Nomadacris septemfasciata)* was sprayed and destroyed in the lowveld of Swaziland in August last. This is the first recorded case of a red locust swarm recurring south of the Limpopo River since 1944, although the pest has been noted in the sugar areas of Natal for a hundred years or so. Before modern insecticides and light aircraft were available to match the mobility of the locusts it was virtually impossible to prevent crop loss and sugar cane has always been a prime target for the red locust. In August the locusts were sprayed in the early morning when they were all in the upper cane foliage, using a 40% ULV formulated Fenitrothion spray applied from atomizers mounted on a helicopter.

Turkish sugar industry expansion postponed[10]. — The Turkish government announced several years ago that thirteen new plants were to be built in order to avoid imports. It was believed at that time that this was a political decision rather than an economic requirement. The matter was reviewed after the military takeover in September 1980 and it has been decided that construction of four new plants (Mus, Ilgin, Bot and Agri) should continue but that the remaining nine plants (Carsamba-Samsun province, Elbistan-Maras, Eregli-Kenya, Erois-Van, Nusaybin-Mardin, Urfa, Civrili-Denizli, Corum and Igdir-Kars) should be postponed.

US beet sugar factory to re-open[11]. — Great Western Sugar Co. has reached agreement with growers in Ohio to plant about 22,000 acres of sugar beet during 1983; they expect as a consequence to be able to reopen their Fremont facility for 1983/84. No sugar was produced in Ohio in the 1982/83 campaign.

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1 *Westway Newsletter,* 1982, (108), 9.
2 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 620.
3 *I.S.J.,* 1982, **84**, 384.
4 F. O. Licht, *International Sugar Rpt.,* 1982, **144**, 644.
5 *Reuter Sugar Newsletter,* October 21, 1982.
6 *World Sugar J.,* 1982, **5**, (5), 21.
7 *I.S.J.,* 1982, **84**, 371.
8 *World Sugar J.,* 1982, **5**, (5), 29.
9 *S. African Sugar J.,* 1982, **66**, 426, 428.
10 *World Sugar J.,* 1982, **5**, (5), 31.
11 *Sweetener News* (McKeany-Flavell Co.), December 20, 1982.

Indonesian sugar consultancy contract. — ABA International Inc., of Hawaii, has been awarded a contract to provide advisory services for the start of a large project involving construction of six factories in Indonesia. One of the new factories will be on Java, three on Sumatra and two on Sulawesi. They will have a production capacity of about 1,000,000 tons of sugar a year which will all be required to meet domestic consumption.

Abay S.A. contracts. — Abay S.A. has been awarded a contract by Cía. de Industrias Agrícolas (CIA) to participate in the expansion of two beet sugar factories in southern Spain. The aim is to increase the slice by 50% to 12,000 tonnes/day by 1984/85. An ABR silo for the storage of 45,000 tonnes of white sugar is to be erected at Regensburg sugar factory by Hermann Wiedemann under licence from Abay S.A. All operations, including sugar recovery from the metal silo, are fully automatic, while operating costs are low. The Regensburg silo, which is planned for use from October 1983, will bring to 24 the total number of ABR silos that have been constructed in various countries.

Papua New Guinea distillery. — A contract has been placed for the supply and erection of a 30,000 litres/day ethyl alcohol distillery to be located adjacent to the existing sugar factory. Using molasses as the feedstock, it is expected that the distillery will produce 6,000,000 litres of alcohol per year. It will be sold to the oil companies operating in Papua New Guinea for blending with motor spirit. The distillery is expected to be commissioned before the end of 1983. Booker Agriculture International Ltd. is responsible for the planning, implementation and management of this project.

Fuel alcohol in France[1]. — The French Minister of Energy has announced that alcohol is to be added to gasoline in 1983. 500 million francs are to be invested in the production of ethyl alcohol from beets or Jerusalem artichokes or methyl alcohol from wood, coal or gas, during the three years 1983/85. Of the total sum, 75% will come from the government, whose aim is to produce 1,000,000 tonnes of alcohol in 1990. This is in accordance with the government's energy policy which aims to reduce by 1990 the role of oil in French energy needs to 32% from 48% in 1981.

French sugar beet area reduction plans[2]. — The French beet growers and sugar producers associations have announced that beet farmers will be asked to reduce plantings for 1983/84 by 10%. If implemented, this will reduce the beet area in France to about 489,000 hectares, compared with 543,000 ha in 1982/83 and 616,000 ha in 1981/82. Such a cut is considered necessary in the light of the depressed world sugar market. Sugar producers have agreed to hold off the market about 500,000 tonnes, white value, of sugar in 1982/83; this compares with 504,000 tonnes withheld from the 1981/82 crop.

New Pakistan sugar factories[3]. — Four more cane sugar factories are under construction in Pakistan which will have a combined cane crushing capacity of 9500 tonnes per day. Two will be located in the Punjab and the other two in the Sind area. The first factory, to go into trial operation some time during 1983, will probably be the Bahawalpur Sugar Mill, which will have a capacity of 2000 t.c.d. and will produce white sugar. The other units are Faran Sugar Mills Ltd. in Sind, with a processing capacity of 1500 t.c.d., the Ittefaq Sugar Mills Ltd., near Sahiwal, which will be the largest unit, with a capacity of 4000 t.c.d., and the Badin factory reported earlier[4].

Japan raw sugar requirements[5]. — The Japanese Ministry of Agriculture has revised its estimate of raw sugar requirements for the marketing year October 1982-September 1983 to 1,810,000 tonnes from the previous estimate of 1,900,000 tonnes. This is substantially below the 2,207,000 tonnes imported in the previous year and the reduction results from an unexpected larger domestic sugar production for the current year. Japan's refined sugar consumption in 1982/83 is estimated at 2,630,000 tonnes, slightly lower than the 2,690,000 tonnes consumed in 1981/82, while HFCS demand is estimated at 487,000 tonnes against 496,000 tonnes in the previous year.

Kenya sugar production decline[6]. — After a major increase in sugar production from 90,000 tons in 1976 to 370,000 tons in 1981, production in 1982 was not expected to exceed 290,000 tons. This is attributed to escalating costs of inputs and transport, and the higher cost of labour and loan recoveries, all of which have depleted working capital. A survey by the Kenya Sugar Authority has warned that Kenya may have to import sugar in 1983 to meet the domestic demand of 270,000 tons.

West Indies sugar production 1982[7]. — The latest official estimate of sugar production is: Barbados 87,854 tonnes, raw value; Guyana 296,000 tonnes; Jamaica 202,195 tonnes; St. Kitts 37,127 tonnes; Trinidad 78,685 tonnes, totalling 701,861 tonnes, raw value. The figures are all final except for Guyana where the Autumn crop was not complete. Indications are, however, that the Guyana estimate would be achieved so that total production for 1982 should slightly exceed 700,000 tonnes, raw value. Of this, somewhat less than 600,000 tonnes will be available for export outside the region, when account is taken of stocks on hand at the beginning of 1982. The figures for 1982, both for production and exports, are the lowest for more than 30 years and reflect the steady decline of the Caricom sugar industries which began in the late 1960's and early 1970's. Indications for 1983 are that there will be little, if any, improvement on the 1982 figures.

Chile beet sugar recovery plans[8]. — Chile's sugar production declined to 136,424 tonnes, raw value, in 1981/82, representing a drop of almost 50% from the 267,401 tonnes of 1980/81, owing to reduced plantings due to low prices and to the closure of two plants through bankruptcy of their owner. Production in 1982/83 is expected to increase to 230,000 tonnes, owing to a sharp rise in the price paid to growers and to the reopening of the Linares and Los Angeles sugar factories. The government decided to intervene because the economic survival of the areas where the two plants are located depends on the cultivation of sugar beets, and re-opening of the factories will generate more than 20,000 jobs.

Japanese sugar refineries rationalization[9]. — According to Japanese press reports, sugar refiners' rationalization plans, consisting of closure of refineries and discharge of employees, have been in progress since March when Dai-Nippon closed its Sakai refinery and transferred its Moji refinery to the newly-established Nishi-Nippon Seito K.K. In June Meiji Seito closed its Tobata refinery, while in October Kobe Seito was liquidated, and Mitsui Seito closed one of its three refineries.

Brazil alcohol production targets[10]. — In its marketing year 1981/82 Brazil produced 4240 million litres which compares with the planned production of 4300 million litres. Plans call for production to rise to 5200 million litres in 1982/83 and production has been authorized by the IAA to match the plan. Production is projected to increase to 8300 million litres by 1985/86, when consumption is expected to reach 7600 million litres, and to 9100 million litres in 1989/90. A study by the Brazilian National Energy Commission suggests that the projections may have to be revised upward if the government decides to reduce petroleum imports drastically in 1983.

USSR sugar industry[11]. — At January 1, 1966 there were 296 sugar factories in the Soviet Union with a total daily slicing capacity of 535,400 tonnes, corresponding to an average of 1800 tonnes/day. Since then 28 new sugar factories have been built and numerous others reconstructed so that, at January 1, 1982, there were 324 factories in operation with a total daily slice of 804,160 tonnes/day, corresponding to an average daily capacity of 2480 tonnes per factory.

El Salvador sugar production[12]. — From a record of 293,550 tonnes, raw value, in 1977/78, sugar production in El Salvador fell to 180,496 tonnes in 1980/81, owing to confiscation of land by the government, reduction of plantings from 45,000 to 35,000 ha and to guerrilla activity. Reduction of this activity and an increase in the guaranteed price for growers are now expected to result in a rise of sugar production in 1982/83 to between 205,000 and 225,000 tonnes. Of this, 155,000 tonnes is expected to be consumed domestically and the balance exported against the US quota of 66,000 tonnes.

Fuel alcohol distillery projects in Malawi and Zambia[13]. — The World Bank is to aid establishment of molasses distilleries in Malawi and Zambia in order to develop a fuel alcohol program.

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2 *World Sugar J.*, 1982, **5**, (6), 29.
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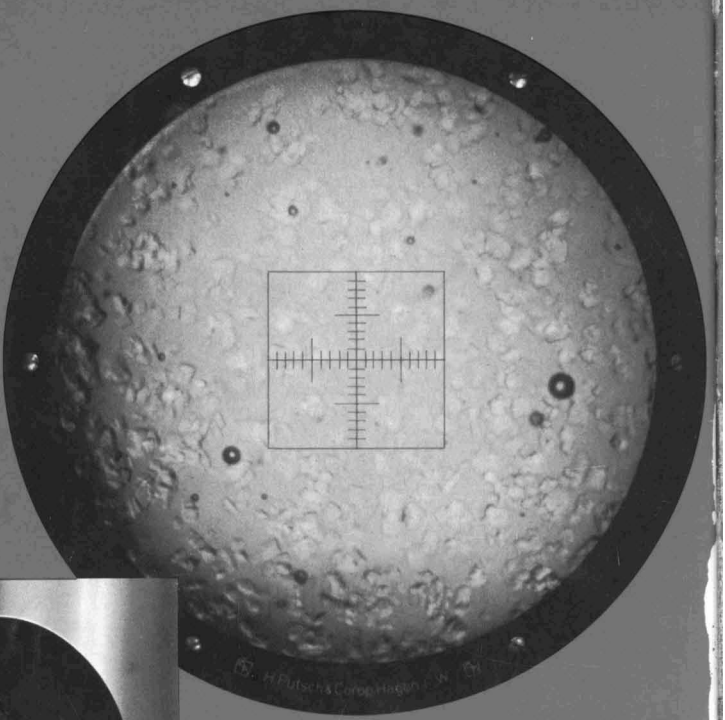

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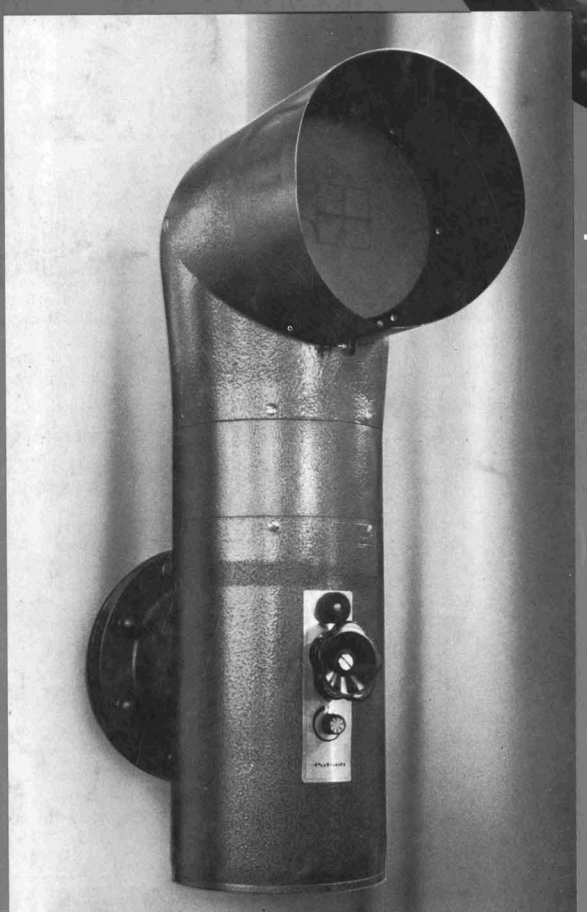

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