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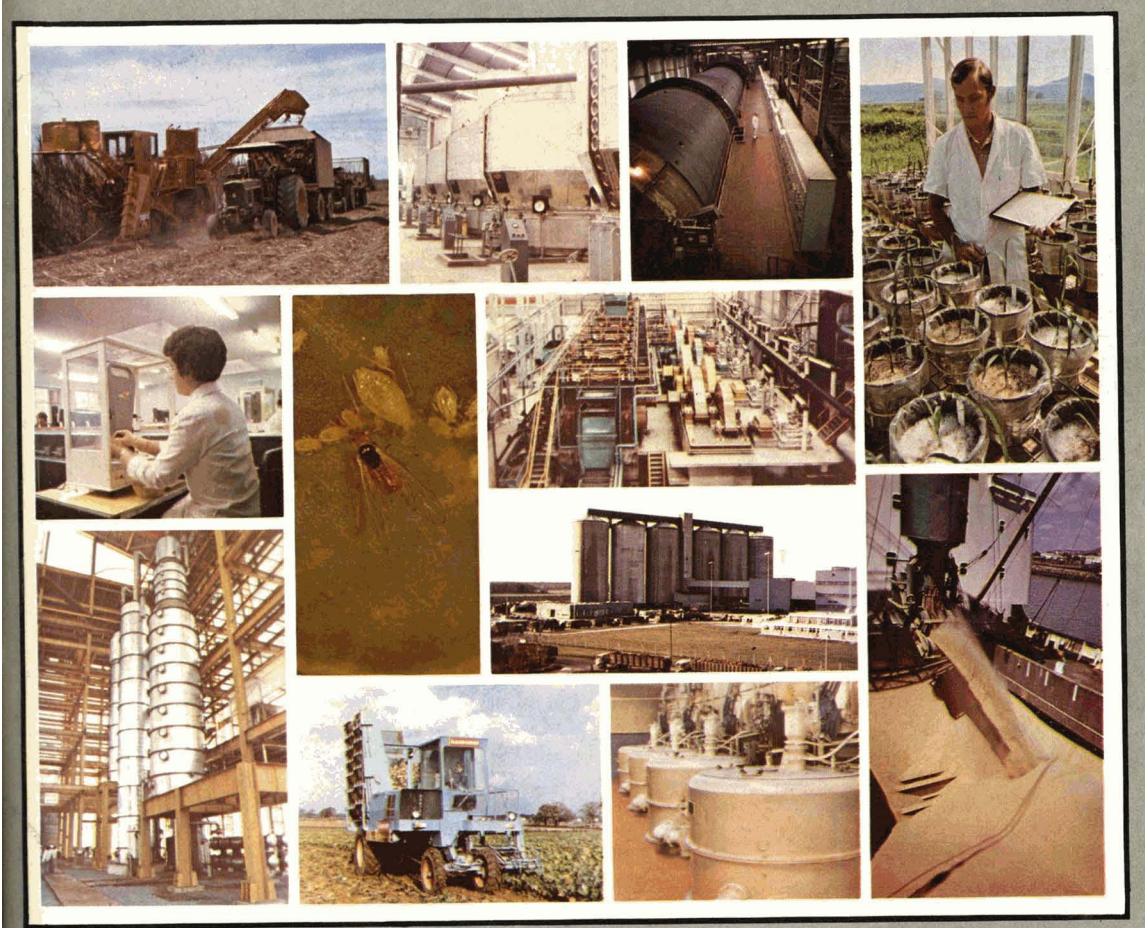

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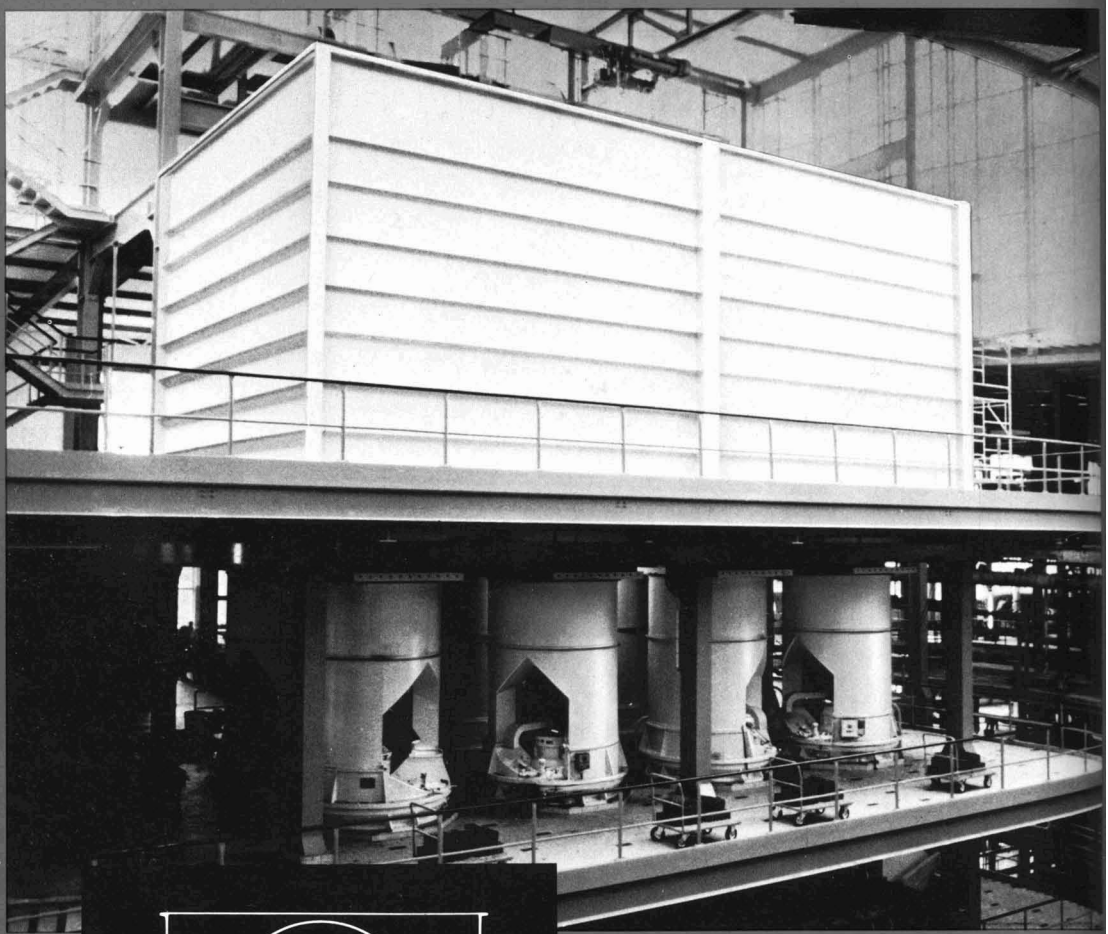

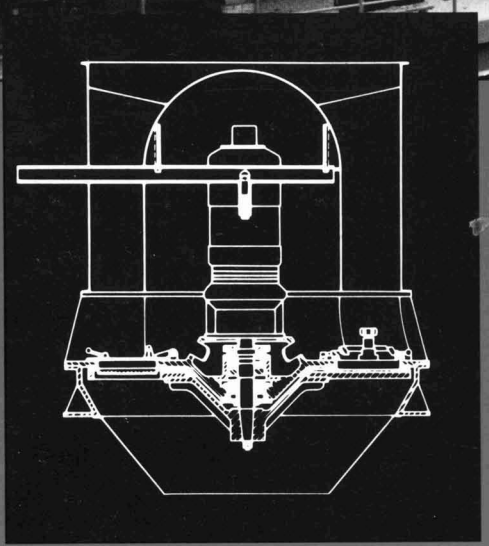

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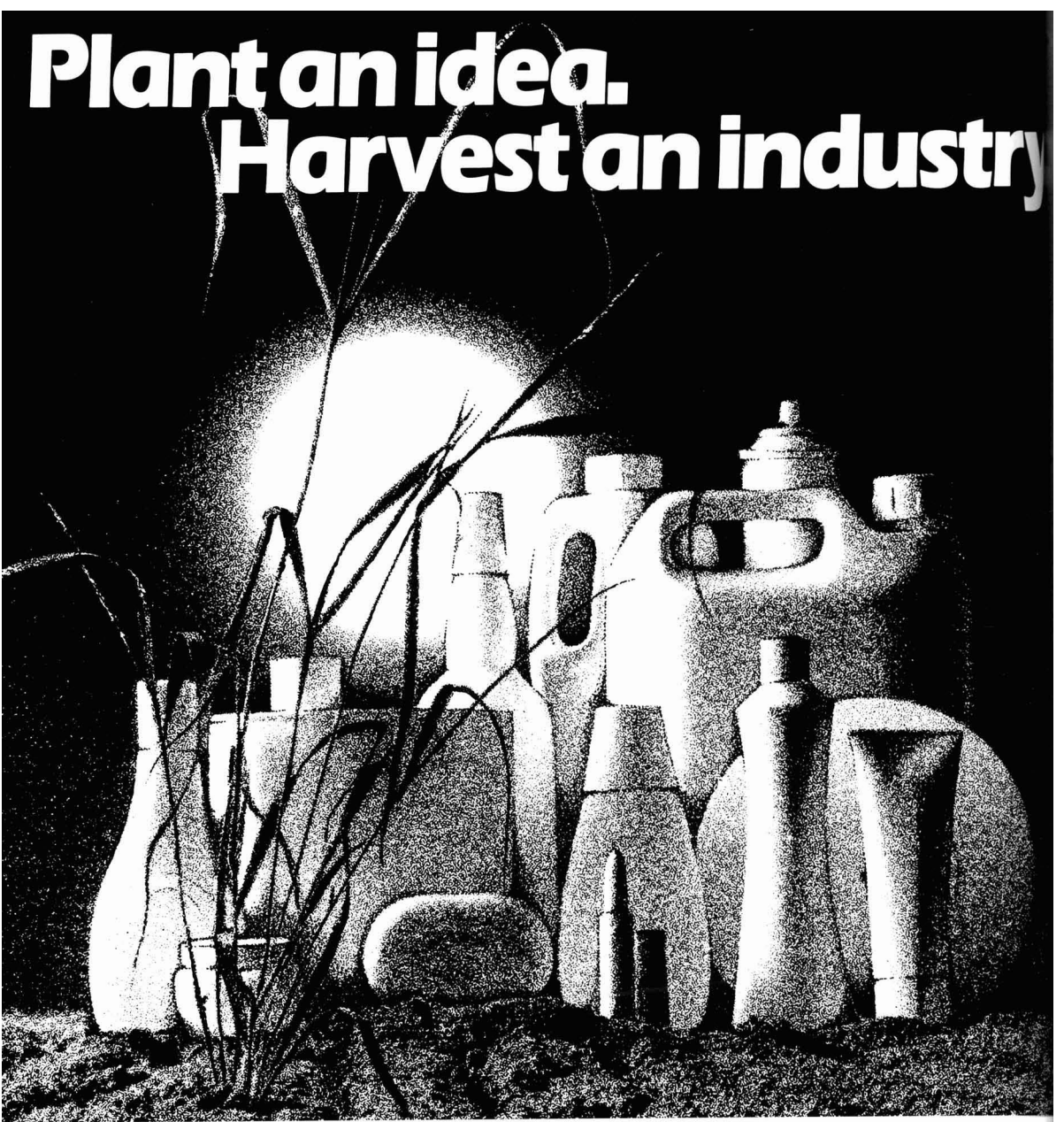

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*The World Sugar Economy Structure and Policies; Volumes I & II; International Sugar Council, 1963. World Sugar Capacity Cost and Policy; Connell Rice & Sugar Co Inc; 1977. (Note: World Sugar Economy Structure and Policy is being up-dated since 1976 by the International Sugar Organization and issued in the form of country chapters. Only a limited number of chapters have been issued and their coverage is from three to ten years out of date.)

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NOTES AND COMMENTS

National interests and international trade

Earlier this year the United States introduced measures designed to protect the interests of its own farmers and sugar producers. The EEC sugar regime has come under considerable criticism for protecting and subsidizing European farmers and sugar producers in a way that has encouraged the production of large surpluses which have had to be given large restitutions or subsidies to enable them to be disposed of. Many countries have persisted in developing high-cost sugar industries of their own and protecting them with high tariff barriers against imports of cheaper foreign sugar. None of these actions can be seen as beneficial on the wider international scene.

However, as C. Czarnikow Ltd.[1] point out, "the first duty of a government is to attend to the interests of its nationals and it is understandable that the requirements of the agricultural sector must be considered particularly important. For wealthy and highly industrialized countries, however, there are also other considerations. Currently the world is suffering from a recession which is the worst for half a century and some centrally planned countries are finding difficulty in servicing their debts. . . . . If the developed countries continue, with the best of intentions, to protect their domestic industries in those areas where the developing countries are able to provide the goods and service needed by mankind, the present imbalance can only be exacerbated. The cash flow of the developing countries can only further deteriorate and with it the demand for the more advanced products of the highly developed countries of the world. It would seem, therefore, that enlightened self-interest calls for more than continuing support for domestic agriculture, however efficient it may be. Indeed, one might consider that its very efficiency makes it no longer an appropriate recipient for the type of governmental assistance which has hitherto been granted.

"Either the governments of developed countries take steps to limit their own production, thereby permitting industries in developing countries to exist, or they continue to pursue their present policies in which case industries gauged to exports in developing countries will eventually disappear, taking with them the means whereby the produce of the developed world can be purchased."

International Sugar Agreement

The Executive Committee of the International Sugar Organization met in London in September to review market developments. Authority was granted for members to hold additional voluntary special stocks up to 50% greater than their obligations under the Agreement. Under the terms of the ISA they are obliged to build up stocks of 2.5 million tonnes, raw value, by December 1983 and they are now permitted to raise this total to 3.75 million tonnes. The resources of the Stock Financing Fund are insufficient to meet the cost of additional stocks and exporting members which are members of the International Monetary Fund will be able to apply for IMF financial help for this extra sugar segregation. Not all exporting members of the ISA are members of the IMF, however, and these will presumably have to seek other assistance if they are to be able to hold the additional stocks.

World sugar prices

The gradual slide in sugar prices continued during September and from an initial £89 per tonne, the LDP fell to £82 on September 15, its lowest level since July 1978. Reports were then received of purchases by the USSR and a small recovery started, bringing the price to £88. After three days, however, the slide resumed and the month ended with an LDP of £85 per tonne. By contrast, the LDP(W) first rose in early September, from £109 to £115 on September 7, thereafter moving roughly parallel to the raw sugar price, and ending the month at £110 per tonne.

World sugar production 1982/83

Estimates of world production of sugar in the period 1982/83 have been published recently by *World Sugar Journal*[2] and E. D. & F. Man[3]. They are on a different basis and so are not strictly comparable. However, both indicate a fall in output from the level of 1981/82 but only by some 1½-2%. *World Sugar Journal* estimates output at 96,019,000 tonnes, raw value, some 2% less than the 98,041,000 tonnes at which it sets 1981/82 production. E. D. & F. Man look for a total of 97,457,000 tonnes in the 1982/83 season against 99,039,000 tonnes in the previous one, a reduction of 1.6%. Such small reductions indicate production levels still considerably higher than the 1980/81 figure of about 87½ million tonnes and will almost certainly lead to further increases in the burdensome stocks which have so drastically affected the sugar markets.

US sugar import quota for 1983[4]

It was not until the deadline had been reached on September 15 that the US Department of Agriculture announced an overall import quota for the fiscal year 1983. At 2.8 million short tons, raw value, the new quota is 500,000 tons below the first tentative indications given by the USDA in June but nonetheless it came as no great surprise to the market. Suppliers with entitlements in excess of 2.0% of the total have been given quarterly shipping programs based upon historical performance. Those with quotas between 1.0 and 2.0% will be required to ship not more than half of their entitlement in any one quarter while those with less than 1.0% may ship at any time.

In the fiscal years 1978/79 to 1980/81 the US imported between 4.3 and 4.5 million tons per annum. The administration said[5] that the small quota was necessary if domestic prices were to be kept above the target level of 20.73 cents per lb in the face of a large domestic crop and reduced demand for sugar.

Brazil sugar finance measures

The level of sugar prices on the world market is lower than half the cost of production in Brazil and the authorities face a deficit in the sugar sector of 120,000 million cruzeiros ($680 million) on export sales. They have consequently announced a series of measures aimed at wiping out the deficit, including a 35% rise in

[1] *Sugar Review*, 1982, (1613), 147-148.
[2] 1982, 5, (2), 16.
[3] *The Sugar Situation*, 1982, (354).
[4] C. Czarnikow Ltd., *Sugar Review*, 1982, (1614), 154.
[5] *Public Ledger's Commodity Week*, September 18, 1982.

the local retail price of white sugar, a 5.6% increase in the pump price of petrol but only a 5.4% increase for alcohol. Producer prices for sugar and sugar cane have been raised between 22 and 24%, depending on the region.

The government also plans to rearrange some agricultural and agroindustrial programs and the treasury will cover a quarter of the deficit by issuing new money. There had been a delay in releasing sugar by the factories which had built up sugar stocks in anticipation of the announcement of new higher prices; it had not affected harvesting, however, and the sugar crop plan for 1982/83 is for a production of 9,000,000 tonnes of sugar against 8,450,000 tonnes in the previous season.

Sr. Hugo de Almeida, President of the Brazilian Sugar and Alcohol Institute Institute, resigned in July, shortly after announcement of the new measures and following widespread criticism by factory owners of domestic sugar policy. He has been replaced by Colonel Confucio Pamplona.

European beet sugar production, 1982/83

F. O. Licht GmbH have recently published their first estimate of sugar production in Europe[1] and their figures are reproduced below, with comparative figures from the two previous campaigns.

	1982/83	1981/82	1980/81
	tonnes, raw value		
Western Europe			
Belgium/Luxembourg	1,050,000	1,120,000	868,000
Denmark	515,000	522,000	464,000
France	4,900,000	5,567,000	4,253,000
Germany, West	3,200,000	3,691,000	2,988,000
Greece	315,000	351,000	189,000
Holland	1,185,000	1,135,000	951,000
Ireland	200,000	183,000	161,000
Italy	1,575,000	2,226,000	1,934,000
UK	1,200,000	1,187,000	1,202,000
Total EEC	*14,140,000*	*15,982,000*	*13,010,000*
Austria	485,000	486,000	456,000
Finland	95,000	88,000	123,000
Spain	1,180,000	1,097,000	967,000
Sweden	330,000	374,000	326,000
Switzerland	135,000	135,000	105,000
Turkey	1,570,000	1,516,000	944,000
Yugoslavia	820,000	868,000	728,000
Total Western Europe	*18,755,000*	*20,546,000*	*16,659,000*
Eastern Europe			
Albania	35,000	40,000	40,000
Bulgaria	180,000	145,000	155,000
Czechoslovakia	680,000	729,000	810,000
Germany, East	710,000	747,000	600,000
Hungary	625,000	601,000	480,000
Poland	1,600,000	1,872,000	1,134,000
Rumania	680,000	663,000	553,000
USSR	7,700,000	6,200,000	7,150,000
Total Eastern Europe	*12,210,000*	*10,997,000*	*10,922,000*
Total Europe	30,965,000	31,543,000	27,581,000

Licht emphasize that it is too early to forecast production with a high degree of accuracy; nevertheless, beet test results so far released indicate that the crops in many West and some East European countries are in a remarkably good condition and a substantial output is again in prospect. The EEC Commission recently estimated Community beet sugar output at 11.7 million tonnes, white value, and the USDA also published an estimate of 12.6 million tonnes. Licht believes that beet tests point to a figure higher than both – 13.0 million tonnes, equivalent to 14.14 million tonnes, raw value – which, against a consumption not likely to exceed 9.5 million tonnes, white value, gives a surplus of 3.5 million tonnes to which must be added the 1.7 million tonnes withheld from the market out of 1981/82 production, 1.3 million tonnes of ACP imports and 300,000 tonnes of cane sugar from the French overseas territories. Thus the EEC is faced with the problem of disposal of 6.8 million tonnes in addition to any remaining exportable surplus from 1981/82. It seems probable that the 1.7 million tonnes will continue to be segregated but even so a formidable disposal problem will remain, in spite of the reduced beet area for 1982.

Mixed prospects for the other countries of Western Europe mean that smaller crops in prospect for some are balanced by increases for others so that, overall, little difference is expected from 1981/82. Better weather in the USSR augurs higher sugar output in 1982/83 than in the disastrous campaign of a year earlier, and the increase dwarfs the changes estimated for the other countries of the Eastern bloc. Because the USSR is such a large producer, the influence of bad weather at harvest time, whether the beets are diverted for use as fodder, etc., could make a complete change in the picture for Eastern Europe and time alone will tell how near Licht's forecast comes to the real result.

Mexican sugar expansion program setback[2]

The ambitious sugar expansion scheme, Programa de Desarrollo Integral de la Industria Azucarera (PDIIA), was launched two years ago and aims at regaining Mexico's status as a sugar exporter by raising output to 4.5 million tonnes, raw value, by 1985 through expanded cane plantings and improved productivity in field and factory. The bulk of the PDIIA investment was earmarked for rehabilitating and expanding existing sugar factories and building seven new ones.

As a consequence of public spending cuts caused by economic conditions in Mexico, no more new mills are to be authorized although the rehabilitation program will continue and, while cane production has increased from 35 million tonnes in 1979/80 to 37 million tonnes in 1981/82, the target of 50 million tonnes by 1985 is still a long way off.

Liquid/solid separation exhibition and symposium. – A one-day symposium and associated exhibition will be held at the University of Manchester's Institute of Science and Technology on November 24. The symposium will commence at 9 a.m. and finish at 5.45 p.m. during which time eight papers concerning practical aspects of the subject will be presented, while the adjoining exhibition will allow participants to see the equipment featured in the papers and to discuss their problems with manufacturers. Further information may be obtained from Mr. A. L. Clarke, Diamond Shamrock (UK) Ltd., P.O. Box 1, Eccles, Manchester M30 0BH (Telephone: 061 789 7300, Extension 250 or 272).

EEC Commission meeting with ISO producer members[3]. A meeting between the EEC Commission and exporting members of the International Sugar Agreement was held on September 24 to discuss terms under which the Community might enter a new Agreement from 1985 onwards. The Commission is known to favour participation in the next ISA but some member states, notably France, are unhappy about the restrictions on exports which would follow from membership. The Commission has set up an ad-hoc working group with a dozen ISO exporters to work out a clear Community stance before the current ISA expires at the end of 1984.

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1 *International Sugar Rpt.*, 1982, **114**, 447-449.
2 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 458.
3 *Public Ledger*, September 25, 1982.

Beet juice concentration by reverse osmosis

By WENDY CAPELIN

Introduction

The processing of sugar beet requires high volumes of water and is very energy intensive, with factories running 24 hours a day throughout the campaign. In order to study the technical and economic viability of installing a reverse osmosis system and its potential for reducing energy consumption, the Reverse Osmosis Division of Paterson Candy International Ltd. conducted a series of trials in conjunction with a major beet processor in Western Europe.

Evaporator condensate may be recycled back to the diffusion extraction stage, but not without possible further treatment to reduce the COD level. The use of reverse osmosis within the system would ideally be situated directly after the settling and filtration plant, although reverse osmosis at other stages within the flow system is quite feasible.

This could either be by treatment of raw juice prior to liming (Option 1), or treatment of thin juice prior to evaporation (Option 2). In both cases the permeate may be recycled back to the diffusion stage.

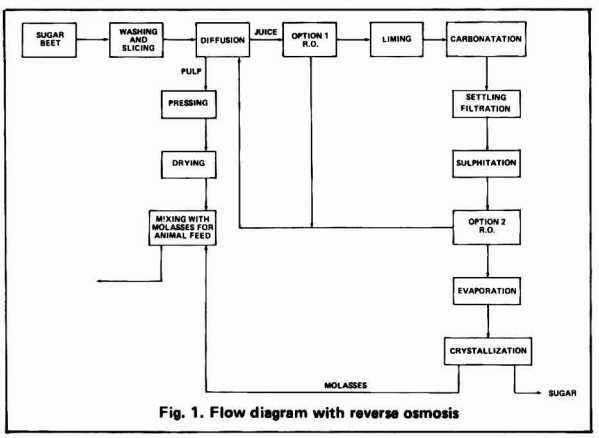


Fig. 1. Flow diagram with reverse osmosis

The purpose of introducing reverse osmosis of beet juice would be to reduce the volume of water to be removed by evaporation, especially when the juice extraction end of the factory is being expanded. The permeate from the R.O. plant may be fed directly back to the diffusion plant without need for further treatment.

When ion exchange is used in the process, there are additional prospects for use of reverse osmosis to re-concentrate dilute sugar solutions and take out the water that is added at the ion exchange section.

Wendy Capelin

Pilot trials

In order to simulate a large installation and enable accurate representation for a full scale plant, test work has been carried out using a P.C.I. reverse osmosis pilot plant. This unit has six stainless steel tubular modules, each module having a membrane surface area of 2.6 m^2. The modules are arranged in two recirculation stages with three modules connected in parallel at each stage (Fig. 2).

Flow indicators are provided to give easy recording of feed flow, bypass flow, and concentrate flow rates. The feed to the R.O. plant can be varied by adjusting the bypass flow rate. The plant also has pressure and temperature indicators and high/low pressure safety cutouts.

The plant has a high pressure pump capable of developing up to 80 bar and recirculation pumps which maintain a constant velocity across the membrane surface and provide increase in pressure which is needed to compensate the pressure drop across the modules. The method of operation of the plant is indicated in Figure 3.

Trial results

Various runs were carried out on thin and raw juice. Some were designed to find the osmotic pressure of beet juice and others to establish constant running conditions. At the same time cleaning requirements were also investigated. Typical trial results are summarized in Table I which records the fall in concentration of treated juice over a period of 1-6 hours from start, using an average pressure of 52 bar and at a temperature of 55°C.

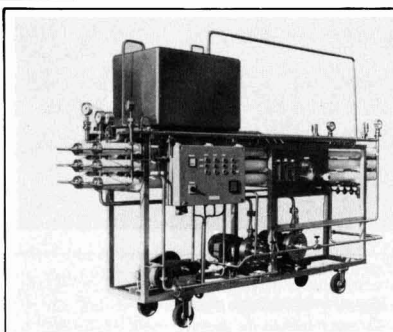


Fig. 2. Multi-stage reverse osmosis pilot plant

Basic capital and operating costs

The figures are based on a typical plant with a capacity to treat 200 $m^3.hr^{-1}$ of thin juice and concent-

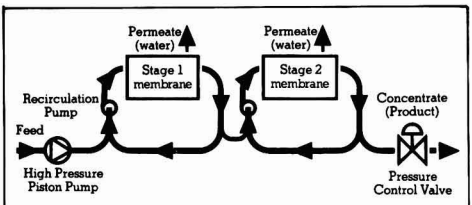


Fig. 3. A typical reverse osmosis flow diagram for a P.C.I. multi-stage recycle system

rate from 14° Brix to 26° Brix. Operating and running costs are based on running the plant 24 hours a day for 120 days, and removing 93 $m^3.hr^{-1}$ of water. The capital cost of such a reverse osmosis plant will be between £1,250,000 and £1,750,000.

The main operating costs are for membranes, which over 6000 hours averages £0.36/m^3 water removed, and power, which at 600 kW costs £0.23/m^3 water removed, giving a total of £.59/m^3 water removed. Figs. 4 and 5 illustrate plants for treatment of 36 and 180 $m^3.hr^{-1}$, respectively, with membrane areas of 220 and1100 m^2.

Table I. Concentrations (°Bx) after 1 and 6 hr

Time	Feed	1st Stage	2nd Stage	Average permeate
1 hr	14.86	22.33	28.06	0.13
6 hr	13.63	19.85	26.21	0.11

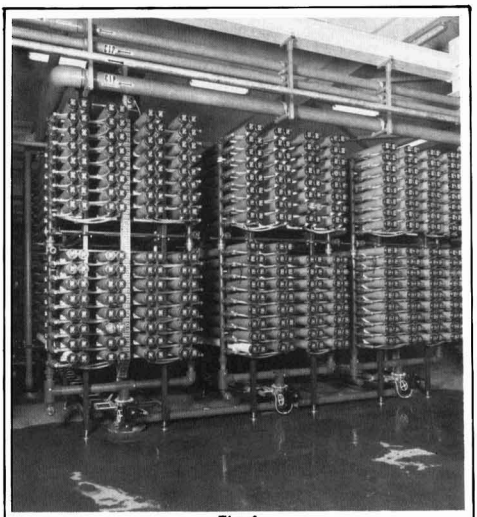


Fig. 4

The tests indicated that the concentration of thin juice is technically feasible with fluxes varying directly with concentration. Using a caustic clean followed by an acid flush, full recovery of water fluxes were obtained, demonstrating that membranes can be easily cleaned.

The results indicated that reverse osmosis would:— (1) reduce the evaporation load by about 50%, (2) provide a permeate of sufficient quality to re-use in the diffusion process without further treatment, (3) reduce the size/volume of plants required further along the process line, and (4) allow expansion of capacity without increasing evaporator size or installing a new evaporator.

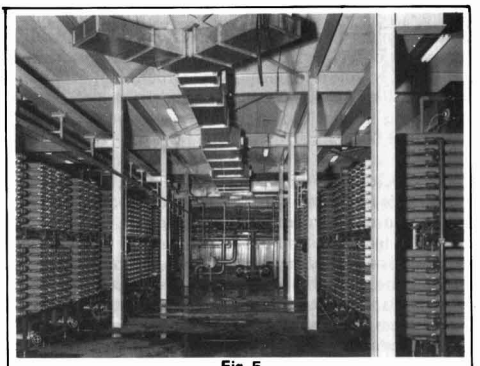


Fig. 5

Summary

A brief report of pilot plant trials using a two-stage reverse-osmosis system indicates that beet juice may be concentrated from about 14° to 27° Brix, halving the evaporator load, at a cost of £0.59 per m^3 of water removed.

La concentration du jus de betteraves par osmose inverse

On donne un bref résumé d'essais à échelle pilote au cours desquels on a utilisé un système d'osmose inverse à deux étages. Les résultats indiquent que le jus de betteraves peut être concentré de 14 à environ 27 Brix. Ceci réduit de moitié la charge sur l'évaporateur et entraine des frais de £0,59 par m^3 d'eau enlevée.

Rübensaftkonzentrierung durch Reversosmose

Ein kurzer Bericht von Pilotversuchen mit einem zweistufigen Reversosmosesystem zeigt, daß Rübensaft von 14 bis 27% TS konzentriert werden kann, und dabei die Belastung der Verdampfstation halbiert wird, bei kosten von 0,59 £/m^3 entfernten Wassers.

Concentración de jugo de remolacha por osmosis inverso

Un informe breve de ensayos en escala pilota, empleando una sistema de osmosis inverso en dos etapas, indica que es posible concentrar jugo de remolacha de unos 14° a 27° Brix, reduciendo por mitad la carga sobre el evaporador, a un costo de £0.59 por m^3 de agua separada.

Indian sugar stockpile[1]. — The Agriculture Minister, Rao Birendra Singh, told the Indian Parliament in July that the Government will create a buffer stock of 500,000 tonnes of white sugar. The stock will be out of "free-sale" sugar and will be retained at the factories, but he did not say when stockpiling would be completed. Under the present policy, the sugar factories are required to deliver to the government as levy 64% of their output at an official price for sale through the public distribution system, but retain the balance — "free-sale" sugar — to sell on the open market. The factories holding the stocks will receive bank credits and will be compensated financially. In view of an officially estimated peak white sugar output of 8.4 million tonnes in the 1981/82 sugar season just ended, the Indian Sugar Mills Association urged the government to build this year a buffer stock of 1.0 million tonnes, to be raised next year to 1.5 million tonnes.

[1] *Reuter Sugar Newsletter,* July 27, 1982.

Make a safe investment in alcohol. Rely on the greatest Brazilian experience.

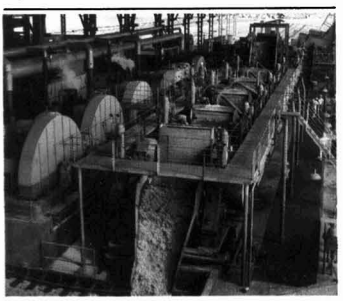
Every six days, Dedini produces a complete alcohol distillery. More than 400 units installed in Brazil, and the company is already exporting turn-key distilleries. Of the 4.5 billion liters alcohol expected for the 82/83 harvest, at least 3.1 billion will be produced by equipments with the Dedini trade mark.

More than 60 years of solid experience in processes and equipments for the sugar industry have made it possible for Dedini to develop the most up-to-date technology for the manufacture of the equipments used by the alcohol industry.

Dedini is a market leader and the most experienced Brazilian firm in this field of activities. They supply crushing mills, steam turbines, speed reducers, boilers, syrup heaters, as well as fully assembled systems for distillation.

Dedini equipments: efficiency and profits

By supplying highly enduring and efficient equipments - which are also of easy maintenance and have a low energy consumption - Dedini assures real profits in alcohol production.



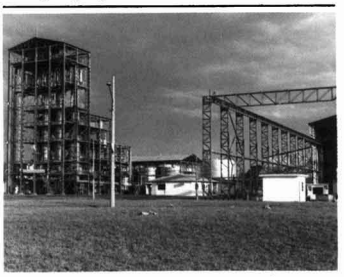
Dedini produces 5 distilleries/month, with a 120 thousand liters/day production capacity.

This is possible owing to the fact that every product is planned in accordance with specific needs and - through manufacture - submitted to the most advanced tests, which comply with Brazilian and international technical standards, such as ABNT, ASTM, SAE, DIN, AFNOR, NEMA, etc.

Mechanical, metallographic, macrographic, chemical exams and dimensional controls are carried out to guarantee an absolutely perfect performance of the equipments.

Exports: a growing capacity

Dedini's services start even before a product is bought, when the company gives advice on the best way to invest the available capital, thus simplifying the arrangements for financing.



Turn-key alcohol distillery delivered to Paraguay in September 1980.

Then, from project to final installation, Dedini supplies equipments or complete distilleries for any and every company or country that might be interested in replacing oil by alcohol-chemistry.

Dedini's capacity also makes it possible to supply turn-key distilleries. Indeed, Paraguay has already imported a unit through this system, pioneer in the history of alcohol industry.

Technical assistance: quickness and safety

Dedini's services do not finish here. They are still present during the project implantation, when specialized technicians supervise assembly. And they go on, with permanent technical assistance, providing spare parts in every country, quickly and efficiently.

Projected, manufactured, installed and assisted by Dedini, the distillery starts producing alcohol and profits.

From the project, through final installation, the client may count on a specialized staff's advice.

Trust the capacity of the experts in alcohol. Ask for Dedini's advice.

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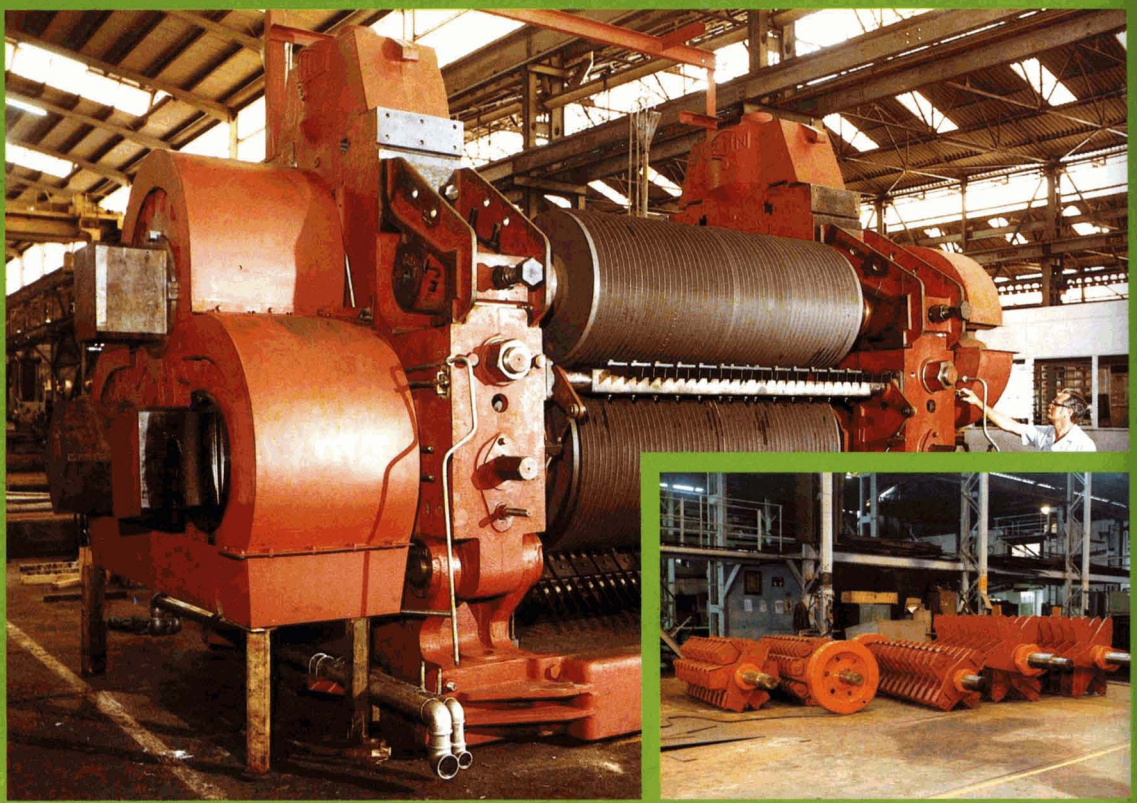

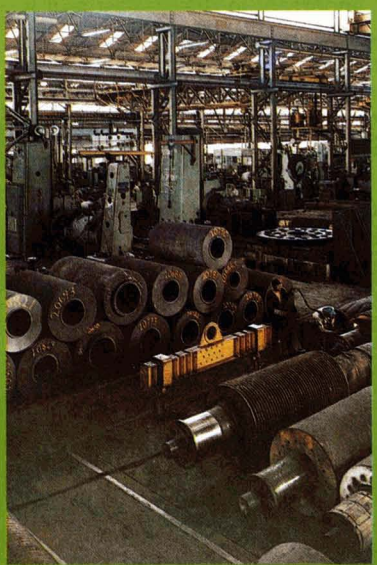

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Cane sugar decolorization by ion exchange resins*

By WILLIAM FRIES
(Rohm and Haas Company, Philadelphia, PA, USA)

Introduction

For over 30 years, quaternary ion exchange resins in the chloride form have been used as colour polishers following the traditional decolorizers of granular activated carbon and bone char. These resins were based upon styrenic polymers and were severely limited in the level of colour in the syrup which they could treat. Beyond a certain colour level, the aqueous brine regenerant was incapable of completely desorbing the colour bodies and the resins were slowly poisoned.

In the late 1960's, this situation changed dramatically with the invention of an acrylic-based ion exchange resin. This resin has a slightly lower thermodynamic selectivity for the colour bodies in sugar syrup, but the adsorbed colour can be removed completely with aqueous brine. It offers the first real alternative to activated carbon or bone char for handling dark syrups. The ideal resin system for decolorization would consist of an acrylic resin for gross decolorization followed by a styrenic resin for polishing the syrup from the primary resin bed.

This two-resin bed system was introduced to South American and Asian cane refineries 14 years ago. At first it was used as an adjunct to the carbon and bone char systems; however, over the years, carbon and bone char have been gradually phased out until, in a number of refineries, the resin system has become the exclusive syrup decolorizer. The two-bed resin system has subsequently proven to be efficient and reliable in this new role. Use in the USA and Europe was delayed by the lack of FDA approval for the acrylic resin for food processing but this approval has been obtained recently and it is expected that current laboratory testing in US domestic refineries will reconfirm the cost-effectiveness of the two-resin bed system.

Colour adsorption mechanism

The mechanism of colour adsorption by quaternary resins used in the chloride ion form is not ion exchange in character. The ion exchange functional groups act only to make the resin hydrophilic and provide efficient pathways for the aqueous sugar syrup and colour bodies to reach the true adsorption site which is the polymeric backbone of the resin. Ion exchange resin structure may be considered as knots of hydrophobic polymer crowding together, as much as steric restrictions will allow, in a continuous phase of hydrophilic functional groups and their waters of hydration (See Figure 1). The bonds holding the colour bodies to the resin are hydrophobic in nature and are of low energy. This low bonding energy gives these decolorization resins their unique ability to be easily and cheaply regenerated with aqueous brine. The corresponding bonding energies between activated carbon or bone char and the colour bodies are much larger and therefore require thermal regeneration.

Specific resins

Amberlite IRA-958, a macroreticular resin, is an acrylic based resin, while Amberlite IRA-900, a macroreticular resin, and Amberlite IRA-401S, a gel-type resin, are styrenic based resins. The differences between the two styrenic resins lie in the superior physical strength of the macroreticular resin and the slightly superior colour adsorption of the gel-type resin (See Table I).

Table I. Resin properties

Product	Structure	Stability	Colour absorption	Regeneration
Amberlite IRA-401S	Gel-type, polystyrenic, quaternary	Good	Best	Poorest
Amberlite IRA-900	Macroreticular, polystyrenic, quaternary	Excellent	Near best	Good
Amberlite IRA-958	Macroreticular, polyacrylic, quaternary	Excellent	Good	Excellent

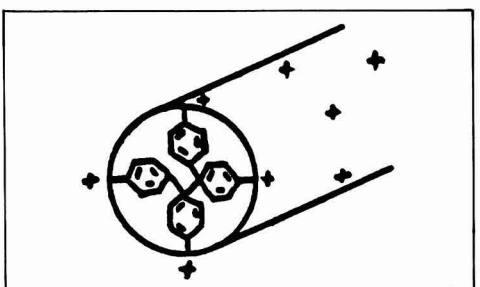

Fig. 1. Orientation of resin matrices

The colour range treated most efficiently by each resin is:

Amberlite IRA-401S – 150 mau or less
Amberlite IRA-900 – 400 mau or less
Amberlite IRA-958 – 400 mau or greater

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

Efficiency estimate

The approximate level of decolorization for either a single resin treatment using the acrylic resin or with an acrylic resin followed by a styrenic resin in series is can be predicted from the colour load to be put through the system. The colour load is defined as the influent colour (mau) multiplied by the number of bed volumes of syrup to be treated. The number of bed volumes of syrup is defined as the volumes of syrup divided by the volume of resin in the column.

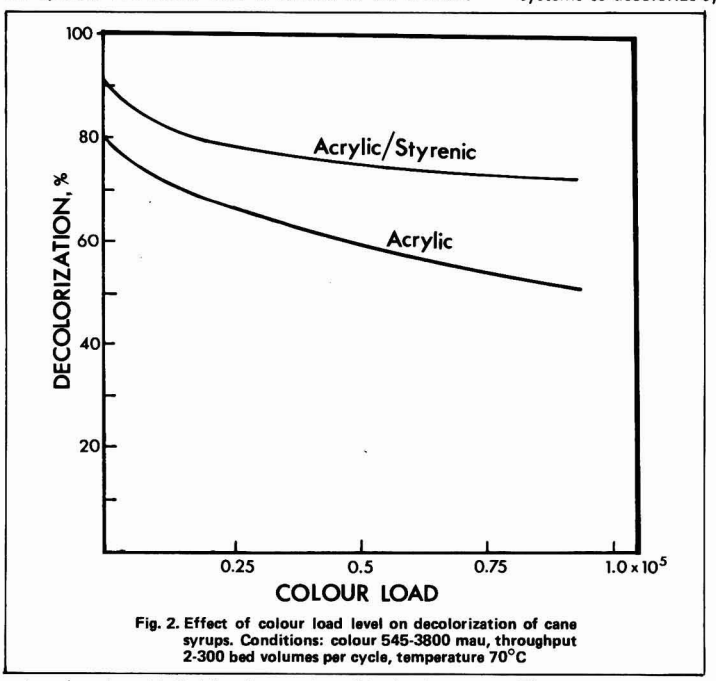

Fig. 2. Effect of colour load level on decolorization of cane syrups. Conditions: colour 545-3800 mau, throughput 2-300 bed volumes per cycle, temperature 70°C

As shown in Figure 2, the single acrylic bed system removes less colour than the two-resin system and is more sensitive to colour load. Multiple types of adsorbent give more consistent results in decolorization because of their ability to adjust readily to the varying levels and character of the colour bodies.

A secondary negative effect on the ability of resin systems to decolorize syrups is the ash load of the syrup. An adjustment to the percentage decolorization in Figure 2 must be made for this effect. This parameter is defined as the ash level in the syrup (ppm on solids basis) multiplied by the bed volumes of syrup to be treated. Again, the influence of ash is more marked upon the single acrylic resin decolorization process (See Figure 3).

The usual parameters of ion exchange resin column operation influence colour removal only slightly and really do not have to be considered in the initial design and thinking about a refinery. Their effect can only be seen in an operation where everything else is carefully controlled (See Table II).

Regeneration mechanism

The regeneration of ion exchange resins used in the decolorization of sugar syrup with 10% aqueous NaCl is not stoichiometric. Rather, it is concentration-dependent. This is really a continuation of the salt load effect upon adsorption; if the salt concentration in either syrup or water is progressively increased, the colour adsorption phenomenon reverses at about the 4% NaCl level and desorption occurs.

In the usual method of downflow regeneration following sweetening-off, the NaCl level builds up slowly because the more dense brine tends to sink into the resin bed causing mixing. As a result, a minimum of 13.5 lb of NaCl per cubic foot of resin is required to exceed the 4% NaCl concentration in the resin bed required for colour desorption. Upflow regeneration into an unrestrained bed, on the other hand, takes advantage of the density difference, advantageously achieving a plug-flow displacement of the water by the brine. Consequently, a minimum NaCl usage of 7.0 $lb.ft^{-3}$ can achieve effective regeneration. It is possible to carry this concept of reduced brine use even further by brine re-use. The acrylic resin is so easily regenerated that even the very dark waste regenerant from the styrenic resin can be used to regenerate the acrylic resin, i.e., the

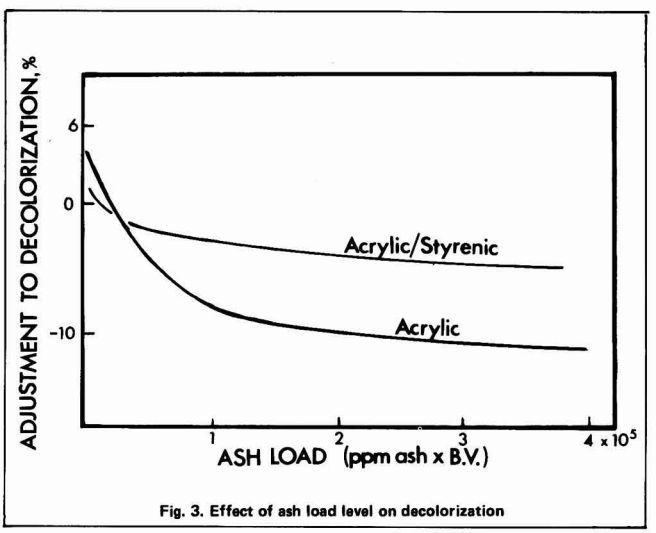

Fig. 3. Effect of ash load level on decolorization

Table II. Parameters affecting performance		
First order	Syrup colour Throughput per cycle Resin selection	(–) (–)
Second order	Salt content Resin age	(–) (–)
Third order	Syrup flow rate Regenerant level, type Syrup temperature Syrup Brix Syrup pH	(–) (+) (–) (–) (+)
( ) Direction of decolorization effect		

brine regenerant may be passed through the styrenic resin directly into the acrylic resin either co- or counter-current to the syrup flow (See Table III and Figure 4).

Table III. Regenerant NaCl consumed
Single-pass regeneration
Downflow = 13.5 lb NaCl per ft^3
Upflow = 7.0 lb NaCl per ft^3
Styrenic/acrylic regeneration in series
Downflow = 6.8 lb NaCl per ft^3
Upflow = 3.5 lb NaCl per ft^3

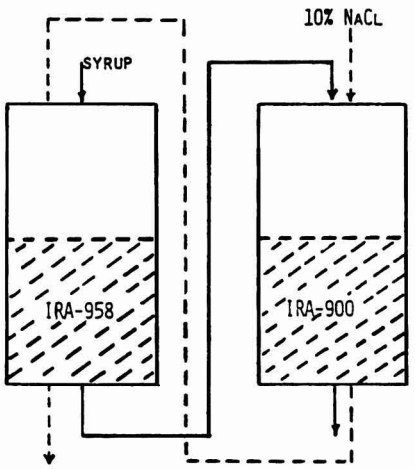

Fig. 4. Two-bed decolorization regenerant reuse

The ultimate in savings can be realized by regenerant reclamation. Since the NaCl is not consumed in the regeneration (essentially all that enters leaves the resin), the brine can be reclaimed repeatedly if the colour is removed. Three well-developed experimental techniques for doing so are available. Two involve the oxidation of the colour bodies to CO_2 by either sodium hypochlorite or ozone. The use of sodium hypochlorite has been studied in our laboratory and the reclaimed brine has been used for 20 successive cycles with no loss in decolorization efficiency. About 5-10% per cycle of the brine is lost in the dilute tailings of the regeneration. A third method was developed by the Australian sugar industry and has been demonstrated on a commercial scale. This involves the most efficient use of activated carbon and resin in combination. The resin system is used to decolorize the syrup and the activated carbon is used to decolorize the waste brine regenerant for recycle. This process reduces the use of activated carbon by 90%.

Cost analysis

The cost of sugar decolorization by ion exchange resins is approximately one-half that of traditional granular carbon or bone char methods. The capital expense is reduced because smaller columns are required (higher flow rates) and because of the elimination of kilns for regeneration. The operating expense is reduced because of the use of low-cost brine as the regenerant as well as its ease of application since the resin is regenerated in place (Refer to Table IV).

Conclusion

Ion exchange resin decolorization of cane syrup has proven to be an effective, low cost alternative to the traditional methods of activated granular carbon or bone char. The key to this success is the use of an acrylic-based resin which does not foul, and which is easily regenerated with brine. There is now enough commercial experience with this system to predict its performance in new installations treating a variety of sugar syrups with some accuracy. There is also the potential for reducing or eliminating brine waste effluents from ion exchange decolorization systems, by use of recycling.

Summary

The introduction of acrylic resins for treatment of raw sugar liquor is shown to provide economical and effective gross decolorization especially when combined with the use of styrenic resins for polish treatment. Methods for minimizing regeneration costs and eliminating the problem of effluent disposal are described.

Décoloration du sucre de canne par résines échangeuses d'ions

On montre que l'introduction des résines acryliques pour le traitement de la refonte de sucre brut est économique et permet de réaliser une décoloration brute effective, surtout en combinaison avec les résines styréniques pour le traitement de polissage. On décrit des méthodes pour minimiser les coûts de régénération et pour éliminer le problème de la pollution des effluents.

Rohrzuckerentfärbung mit Hilfe von Ionenaustauschern

Die Einführung von Acrylharzen für die Behandlung von Kläre zeigte, daß eine ökonomische und effektive Hauptentfärbung möglich ist, insbesondere in Kombination mit Styrolharzen für die Nachentfärbung. Methoden für die Minimierung der Regenerationskosten und die Eliminierung der Probleme der Abwasserbeseitigung werden beschrieben.

Descolorización de azúcar de caña por resinas para cambio de iones

Es demostrado que la introducción de resinas tipo acrilico para tratamiento de licor de azúcar crudo provee economía y efectividad en la descolorización bruta, sobre todo cuando es combinado con el uso de resinas del tipo stirenico para tratamiento final. Métodos para minimizar los costos de regeneración y para eliminar la problema de disposición de efluente se describen.

Table IV. Cost analysis

	Capital	*Assumptions*
Equipment	$459,000	500 tons/day sugar solids
Resin	$196,000	4 x 250 ft^3 80 BV/cycle 3 BV/hr flow rate
	Operational	
Chemicals	$0.33 per ton sugar solids	1500 kg NaCl/day 150 kg NaOH/day
Maintenance	$0.15 " " " "	5% of installation cost
Evaporative recovery	$0.50 " " " "	500 ft^3 water/day 1000 lb steam/1000 lb H_2O $7-8/1000 lb steam
Resin replacement	$0.33 " " " "	5-year life
Equipment amortization	$0.52 " " " "	11 years; 15% interest
Total	$1.83 " " " "	

Effect of extraction method on cane juice quality

By A. ABOU EL-ELA
(Chemistry Department, Faculty of Science, University of Aswan, Egypt)

The aims of economical sugar manufacture from sugar cane are the preservation, extraction and recovery of the maximum yield of sugar and production of good quality crystal. In the evaluation of an extraction process not only the yield of the extraction but also the quality of the extract is of the greatest importance. Comparisons between the diffusion and mill train systems used in juice extraction have been reported by many authors[1-7].

A. Abou El-Ela

However, such studies have not previously been reported from Kom-Ombo sugar factory, Egypt, where a diffuser and a milling train operate side-by-side. The present paper is concerned with a comparison of the two systems of cane juice extraction and the effect of each system on the extraction of non-sugars. The different constituents, including dry matter, apparent purity, reducing sugars, ash content, waxes, gums, total nitrogen, starch, inorganic nitrogen and proteins, were investigated during three different periods of the season.

Experimental

Samples were collected for analysis from each of the extraction systems at Kom-Ombo sugar factory.

Secondary mill juice samples were continuously

1 Schaffer & Huckeba: *Sugar J.*, 1962, **25**, (6), 8-18.
2 Baikow: *ibid.*, 1964, **27**, (7), 75-76.
3 Keller: *ibid.*, 1966, **29**, (2), 60-70.
4 Diaz-Compain: *Proc. 12th Congr. ISSCT*, 1965, 1474-1480.
5 Walter: *Sugar J.*, 1967, **30**, (3), 56-66.
6 Payne: *Proc. 13th Congr. ISSCT*, 1968, 103.
7 Townsley: *Sugar y Azúcar*, 1965, **60**, (10), 27-31.

collected from the juice of the second mill in the mill train.

Diffusion juice is the juice extracted by the diffuser from the bagasse leaving the first mill and was sampled continuously also.

Determinations of apparent purity and reducing sugars were carried out every three hours. The analysis of non-sugars was carried out on composite samples every 24 hours.

All the analyses were carried out at 3 different intervals during the 1980 season when cane varieties used were N:Co 310, Co 413 and 54/Cg, respectively.

The methods used for determination of dry matter % w/w, apparent purity, reducing sugars, ash, gums, waxes, starch, anions in the ash, total nitrogen, inorganic nitrogen, organic-nitrogen, amino acids and proteins were as described in the literature[11-15].

Iron, aluminium, calcium, magnesium, copper, zinc, nickel, cobalt, manganese and lead were determined using a Unicam SP atomic absorption spectrophotometer. The optimum operating conditions and flames for each element were chosen according to Sang *et al.*[16]. One- and two-dimensional descending paper and thin-layer chromatography were employed for amino-acid analyses. The results are recorded in Tables I-IV.

Results and discussion

The data obtained (Table I) showed the following advantages concerning the quality of the diffusion juice compared to the secondary mill juice.

while calcium, zinc, manganese and sulphate were higher in diffusion juice (Table III). These differences were attributed to the addition of lime in the diffusion process.

Table II. Analytical data for anions and the major cations in the ash of secondary mill and diffusion juices

	Diffusion juice		Secondary mill juice	
	% Ash	% Brix	% Ash	% Brix
Silica	5.94	0.303	5.85	0.271
Sulphate	20.45	1.043	18.75	0.868
Sulphite	0.20	0.010	0.25	0.012
Phosphate	4.35	0.222	5.01	0.232
Chloride	15.05	0.768	16.30	0.755
Carbonate	9.98	0.509	10.05	0.465
Iron	0.79	0.040	1.70	0.033
Aluminium	0.62	0.032	0.85	0.039
Calcium	9.81	0.500	6.20	0.287
Sodium	0.11	0.005	0.07	0.003
Potassium	24.66	1.258	26.58	1.231
Magnesium	2.90	0.148	2.95	0.137

(4) The organic non-sugars such as gums, waxes, starch, nitrogen and proteins occur to a smaller extent in diffusion juice than in the secondary mill juice, these results proving consistent during the three periods of both seasons during the three periods of both seasons (Table I).

(5) Although the mill extracted more starch than the diffuser when the latter was operated at below 70°C, the amounts were of the same order of mag-

Table I. Comparison of the different components of the secondary mill and diffusion juice during the three periods

	Secondary mill juice				Diffusion juice			
	Period			Mean value	Period			Mean value
	1st	2nd	3rd		1st	2nd	3rd	
Dry matter % w/w	13.98	15.75	16.01	15.25	9.95	10.40	10.61	10.32
Apparent purity	76.9	77.5	77.8	77.4	79.1	78.9	79.4	79.1
Reducing sugars								
% Sucrose	6.9	6.8	7.1	6.9	6.5	6.1	6.2	6.3
% Brix	5.3	5.3	5.5	5.4	5.1	4.8	4.9	4.9
Ash % dry matter	4.34	4.90	4.65	4.63	5.20	5.31	4.79	5.10
Total nitrogen								
% dry matter	0.356	0.337	0.450	0.381	0.345	0.295	0.362	0.334
Inorganic nitrogen								
% dry matter	0.059	0.064	0.070	0.064	0.050	0.054	0.059	0.054

(1) The apparent purity of the diffusion juice is higher than the juice from the secondary mill train by 1.7 units.

(2) The diffusion juice had a lower reducing sugars content (% sucrose and % Brix) than the secondary mill juice. The higher reducing sugars content in the mill system is due to the action of micro-organisms; inversion of sucrose by bacterial action during the diffusion process is insignificant to low, as reported earlier[8-10].

(3) The ash content of diffusion juice is slightly higher than that of secondary mill juice, and this may be due to the partial liming of thin juice (Table II). The data obtained showed that contents of silica, iron, aluminium, magnesium, potassium, cobalt, nickel, lead, phosphate, sulphite and chloride in the diffusion juice were less than in secondary juice,

[8] Tantawi: *Proc. 12th Congr. ISSCT*, 1965, 1496-1504.
[9] Graham *et al.: Proc. 13th Congr. ISSCT*, 1968, 122-132.
[10] Sayed: *Ph.D. Thesis* (Assiut University, Cairo, Egypt), 1972.
[11] Spencer & Meade: "Sugar cane handbook", 8th Edn. (Wiley, New York), 1959.
[12] Browne & Zerban: "Physical and chemical methods of sugar analysis", 3rd Edn. (Wiley, New York), 1941.
[13] de Whalley: "ICUMSA methods of sugar analysis", (Elsevier, Amsterdam), 1964, p.36.
[14] Vogel: "A text book of macro and semimicro inorganic analysis", (Longmans, London), 1954.
[15] Albanere: "New methods of nutritional biochemistry", 1963, p.48.
[16] *Taiwan Sugar*, 1976, 23, (1), 22-28.

Table III. Analytical data for minor elements in secondary mill and diffusion juice

	Diffusion juice	Secondary mill juice
	p.p.m. on dry matter	p.p.m on dry matter
Copper	9	9
Lead	16	17
Zinc	50	59
Nickel	15	16
Cobalt	15	15
Manganese	26	32

nitude as those extracted by the diffuser when it was operated at high temperatures.

(6) The amino-acids contents in diffusion juice and secondary mill juice were investigated using ion exchange resin and paper chromatography. Qualitative determination of the free amino-acids showed that cystine, ornithine, glutamic acid, alanine, phenylalanine, glycine, lysine, leucine, aspartic acid and asparagine were easily detected (Table IV) and all were unaffected by the different methods of extraction.

(7) Complete acid hydrolysis with 8N HCl for 36 hours at 100-105°C of the diffusion juice and secondary mill juice and study of their corresponding hydrolysates showed some additional amino-acids. L-threonine, L-valine, L-serine and L-methionine were identified in the hyrolysates in addition to the free amino-acids (Table IV). The total amino-acids present in the free form and liberated by hydrolysis of diffusion juice and secondary mill juice are listed in Table IV.

Table IV. Results of qualitative examination for amino acids

Amino-acids	Diffusion juice		Secondary mill juice	
	Free	Total	Free	Total
L – cystine	+	+	+	+
L – ornithine	+	+	+	+
L – glutamic acid	+	+	+	+
L – alanine	+	+	+	+
L – threonine	–	+	–	+
L – phenyl alanine	+	+	+	+
L – valine	–	+	–	+
L – serine	–	+	–	+
L – glycine	+	+	+	+
L – lysine	+	+	+	+
L – leucine + isoleucine	+	+	+	+
L – aspartic acid	+	+	+	+
L – asparagine	+	–	+	–
L – methionine	–	+	–	+

Summary

Comparison between juice extracted by diffusion and by milling revealed that the diffusion juice was of higher apparent purity and contained slightly more ash but had lower reducing sugars, gums, waxes, starch, nitrogen and protein contents than mill juice. The diffusion juice contained less silica, iron, aluminium, magnesium, potassium, sodium, sulphite and chloride but more calcium and sulphate than mill secondary juice.

L'influence de la méthode d'extraction sur la qualité du jus de canne

La comparaison entre du jus de diffusion et du jus de pression montrait que le jus de diffusion avait une pureté apparente supérieure, qu'il contenait — par rapport au jus de pression — un peu plus de cendres, mais moins de sucres réducteurs, de gommes, de cire, d'amidon, d'azote et de protéines. Le jus de diffusion contenait, par rapport au jus secondaire de pression, moins de silice, de fer, d'alumine, de magnésium, de potasse, de sodium, de sulphite et de chlorure, mais plus de calcium et de sulphate.

Einfluß der Extraktionsmethode auf die Rohrsaftqualität

Ein Vergleich zwischen Rohsäften aus einer Diffusion und einer Mühlenstation zeigte, daß der Extrakt gegenüber dem Preßsaft sichtbar höhere Reinheit und etwas höheren Aschegehalt, jedoch niedrigere Werte für reduzierende Zucker-, Harz-, Wachs-, Stärke-, Stickstoff- und Eiweißgehalt aufwies. Der Extrakt enthielt weniger Siliziumdioxid, Eisen, Aluminium, Magnesium, Kalium, Natrium, Sulfit und Chlorid, jedoch mehr Calcium und Sulfat als der 2. Mühlenpreßsaft.

Efecto del método de extracción sobre calidad de jugo de caña

Comparación entre jugo extraido por difusión y por molienda demuestra que el jugo de difusión estuvo de más alta pureza aparente y contuvo un poco más de ceniza pero contuvo menos azucares reductores, gomas, ceras, almidón, nitrógeno y proteína que jugo de molienda. El jugo de difusión contuvo menos silica, hierro, aluminio, magnesio, potasio, sodio, sulfito y cloruro pero más calcio y sulfato que jugo del molino secondario.

Poland sugar imports and exports, 1981[1]

	1981	1980	1979
	tonnes, raw value		
Imports			
Austria	0	36,808	0
Cuba	67,063	60,449	61,652
Czechoslovakia	0	5,353	0
EEC	112,602	17,016	0
Hungary	0	21,652	0
Sweden	0	4,729	0
	179,665	146,007	61,652
Exports			
Algeria	0	0	8,234
Dubai	0	221	217
EEC	13,314	31,808	36,677
Ivory Coast	0	0	1,085
Kuwait	73	550	325
Libya	0	11,821	57,018
Norway	0	108	0
Persian Gulf	362	0	0
USSR	0	3,248	0
Other countries	0	0	63
	13,749	47,756	103,619

Scale insect infestation in India[2]. — The scale insect, considered a minor pest ten years ago, is playing havoc with the sugar cane crop of the state of Andhra Pradesh. From attacks in West Godavari district it has spread to Srikakulam and Visakhapatnam districts, almost the whole of the 25,000 hectares in the last-named being affected. Losses are estimated at between 4 and 5 million rupees and a three-year chemical treatment scheme is to be launched, with half the cost borne by the State agricultural department and the remainder by sugar cane councils.

[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, S324.
[2] *Indian Sugar*, 1982, **31**, 724.

Decolorizing resins — plant development at Westburn refinery*

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Introduction

Tate & Lyle's operating experience with decolorizing resins goes back about twenty years to the early sixties, when Plaistow Wharf refinery in London installed a decolorizing plant on polishing duty after char and, separately, a mixed-bed unit for the preparation of liquid sugar. Plaistow Wharf stopped refining in 1968, and two of their 7 m^3 polishing cells were transferred to Walker's refinery in Greenock, where they continued in use for the next ten years on a similar duty.

The Process Development section at Thames refinery, in close collaboration with our Research Centre at Reading and with the Talo division of our Company, carried through a long program of work on alternative means of liquor decolorization. This program included carbonatation and Talofloc phosphatation, bone char and granular carbon, and resin, using 2 ft^3 glass cells. We confirmed to our own satisfaction the complementary nature of carbonatation with char, and of Talofloc phosphatation with carbon, but the most exciting conclusion to us was the potential benefit to be obtained from resin. Use of styrene-based resin as a polisher is well known, but if overloaded its performance can rapidly decline and some form of protection is required to get the best from it. Acrylic resin may not remove colour so completely but, if properly looked after, is capable of being very fully regenerated, with both long cycles and a very slow rate of deterioration. Several other refiners have been thinking along the same lines, and the benefit of acrylic resin in a macroreticular form is by now well established, with notable published reports from Huletts refinery in South Africa, and by Cheong & Mussebah in Malaysia. One conclusion from our work is the significant improvement to be obtained by operating the resin liquor supply at a high pH, say 8+ instead of 7+. The explanation for this is a matter for speculation, but it is likely that progressively more colour is ionized as the pH rises and in the anionic form can be absorbed by resin.

When Walker's refinery in Greenock closed down in 1979, a bid was made to transfer their two resin cells to London for full-scale acrylic resin trials. The view was taken, however, that our other Scottish refinery, Westburn, could make good use of them, with an understanding that acrylic resin would be given a chance to prove itself. The transfer to Westburn was carried through with enthusiasm, and the most encouraging results obtained since have supported our plans for future process changes for Thames refinery, where we are looking towards a pan feed liquor significantly better than our current colour of about 80 i.u.

Westburn plant development

Westburn refinery was founded in 1852 and has run ever since, apart from 1941-46 when it suffered extensively from bomb damage. Today it operates at 25 tonnes.hr^{-1}, using carbonatation, char and resin to supply a product mix of 30% packet sugars, 30% bulk granulated sugar, 25% bulk liquid and 15% granulated sugar in sacks.

At Westburn the char house is by far the oldest section of the wet process and there has been a pressing need for some time to renew it, replace it or supplement it. We were interested in styrene resin polishing as it had been known for many years to be a most effective supplement. Walker's refinery in Greenock did this and was able to reduce char burn % melt from 12% to 8%. As explained above, the closure of Walker's enabled us to move the two polishing cells (each sized for 7m^3 of resin) and build them into a project that would:

(a) supplement the char house, and
(b) facilitate plant-size trials of acrylic resin consequent to the Thames pilot plant evaluations.

The preferred operational mode was to set up the sequence: acrylic — char — styrene. Before discussing the results of 15 months' operation to date, we should point out some of the limitations of the Stage I installation. In the first place, as there is only one cell for each duty, there is no resin treatment during the periods of regeneration; consequently the char house receives a colour shock for 15% of the time. Also, in the knowledge that

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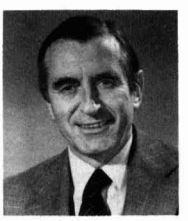
B. W. Drean

from time to time chalk can carry over from the filter station, we agonized over the choice of converting one of the five carbonatation filters to check filtration or taking a chance and hanging on to the full capacity of the filter station. With tight production requirements to meet we had to take a chance and chose the latter. As a result we have learnt something about chalk contamination of resin! We should also note that the styrene resin was second-hand, having performed 50 cycles at Walker's two years previously.

Table I shows a summary of the "before and after" results:

Table I. Summary of colour comparisons in standard ICUMSA units (all colours read at pH 7.0)

	Char only 11% burn	Char 4% burn + resins
Melter liquor	1200	1200
Brown liquor	600	600
After acrylic resin		250
After char	90	90
After styrene resin		45
Fine liquor to pans	90	45

A marked improvement in colour to the pans may be noted; the benefits of this will be discussed below. In this régime the char house acts as a good moderator; the entire melt goes over one acrylic cell of 2.75 m diameter, emerging at the start at perhaps 100 colour units and ending at 300 after 24 to 36 hours. Then there is a 4-5 hour gap for regeneration during which the liquor to char reverts to 600 i.u. Clearly, in the final design, the modular sizes need careful consideration.

The general operating conditions are shown in Table II.

Table II

Feed Liquor –	Brix	62°
	Temperature	75 – 80°C
	pH	8.5
	Rate	3.5 – 4.5 B.V./hr
Regeneration –	Salt	0.24 tonnes.m^{-3} (at 13%)
	Sulphamic Acid (every 15 cycles)	15 kg.m^{-3}
Origin of raws		Guyana Mauritius Belize

It may be wondered why the Brix is not higher. The answer is that the cast iron char cisterns are uninsulated and will not take pressure. The plant is arranged so that between surges from the filters there is a degree of recycling through the acrylic resin. Recycling through the styrene resin is also actuated when level in the feed tank is low. Thus, positive flow in both cells is maintained at all times.

The performance of an acrylic resin for 65 cycles is summarized in the following indicative figures:

Feed liquor colour	500 – 700
Tonnes solids/m^3/cycle	106
Decolorization	62%
Colour load/m^3/cycle (Tonnes x colour)	59,000
Colour removed/m^3/cycle (Tonnes x colour)	37,000

Two brands of the macroreticular version of the acrylic resin have been tried and over the common range of 65 cycles the performance has been similar. One resin has gone on to complete more than 120 cycles; all in all, we can with confidence expect an acrylic resin to last for at least 100 cycles. Before further comment we should look at the nub of the development work; that is the comparative economics set out in Table III.

Table III. Decolorizing costs comparison

	(A) 11% Char		(B) 4% Char + Resin	
	%		% Total (A)	
New char	10		4	
Fuel oil – kiln	16		6	
Steam	18		6	
Resin – acrylic	–		5	
styrene	–		1	
Salt + chemicals	–		3	
		44		25
Process labour	27		16	
Maintenance	15		10	
Sugar loss	14		6	
Ash increase	–		2	
	100		59	

The first conclusion to be drawn from this is that in the development of a resin process we should not be too narrow in our view. At the research stage one is quite rightly concentrating on performance in terms of % decolorization and resin life; but thereafter, we should take care not to overlook other factors that are crucial to the economics. An instance is the direct energy costs in the two cases: 34 compared with 12. The relatively high figure for steam is something of a shock; it covers the energy cost of hot water for char washing/resin regeneration and of the evaporation of char and resin lights surplus to the requirements of melting and centrifugal wash water. This item obviously varies considerably among refineries depending upon the refining régimes.

The comparative figures in the table have been derived from annualized costs. The sub-totals beneath the first 6 items are of universal interest; they exclude the high labour and maintenance costs of our particular char house which is old, as well as the more controversial or nebulous estimates for sugar loss and for the effect of ash increase.

The cost of replacement resin is based upon somewhat pessimistic conclusions, i.e. the acrylic resin having a life of 10,000 tonnes solids/m^3 and the styrene resin having a life of 48,000 tonnes solids/m^3. In terms of capital outlay we reckon that, at the completion of Stage II of our project, when the process will have reached a consolidated status with 4 cells on station, the pay-back in simple terms will be less than 4 years. Stage II, which

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is now under construction, will provide the potential for making fuller use of resins.

It will be noticed that the operating comparisons are not entirely on a "like-for-like" basis. Resins with char have, in the case cited, halved the colour of fine liquor to the pans. By sticking to our four-boiling system but introducing back boiling of syrups to maintain the same massecuite colour in the first boiling we have changed substantially the ratio of boilings. We have also dropped the charring of second refinery massecuite run-off.

Table IV

Pan ratios

	11% char	4% char + resin
1st	10	14
2nd	4 } = 82%	4 } = 86%
3rd	2	2
4th	1	1

The overall effect has been (a) to increase the extraction i.e. reduce the final syrups going to recovery by 20% and (b) to increase the proportion of premium grade granulated sugar as required by the market (1st and 2nd boilings).

The need to produce some 25% of melt for liquid sugar from char at 20/30 colour has restricted our flexibility (a) to reduce further the char burn or (b) to exploit other combinations very far. However, limited production runs with the sequence acrylic – acrylic – char have indicated the need for more char for the same end result compared with acrylic – char – styrene. But, on the other hand, this has also indicated that the more complex sequence acrylic – acrylic – char – styrene (in which older stocks of acrylic resin are used for the first pass) will enable the char burn to be reduced further.

The handling of waste effluent is a topic not to be overlooked. Fortunately in our case there is no problem in disposing of highly coloured brine.

And finally a word about any chalk carry-over. There is no doubt that this impairs the performance of the resin, eventually calling for acid washing. Heavy contamination can cause plugging, as with a char house, and the remedial action of air sparging and vigorous backwashing increases the rate of attrition, not to mention plant down-time losses. Good filter performance, by whatever means, is a must.

Conclusion

What we can say from operating experience is that, in general, the macro-form of anionic resin has a future in taking up the role of front runner in the stages of decolorization following defecation and that, in conjunction with the styrene polishing resins, there are several operating modes yet to be tested that will yield further advances.

Summary

An account is given of results obtained using acrylic based resin before char and styrene resin afterwards in decolorizing raw sugar liquor at Westburn refinery. Char burn was reduced from 11 to 4%, fine liquor colour was halved and the quantity of liquor sent to the recovery house was reduced by 20%. Decolorization costs were also reduced by 40%, while further improvements are to be sought by modifying the system of operation.

Le développement d'une unité de décoloration sur résines à la Raffinerie de Westburn

On rapporte les résultats obtenus à la Raffinerie de Westburn par l'utilisation de résines acryliques avant noir et de résines styréniques après noir pour décolorer la refonte de sucre brut. Le noir brûlé fut réduit de 11 à 4%, la couleur de la claire blanche fut réduite à la moitié et la quantité de sirop envoyé à la section de récupération fut réduite de 20%. Le coût de décoloration fut aussi diminué de 40%, tandis qu'on cherche encore à modifier le système opératoire en vue d'améliorations supplémentaires.

Entwicklung einer Harz-Entfärbungsanlage in der Raffinerie Westburn

Berichtet wird über die Ergebnisse bei der Verwendung von Acrylharzen vor der Behandlung mit Knochenkohle und mit Styrolharzen bei der Entfärbung von Rohzuckerkläre in der Raffinerie Westburn. Die Menge von regenerierter Knochenkohle wurde von 11 auf 4%, die Farbe der entfärbten Kläre um 50% und die in das Zuckerhaus gesandte Saftmenge um 20% reduziert. Die Entfärbungskosten wurden um 40% gesenkt. Nach weiteren Verbesserungen durch Modifizieren des Systems wird gesucht.

Desarrollo de la planta de resinas descolorizantes en la refinería Westburn

Se presenta un examen de resultados obtenido con el uso de resinas del tipo acrilico antés de carbón animal y resina del tipo stirenico después para la descolorización de licor de azúcar crudo en la refinería Westburn. La cantidad de carbón animal regenerado se ha reducido de 11% en 4%, el color de licor fino se ha reducido por la mitad y la cantidad de licor enviado a la casa de recuperación se ha reducido por 20%. Los costos de descolorización se han reducido por 40% y se buscan otros mejoramientos por modificación de la sistema de operación.

Dominican Republic sugar factory closure[1]. – The sugar industry in the Dominican Republic is in financial difficulties because of the recent slump in world prices, and industry sources said that immediate assistance was needed to avoid an economic collapse. The Vicini Group, the third largest in the country, has announced the closure of Centrals Cali and Angelina because of low world prices. The Consejo Estatal del Azúcar also proposes to close Centrals Amistad, Catarey. Esperanza and Monte Llano, but for how long is not known.

US sugar refinery closure[2]. – Amstar Corporation was to close its Philadelphia sugar refinery in August since it can no longer operate the facility economically owing to reduced US sugar consumption and intense competition from high fructose corn syrup. The refinery is the first US casualty of the new support program for sugar which came into effect at the end of 1981, guaranteeing domestic producers a price of nearly 20 cents/lb against a world price well under 10 cents. The effect of this generous support rate for sugar, which is maintained by import tariffs and quotas, has been built-in price support for the corn sweetener industry, according to sugar traders, and HFCS is selling for 16 cents/lb against 27½ cents for white sugar. With another good maize crop in prospect and weak current maize prices, the HFCS industry can look forward to cheap feedstock for the foreseeable future. Analysts feel that, unless corn sweeteners are integrated into the sugar program, they will continue to benefit from the umbrella of Washington's sugar policy.

1 *World Sugar J.*, 1982, **5**, (2), 39-40.
2 *Public Ledger's Commodity Week*, July 10, 1982.

SUGAR CANE AGRONOMY

Improvement of saline, alkaline and other problem soils in Maharashtra. S. J. Ranadive, D. G. Hapase, N. S. Bawaskar, A. J. Yelwande and S. P. Patil. *Maharashtra Sugar,* 1981, **6,** (11), 47-50, 52. – The problems created by various types of soil are described and the effects of gypsum, sulphur and calcium carbonate (as well as various waste products) indicated.

Studies on the effect of intercropping and nitrogen levels on the yield of spring-planted sugar cane. P. Sethi and K. S. Parashar. *Indian Sugar,* 1981, **31,** 95-100. Trials are reported in which each intercrop (moong, cowpea and soybean) reduced the yield of cane by comparison with the cane grown alone, whereas cane + cowpea proved far more profitable and cane + moong slightly more profitable than cane alone.

The Florida raw sugar industry. Agriculture. J. R. Orsenigo. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 271-275. An outline is presented of Florida cane agronomy.

Achievements of sugar cane research in Punjab 1962-1980. R. S. Kanwar. *Rpt. Sugarcane Research Station* (Jullundur, India), 1981, 22 pp. – Results of research in the period 1962-80 are reported, covering varietal improvement work (including details of seven varieties released for cultivation, mention of a number of promising varieties at the final evaluation stage and an outline of a varietal crushing schedule), investigations of many aspects of cane agronomy (including ratoon crop management), physiological and biochemical aspects of frost resistance and ripening, integrated insect pest control, integrated disease management and seed cane production technology. Also mentioned is research on sugar beet conducted during 1971-80.

A new slant on soil erosion control. A. A. Matthews and P. K. Makepeace. *Cane Growers' Quarterly Bull.,* 1981, **45,** 43-47. – Four different practices were compared for their effect on reducing soil loss caused by erosion on sloping cane land. Results showed that by far the best results were obtained by burning the cane and leaving the tops as a trash blanket on the ground without use of any soil cultivation. This gave a soil loss reduction to 74.66 m^3 per ha (90 tonnes.ha^{-1}) by comparison with 294 $m^3.ha^{-1}$ (353 tonnes.ha^{-1}) when normal cultivation was used, 318 $m^3.ha^{-1}$ (382 tonnes.ha^{-1}) when a rotary hoe was used, and 272.3 $m^3.ha^{-1}$ (327 tonnes.ha^{-1}) when beans were sown in the cane interspace and lightly disced into the soil to provide a dense mat of vegetative cover.

Velpar K4 as a pre-emergence herbicide. L. G. W. Tilley. *Cane Growers' Quarterly Bull.,* 1981, **45,** 49. – Trials at a number of cane farms were used to compare the performances of Velpar K4, Diuron and 2,4-D (sodium salt) as pre-emergence herbicides as well as their phytotoxic effects on three varieties of cane. Results of the four replicated trials showed that, at an adequate soil moisture content, Velpar K4 at 3 kg.ha^{-1} controlled both grasses and broadleaf weeds for up to 10 weeks; the same results were given by Diuron at 3.6 kg.ha^{-1} a.i., while 2,4-D at this rate gave acceptable control for 6 weeks. No visible symptoms of phytotoxicity were observed in any of the trials.

Sizing up those drainage pipes. W. A. C. Webb. *Cane Growers' Quarterly Bull.,* 1981, **45,** 54-57. – The author shows how to use a specially prepared chart to calculate the size of drainage pipes required to carry surface water from a given area of land. The chart is based on knowledge of the head of water, volume of water, run-off coefficient (values of which are given for varying topography and soil texture), hourly rainfall for which the pipes are needed (usually derived from local rainfall statistics, although an estimate can be made on the basis of local experience), and catchment area. Worked examples are given.

Giant sensitive plant in the central district – again. G. N. Turner. *Cane Growers' Quarterly Bull.,* 1981, **45,** 57-58. – *Mimosa invisa* has been found growing in cane in the central district of Queensland (although the most serious outbreaks, affecting hundreds of hectares, have occurred in the northern district). Stalks of the weed can grow to a length of 40 m, climbing over and smothering any crop; cane can be completely overcome by it and pulled to the ground. The seed of the weed can remain viable for up to 50 years and is spread by any means by which infested soil can be carried. The outbreaks have been traced to contaminated seed of a pasture legume imported from Malaysia. Advice is given on practical measures to help control the weed; pre- and post-emergence herbicides (particularly 2,4,5-T) are effective as aids to cultural methods.

Ratooning without cultivation after burnt cane harvest. P. J. Nielsen. *Cane Growers' Quarterly Bull.,* 1981, **45,** 63-64. – Trials in which ratoon cane was grown without any cultivation after pre-harvest burning of plant cane showed that yield was lower by an average of 5 tonnes per ha by comparison with cultivated ratoon plots; only where the ground was dry at harvest was the difference in yield between cultivated and uncultivated plots low (an increase in the cultivated crop yield of 1 tonne.ha^{-1}).

Use of filter mud and mill ash on Burdekin soils. Anon. *Cane Growers' Quarterly Bull.,* 1981, **45,** 67-68. – The benefits of applying a 4:1 filter cake:furnace ash mixture of 70% moisture content to cane fields are discussed. Where the requirement is to provide nutrients and improve soil structure and water penetration, at least 250 tonnes of the mixture is needed per ha. This would provide 440 kg of N, 330 kg of P, 150 kg of K, 608 kg of Ca and 140 kg of Mg per ha. If the mixture is applied solely to provide nutrients, the amount required per ha should be lower than 250 tonnes.ha^{-1}.

Studies on the effect of intercropping and N fertilization on the yield and quality of sugar cane first ratoon. J. C. Bhutada and K. S. Parashar. *Indian Sugar,* 1981, **31,** 273-279. – In trials conducted in 1979-80, mung caused no fall in cane yield by comparison with cane grown alone, while other intercrops had a significant adverse effect on cane, although juice quality was unaffected. Highest return was from onion + cane. There was no significant difference in the various yield parameters when 100 or 150 kg of N was applied per ha, although the intercrops had to receive their recommended fertilizer dosages during the early phase of crop growth.

Preliminary trials with chemical ripeners in Bardoli, south Gujarat. S. K. Patil, V. V. Tembhekar, M. S. Christian and B. N. Patel. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.1-A.10. – Small-plot trials with Cycocel and Glyphosine ripeners are reported in which 2.5 kg.ha^{-1} Cycocel or 4 kg.ha^{-1} Glyphosine accelerated ripening of Co 419 to approximately the same extent. Because of difficulties in ensuring spraying uniformity with heavily lodged cane, and subsequent erratic results, large-scale trials with aerial application are recommended.

A note on micronutrient composition of plant and ratoon crops of sugar cane. S. Ramakrishnarao and K. Ramalingaswamy. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.11-A.14. – The Mn, Fe, Zn and Cu contents in leaves of plant and ratoon cane of four varieties were determined and found to be adequate. Plant cane contained more Mn and Cu, while ratoon cane contained more Fe and Zn.

Studies on the spaced transplanting technique of sugar cane. B. A. Lakhdive. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.35-A.38. Comparison was made between cane yields resulting from transplanting of nursery seedlings and from conventional planting of 1- and 3-budded setts. While there was little difference between the results for all three methods when planting was carried out in January, the transplanting method gave considerably lower yields than the other methods when planting was carried out in February or March. The sett planting methods gave approx. the same yields. There was no difference in cane yield between 30 and 45 cm bud spacing.

Study of different weedicides available in the market. V. G. Satralkar, S. C. Gaikawad and I. K. Kadu. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.43-A.44. – A brief report indicated that Sencor at 2 kg.ha^{-1} a.i. was superior to 2,4-D (at 0.5 kg.ha^{-1} a.i.), Destun (at 4 kg.ha^{-1} a.i.), Asulox-40 (rate of dosage unstated) and hand weeding.

Studies on weed control in sugar cane. R. G. Singh, B. D. Gangwar and K. Lal. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.47-A.54. – A number of herbicides and treatments were tested over a 3-year period. While hand hoeing gave the best results in terms of increased cane and sugar yield and gave the highest return, application of 2.5 litres of Gramoxone + 2.5 kg of Fernoxone per ha after the first irrigation followed by 2.5 litres of Gramoxone per ha after the onset of the monsoons gave results that were almost as good as with hand hoeing. The results of the other treatments were very much poorer.

Effect of levels of soil fertility on soil and crop parameters and their effect on sugar cane yield under restricted supply of water. G. K. Zende and D. B. Bhanavase. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.57-A.76. – A field experiment with Co 740 cane is reported in which 21 different combinations of N, P and K were applied in four soil strips of varying fertility. Determination of various soil and cane parameters showed that throughout the trial there was an adequate supply of nutrients in the soil, whereas the levels of N and K in the leaf and the sheath moisture content were low as a result of physiological stress in the formative and early major growth phase, so that the nutritional status of the crop was unsatisfactory throughout the season. Hence, it is emphasized that the adequacy of soil nutrients is of little value if the cane does not absorb them, and that the only means of increasing yield in soils of high fertility is maintenance of a high water utilization efficiency.

Effect of preplanting treatment with growth substances on sugar cane productivity under saline conditions. G. R. Naik and G. V. Joshi. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.77-A.86. – While treatment with 20 ppm indole acetic acid, naphthalene acetic acid or ascorbic acid of setts subsequently planted in fields of saline soil increased yield, juice Brix and pol, in all cases there was a marked fall in % germination by comparison with the untreated control, so that treatment did little to induce salt tolerance in the variety grown (Co 740).

Effect of neem cake blended with urea on yield and quality of issue of sugar cane Co 1305. A. K. Yadav and S. R. Sharma. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.91-A.96. – Finely powdered neem cake was rubbed thoroughly with urea to give a uniform blend (at an admixture rate of 2.1% on urea) which was applied to cane in three split doses. In all cases, yield increased with urea application, while the neem cake enhanced the effect of the urea, suggesting that it improved N, P and K utilization.

Increasing fertilizer efficiency in sugar cane ratoon. S. N. Pandit and A. K. Sinha. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.98-A.102. – Ratoon yields increased with increase in N dosage up to 150 kg.ha^{-1}, after which there was a slight fall with 200 kg.ha^{-1} N. However, green manure dug into the soil increased the effect of the N at all dosage rates, giving maximum yield with 200 kg.ha^{-1} N.

Scope for greater utilization of results of research in field practices for improving the quality of cane. K. K. Prasadarao. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.135-A.162. – A review, with 51 references, is given of research on various aspects of cane agriculture, results of which could be applied in order to improve cane yield and quality.

Increasing fertilizer efficiency in sugar cane ratoons. S. N. Pandit and A. K. Sinha. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.163-A.168. – See abstract above.

Effect of prolonged irrigation under mulching conditions on the yield and quality of adsali sugar cane (Co 740). D. G. Hapase, J. G. Thokale, S. P. Mulik and V. S. Mane. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.169-A.174. – Trash mulching reduced cane yield at all levels of irrigation (applied at 75%, 50%, or 25% soil depletion) by comparison with the non-mulched controls, while irrigation at 25% depletion gave the highest yield.

Studies on the effect of prolonged irrigation during the summer months on sugar cane *(Saccharum officinarum* L.) planted at different times. D. G. Hapase, P. D. Kawrande, S. P. Mulik and V. S. Mane. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.175-A.184. – Irrigation at 25% depletion during

March-June gave higher cane yields than irrigation at 50% and 75% depletion, while yield fell as the planting date was delayed (extending from July 1 to February 15).

Pre- and post-harvest technology for sugar cane in Maharashtra. M. V. Divekar. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.185-A.188. — Means by which sugar recovery may be increased are briefly discussed, including: application of a small amount of N followed by heavy irrigation a few days before harvest; harvesting on the basis of maturity testing; cutting the cane at ground level instead of leaving 6-8 inches of stubble; and minimization of the time taken to transport the cane to the factory.

Soil management for economic production of sugar cane. G. K. Zende. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), S.1-S.97. — A review is presented of the literature (with 383 references) on soil and cane crop management under Maharashtra conditions.

Effect of levels of nitrogen and their time of application on the growth, yield and quality of sugar cane. S. S. Narwal and D. S. Malik. *Indian Sugar,* 1981, **31,** 333-337. Nitrogen was applied at three dosage rates (100, 150 and 200 $kg.ha^{-1}$) split into three or four applications, the first always being at planting and the second and third coincident with irrigation 57 and 83 days after planting, while the fourth (in two cases) was applied at irrigation 164 days after planting. Results of the trials showed that three equal applications of 50 $kg.ha^{-1}$ N gave the maximum net return, although all treatments substantially increased yield by comparison with the control. N had no effect on juice quality. Although there were varietal differences in respect of stalk thickness under the effects of N, the differences in yield between the three varieties tested were non-significant.

Effect of nitrogen levels and plant population on the yield and quality of sugar beet as an intercrop with autumn-planted sugar cane. R. S. Chauhan, M. P. Motiwale and K. C. Pathak. *Indian Sugar,* 1981, **31,** 343-346. Sugar yield from combined cane + beet crops was greater than from the crops grown separately but was generally unaffected by increasing the N fertilization rate for the beet from 60 to 90 or 120 $kg.ha^{-1}$. Best results were given by a beet spacing of 20 cm (giving a final plant population of 55,000 per ha). Beet intercropping did reduce cane yields substantially in the three years of trials.

The quality of Co canes in ratooning. K. R. Perumal. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.9-Ag.16. — A survey conducted during two crushing seasons demonstrated the superiority of 1st ratoon cane over plant cane in respect of sugar content, while the yield and quality of 2nd ratoon cane in some fields were also better than those of plant cane. Some varietal differences were found. The economics of ratooning are briefly discussed.

Sucrose accumulation in relation to invertase activity in an early and late maturing variety of sugar cane *(Saccharum officinarum* L.). J. Kapur and R. S. Kanwar. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.21-Ag.26. — Investigations of changes in sucrose accumulation in two varieties of cane, CoJ 64 and Co 1148, in relation to the acid and neutral invertase activities in them are reported. The two varieties, one an early-maturing and the other a late-maturing cane, exhibited differences in the patterns of invertase activity and in the values of the acid:neutral invertase ratio.

A note on micro-nutrient composition of soil and sugar cane as influenced by continuous application of farmyard manure or sulphate of ammonia to the crop. S. R. Rao and K. Ramalingaswamy. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.27-Ag.30. While application of farmyard manure equivalent to 112 $kg.ha^{-1}$ N increased the availability of Mn, Fe, Zn and Cu in the soil, application of the same quantity of N in the form of sulphate of ammonia increased the uptake of these micro-nutrients by the cane, so that their concentrations in the cane leaf were greater than with farmyard manure application.

Statistical quality control technique in sugar cane harvest management. G. S. C. Rao. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.31-Ag.39. A monitoring system is suggested on the basis of statistical evaluation of cane leaf trash and tops % cane, whereby the average daily levels of extraneous matter in sampled cane would be compared with charts showing control limits and steps taken when the value was above the "action limit".

Polyethylene bag transplanting technique for seed propagation and replanting of ratoons. R. S. Kanwar and K. K. Sharma. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.41-Ag.47. — Results of an experiment showed that pre-germinated shoots raised from single-bud cuttings in soil-fllled polyethylene bags established themselves quickly in the field and gave significantly higher tiller and millable stalk populations, millable and stalk lengths and cane yields than did shoots raised in a nursery bed and transplanted. Horizontal planting gave better results than vertical planting.

Effect of soil application of gamma-BHC for improving the nitrogen efficiency in sugar cane. I. Ammoniacal, nitrate and mineral nitrogen in soil. S. Thangavelu, E. Lalitha and K. C. Rao. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.49-Ag.59. — Three-year field trials were carried out to assess the effect of applying 1 $kg.ha^{-1}$ a.i. gamma-BHC on the behaviour in the soil of N applied at the rate of 200 or 300 $kg.ha^{-1}$. Analysis of soil samples collected at 20-day intervals up to 100 days after cane planting showed that gamma-BHC inhibited ammonium N nitrification and increased mineralization, so that the total ammonium + nitrate N content was increased.

Effect of inter-row spacing on yield and quality of sugar cane. M. R. Reddy. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.61-Ag.65. — Experiments showed that a cane row spacing of 120 cm gave the highest yield, closely followed by the results with 90 and then 150 cm spacings. Lowest yield occurred with a spacing of 180 cm, while double rows at the above spacings tended to give low yields.

Earlier diagnosis of nutrient deficiencies with DRIS. Anon. *S. African Sugar J.,* 1981, **65,** 461. — See *I.S.J.,* 1982, **84,** 203-205, 238-242.

Variations of non-sucrose solids in sugar cane. I. Potassium. J. E. Irvine. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 58-61. — See *I.S.J.,* 1981, **83,** 269.

CANE PESTS AND DISEASES

Role of soil arthropods in sugar cane ratooning. O. P. Singh, O. Prakash and R. K. Tewari. *Indian Sugar,* 1981, **31,** 41-44. — Insect pests recorded in a field of Co 1158 ratoon cane are discussed and the adverse effects they had on the cane, both directly and indirectly, are described.

Possibilities for control of sugar cane smut *(Ustilago scitaminea).* G. M. Farías. *Rev. Técn. Inst. Nac. Técn. Agropec.* (Tucumán), 1981, **1,** (1), 97-101 *(Spanish).* Setts inoculated by dipping in a suspension of spores of the smut fungus were then treated with four chemicals and with water as a control. Only Triadimefon provided successful control; Benomyl, Pyracarbolid and Carboxin were unsatisfactory.

A systematic approach to the control of the scale insect, *Melanaspis glomerata* **Green.** K. Singh and A. Varma. *Maharashtra Sugar,* 1981, **6,** (11), 15-18. A program for control of *M. glomerata* is described with the aid of a diagram; it involves ploughing-up of heavily infested canes and removal of lower leaves and drench application of 0.1% Malathion where there is only mild infestation. The scheme is a 3-year one aimed at reducing a heavy infestation level to one of only stray occurrences.

Studies on the survival of sugar cane scale insect *Melanaspis glomerata* **(Green) crawlers after emergence.** G. S. Shukla and N. Tripathi. *Indian Sugar,* 1981, **31,** 101-102. — Studies showed that maximum settlement of *M. glomerata* crawlers (21.7%) took place within the first 5 hours after emergence; those that failed to settle within 30 hours died.

Introduction and establishment of an ectoparasite, *Epipyrops melanoleuca* **Fletcher (Epipyropidae: Lepidoptera) in Bundi district (Rajasthan) for the biocontrol of a sugar cane pyrilla,** *Pyrilla perpusilla* **(Walker).** A. D. Pawar, J. Prasad, R. Singh, K. P. Yadav and R. Asre. *Indian Sugar,* 1981, **31,** 103-107. — Details are given of the % parasitization of the title leafhopper by *E. melanoleuca* after its release in a number of localities within Bundi district. Between 40% and 60% parasitization was achieved in an area totalling some 1500 ha.

Influence of some agrotechnical parameters in the planting of sugar cane on pineapple disease *(C. paradoxa* **de Seynes Moreau) in Cuba.** L. Herrera I., R. Mögling and M. A. Valdés. *Centro Azúcar,* 1981, **8,** (1), 3-9 *(Spanish).* — In a study of a number of factors in cane planting in relation to their effect on incidence of pinapple disease, it was found that little damage was caused when setts from the apical part of the stalk were used, with more than three buds and without covering (as against planting 5 or 15 cm deep). No differences were found between C 8571 and J 60-5 varieties, but the pathogen developed better in red soils than black. Trials are to be made of fungicidal treatment of setts.

Problems and usage of insecticides in the control of insect pests of sugar cane. R. A. Agarwal. *Indian Sugar,* 1981, **31,** 175-185. — Major insect pests of sugar cane in India are listed, and reasons for their increased activity are stated. The use and limitations of insecticides are discussed, and recommendations given on crop spraying. Despite various problems associated with chemical control, this has been effective against many pests.

Root rot in sugar cane. O. B. Zamora. *Crystallizer,* 1981, **4,** (3), 13, — Sugar cane root deterioration or failure to function normally is briefly described.

Pest control strategy for the sugar cane stem borer (a review). J. D. Layoso and T. Solsoloy. *Crystallizer,* 1981, **4,** (3), 14-17. — Limitations on the use of pesticides to control borers are discussed, and biological control with *Trichogramma* spp., particularly *T. australicum,* for which host plants are listed, is advocated.

***Eldana saccharina* Walker, the sugar cane stalk borer, in Africa.** M. Betbeder-Matibet. *Agron. Trop.,* 1981, **36,** 279-293 *(French).* — A summary is presented of data in the literature on *E. saccharina* biology, behaviour and incidence in East and Southern Africa, and investigations conducted in several cane-growing areas of West Africa (Ivory Coast, Mali and Upper Volta) as well as in the IRAT central laboratory in France are reported. Since chemical and biological control of the pest has shown little promise to date, only the planting of resistant varieties and/or modification of agricultural practices offer any guarantee of control. In the meantime, the borer remains the chief pest of sugar cane in Africa.

No relationship between Fiji disease susceptibility and yield. Anon. *Cane Growers' Quarterly Bull.,* 1981, **45,** 49-50. — Before 1979, all testing for Fiji disease resistance in the early stages of a selection program was carried out in the glasshouse; because this involved infection of young plants and a disease rating based on the time taken for symptoms to show, it was thought by some that the testing method would discriminate against the more vigorous high-yielding varieties, which would have adversely affected the program. An experiment showed, however, that there was no correlation between yield potential of cane seedlings and resistance to Fiji disease, which means that varieties of low yield will not be selected; nevertheless, it is stressed that many high-yielding varieties will still be discarded, since some 70% of cane seedlings are susceptible to the disease.

Inheritance of Fiji disease resistance. Anon. *Cane Growers' Quarterly Bull.,* 1981, **45,** 50. — Reasonably high values of heritability were obtained in experiments designed to study Fiji disease inheritance in sugar cane; these results confirm that considerable progress can be made in breeding for resistance to the disease as a result of using resistant parent varieties.

EDB fumigation for grub control in north Queensland. K. J. Chandler. *Cane Growers' Quarterly Bull.,* 1981, **45,** 50-51. — Experiments on control of *Lepidiota consobrina* grub in fields of ploughed-out/replanted cane showed that pre-planting fumigation with 15 litres.ha^{-1} of ethylene dibromide (EDB) was effective, while side dressings of EDB gave variable results for a number of reasons. Pre-planting application also controlled wire-

worms and symphyla. For grub control in ratoon cane, a coulter wheel was used to cut a slot through the middle of the stool, and EDB fed through a delivery tube carried on a narrow blade running in the furrow directly behind the coulter. Two discs were set to throw soil directly over the slot and thus seal in the chemical. Variable grub control was obtained by this means; the ability of the operator to keep the implement central on the stool was a limiting factor and depended on the type of soil, but proper use gave effective control at quite low dosage rates.

Rats cause massive cane losses. C. A. Rehbein. *Cane Growers' Quarterly Bull.*, 1981, **45**, 52-53. — A higher incidence of rats than expected in Queensland cane fields in the 1980 crop was attributed to the presence of standover cane and the carry-over of a large breeding population from the previous season. Crop losses estimated at 79,000 tonnes (worth $A 2.3 million) were caused by the pest. Illustrations show various aspects of rat control using wheat baits impregnated with a suitable agent as well as attractants in the form of semi-waterproof paper sachets. The most economical method of distribution is aerial application. Damage caused by the climbing rat *(Melomys littoralis)* is also shown.

Soldier fly damage in Bundaberg district. C. L. Toohey. *Cane Growers' Quarterly Bull.*, 1981, **45**, 59. — After continued application of control measures during 10-15 years had reduced infestation of the soldier fly to a minimum following major damage to the cane crop in the late 1950's and early 1960's, controls were relaxed and the severity of the early attacks tended to be forgotten. However, evidence emerged of the presence of the pest in the Bundaberg region of Queensland in 1980/81, and advice is given on measures to adopt for its control, particularly early investigation and identification.

Progress in Burdekin leaf scald control. I. T. Freshwater. *Cane Growers' Quarterly Bull.*, 1981, **45**, 66-67. — With a continuing decline in the incidence of leaf scald, it is planned to re-introduce Q 63 cane to farms in the Burdekin region of Queensland in 1983, while protection of Q 96 cane, first infected with the disease in 1980, will be necessary. It is estimated that after the re-introduction of Q 63, more than 80% of the crop will be represented by these two susceptible varieties.

Improving seed cane in central Zululand. Anon. *S. African Sugar J.*, 1981, **65**, 441, 444. — The normal procedure for selection of seed cane in South Africa is to select at planting time from the best-looking fields of cane having an age of 12-18 months. Seldom is seed cane produced in a proper nursery. However, because of a poor quality of seed cane, there has been a recent increase in the incidence of smut, mosaic and ratoon stunting disease. In an effort to improve methods of seed cane production and prevent further increase in these diseases, a Seedcane Improvement Scheme was set up in 1980 for central Zululand with the aim of checking all potential seed cane in the area and advise growers on its suitability as planting material. The steps taken in implementation of the scheme are described. Investigation of a total of 234 fields considered potential sources of seed cane showed that, because of a combination of all the factors that make a crop unsuitable for use as seed cane, only 60 were suitable. It is expected that at least four years will be needed before there is sufficient disease-free seed cane available.

Heat treatment of seed cane for preventing spread of seed-borne pests. A. N. Kalra and D. K. Banerji. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1981, (1), A.55-A.56. — Cane setts infested with larvae of the top and stalk borer, nymphs and adults of the mealy bug and nymphs and adults of the scale insect were exposed to temperatures of 45°, 50° or 54°C for 2, 4 or 8 hours before being planted in micro-plots. Determination of pest mortality and % germination (the latter eight weeks after planting) showed that optimum was 2 hours' exposure to 54°C.

Review of research on sugar cane pests in Maharashtra. A. S. Patil, D. G. Hapase and B. P. Gajare. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1981, (1), A.103-A.114. — The review includes: the effect of climatic factors on incidence of cane pests; losses caused by specific groups of pests, including the costs of chemical control; varietal screening for resistance to borers and scale insects; biological control of pests (with a list of parasites and their host species); and chemical control of early shoot borer, leafhopper, white grub, top borer, root aphids and rats.

Effect of chemical treatment on the secondary spread of grassy shoot disease and yield of sugar cane. S. Ponniah, S. Natarajan, T. Kalaimani and A. K. Kadirvel. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India*, 1981, Ag.17-Ag.19. — Various chemicals were applied to cane in an attempt to control grassy shoot by eliminating the vector responsible for its spread. While the various treatments, including insecticides, fungicides, antibiotics, micro-nutrients and organic soil amendments, increased cane yield in most cases by comparison with the untreated control, there was no reduction in disease incidence; on the contrary, there was a 1-2% increase in secondary spread of the disease in the treated cane as a result, it is suggested, of disturbance of the fulgorid vector.

Studies on physiological aspects of top borer resistance in different sugar cane varieties. R. S. Kanwar and H. Kaur. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India*, 1981, Ag.67-Ag.71. — Studies on five cane varieties were aimed at finding possible factors that could be of value in selecting suitable varieties for resistance to the top borer. One possible indicator was a combination of a high midrib moisture content and a low midrib silica content in susceptible varieties; in resistant varieties a high silica content and a correspondingly low moisture content would increase the hardness of the material and thus possibly inhibit movement of larvae endeavouring to reach the growing point.

Frequency of rust susceptibility in the sugar cane variety development program at Canal Point. P. Y. P. Tai, J. L. Dean, J. D. Miller and B. S. Gill. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 40-43. — A total of 1131 clones in the 1979 Stage II variety trial and 105 clones in the Stage III variety trial were rated for susceptibility to rust (caused by *Puccinia melanocephala).* About 15% of the Stage II clones were infected by rust when rated on May 21; by July 9 the proportion had risen to 34%. Most of the clones were resistant, very resistant or highly resistant to the disease, progenies from a few parents producing most of the susceptible clones, which at Stage III were infected consistently at all four locations with varying severity.

CANE BREEDING AND VARIETIES

IAA introduces in Campos, RJ, three new varieties of sugar cane. Anon. *Brasil Açuc.,* 1981, **97,** 281-283 *(Portuguese).* — Three new varieties — RB 705051, RB 705007 and RB 705146 — developed under the Planalasucar improvement program, have been released for cultivation in the north of Rio de Janeiro state. They are, on average, 5% richer in sugar than CB 45-3, the most widely grown cane in the region.

Effect of different yield attributing characters on cane yield. H. V. L. Bathla. *Indian Sugar Crops J.,* 1981, **8,** (1), 19-20. — Relationships between cane weight and other yield parameters (stalk length and thickness and leaf width) were statistically analysed for CoL 29 (an early-maturing variety), CoL 9 (mid-season variety) and CoJ 46 and Co 1148 (two late-maturing canes). Highly significant partial and multiple correlations were established which could be of value in selection trials.

Varietal improvement and the sugar industry. A. S. Ethirajan. *Maharashtra Sugar,* 1981, **6,** (10), 37-40. The role of the Sugarcane Breeding Institute at Coimbatore in producing improved varieties is described and a list presented of Co varieties recently released for growing in the southern states of India. The importance of suitable agronomic practices for obtaining best results is underlined.

CoS 802 replacing old prevalent varieties. H. N. Singh, S. B. Singh and P. S. Verma. *Maharashtra Sugar,* 1981, **6,** (10), 41-44. — CoS 802 is a mid-late variety that has undergone extensive trials in recent years. Comparison with Co 1148 and Co 1158, major varieties in Uttar Pradesh, showed that CoS 802 outyielded both in cane and sugar; it is moderately resistant to red rot and wilt, but moderately susceptible to smut.

Varietal performance of sugar cane in Bardoli, south Gujarat. S. K. Patil, V. V. Tembhekar, M. S. Christian and B. N. Patel. *Maharashtra Sugar,* 1981, **6,** (11), 41-43, 45. — Varietal trials conducted at the experimental farm attached to Bardoli sugar factory are reported in the form of tabulated data.

***In vitro* somatic tissue culture of sugar cane *(Saccharum* spp.).** P. Chagvardieff, E. Bonnel and Y. Demarly. *Agron. Trop.,* 1981, **36,** 266-278 *(French).* — Details are given of experiments on culture of callus tissue from *Saccharum spontaneum, S. officinarum* and a number of interspecific hybrids in various media. Formation of buds and roots, and rapid regeneration of plantlets without transfer of the medium were possible in the presence of 2,4-D or naphthalene acetic acid. Specific and genotypic responses were confirmed, and a correlation was established between the state of differentiation of the leaf tissues and callus formation, with a maximum rate of callus formation occurring in the zone of leaf sheath growth at 4-8 cm above the growing point.

Q 96 performs well in the Burdekin. I. T. Freshwater. *Cane Growers' Quarterly Bull.,* 1981, **45,** 65. — The performance of Q 96 cane is compared with that of Q 63 (which it replaced because of a severe outbreak of leaf scald) and of Q 80, the other major variety grown in the Burdekin region. The pattern of sugar content over 24 weeks demonstrates the superiority of Q 96 despite marked lodging.

Frosted sugar sticks. Anon. *S. African Sugar J.,* 1981, **65,** 427. — Eleven cane varieties were used in an experiment to see if a comparative measure of varietal response to cold could be obtained by placing young plants in pots on the ground in an area of fairly frequent frosts. The height of the primary shoot of each plant and the numbers of tillers were recorded at certain intervals; in addition, from the 71st day, the leaves of the primary shoots were rated for the amount of chlorotic striping characteristic of frost damage, necrosis of the first leaf on the primary shoot and the amount of dead tissue in the spindle leaf. On day 135, primary shoots were dissected to ascertain if the growing point was alive. During the experiment, the grass minimum temperature fell below 0°C on 40 nights. Shoot survival ranged from 100% for varieties N:Co 382 and N 12 to approximately 18% for N 52/219. The results are given in the form of a block diagram.

Sugar cane variety tests in Florida, 1980-81 harvest season. B. Glaz, J. L. Dean, M. S. Kang, J. D. Miller, O. Sosa and P. Y. P. Tai. *Public. Agric. Research Service* (U.S. Dept. Agric.), 1981, 18 pp. — Twenty-nine varieties of sugar cane, interspecific hybrids of *Saccharum* spp., were grown in replicated trials and harvested at eight locations representing five soil types. Cane and sugar yields were compared with those of CP 63-588, the most widely grown variety in Florida. Varieties were also rated for their reactions to smut (caused by *Ustilago scitaminea)* in separate inoculation tests, and to rust (caused by *Puccinia melanocephala)* by natural infection in the yield trials. In plant cane trials, CP 76-1519 produced the most cane and sugar per acre in the average of six tests on three muck soils, while CP 75-1322 was the highest yielder on another muck soil. On a fine sand, the leading variety was CP 63-488. The highest yield in all 1st ratoon trials was given by CP 75-1091, although CP 75-1553, CP 75-1082, CP 75-1257 and CP 75-1632 also gave promising results. In 2nd ratoon trials, CP 74-2005 was the outstanding variety on all soils.

Drought tolerance in sugar cane cultivars. N. B. Singh and S. A. Ali. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.15-A.24. — The drought tolerance of 10 varieties was determined in field trials laid out in a split plot design in which soil was maintained at a moisture content of 3.6 and 11.5%. Plant growth, juice quality and cane yield generally fell as a result of moisture stress, although Co 1148 and BO 54 had fewer small stomata and greater drought tolerance than the other varieties tested.

CoC 67-1 variety in Bardoli (south Gujarat). M. S. Christian, V. V. Tembhekar and S. K. Patil. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.41-A.42. — Results are given of varietal trials in which CoC 67-1 was compared with Co 419 (grown on some 95% of the Bardoli factory area) and a newly introduced variety, Co 6806. Tabulated data show that the title variety was superior in terms of sugar and cane yield.

A new promising variety of sugar cane, Co 7219. V. G. Satralkar, S. C. Gaikawad and I. K. Kadu. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.45-A.46. – In 3-year trials, Co 7219 was compared with Co 740 (a mid-late variety) and found to be superior in cane yield and sugar content.

Ascorbic acid-carotene relation under vegetative and reproductive conditions in *Saccharum* cultivar Co 285. K. C. Rao and M. Vijayasaradhy. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.87-A.90. Studies of the ascorbic acid:carotene ratio in the top six leaves at various stages of development showed that the ratio gradually fell from 1.33 at the vegetative stage to 0.26 at tip emergence, indicating a preferential use of ascorbic acid in flower stalk development.

Post-harvest deterioration in different sugar cane varieties. J. Kapur and R. S. Kanwar. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.1-Ag.7. – The effect of eight days' storage on cane quality was determined for twelve varieties in two successive years. The average results are tabulated for each variety, showing that all suffered a loss of sugar, purity and moisture and an increase in reducing sugars. Of the two early maturing varieties, S 750-74 deteriorated more than CoJ 64; of the six mid-season varieties, CoJ 74 was particularly prone to deterioration, while CoJ 75 late maturing variety was more susceptible than Co 1148.

Leaf anatomical characters and sugar content of cane. K. R. Perumal. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.73-Ag.79. – The possible effect of leaf anatomy on sugar content was studied in five cane varieties. Sugar-rich varieties were found to have high vein numbers per unit leaf area, a high ratio of minor to major veins and low mean interveinal widths. Allowance for these characters in cane breeding is therefore advocated.

CoJ 64 – a promising early maturing high-sugar variety for north India. R. S. Kanwar. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.145-Ag.150. – Details are given of the title variety, which is grown on 50% of the total cane area of the Punjab and has been released for cultivation in a number of other states.

Advancement of new basic sugar cane breeding lines. P. H. Dunckelman. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 33-36. – Attempts are being made at the U.S. Sugarcane Field Laboratory at Houma, Louisiana, to advance new breeding lines suitable for the selection of superior breeding stocks and/or commercial varieties. During 1978, 114 biparental crosses were made with the aim of combining the economic features of the commercial breeding stocks with the hardiness and disease and pest resistance of wild canes and related genera. Over 440,000 viable true seeds were produced, of which 226,000 came from a line *(Saccharum spontaneum* L. US 56-15-8) that is already producing canes having commercial potential. Details of the breeding lines are tabulated and discussed.

Genetic behaviour of sucrose content in the parents and progeny of eight bi-parental sugar cane crosses. C. A. Richard and M. T. Henderson. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 68-71. – The sugar content of 100 clones from each of eight crosses as well as their parents was measured several times during 1971-74. Significant differences were found between the contents of the two parents for six of the crosses. Values for progeny confirmed that sugar content is a quantitative character, since there was a large number of continuously distributed classes around the sugar content of the parents of each cross. However, unlike typical quantitative characters, the progenies of the crosses did not fit a normal curve, and the modal class was below the average content of the two parents of each cross. An epistatic effect probably caused genes for low sugar content to express themselves among the segregates of all crosses. On average, 25% of the progeny occurred outside the range of values of the parents, indicating transgressive segregation; of this 25%, only 2% occurred above the parent of high sugar content. Crosses having one or both parents of high sugar content produced the largest frequencies of high-sugar clones. These results indicate that selection for high sugar should begin at as early a selection stage as possible in order to reduce the frequency of low-sugar clones in later stages.

De-fuzzing sugar cane spikelets with a sample seed scarifier. R. D. Breaux. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 47-50. – See *I.S.J.,* 1981, **83,** 371.

Fibre content of Louisiana sugar cane varieties using the cutter-grinder-press method of cane analysis. C. A. Richard. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 100-103. – Varietal fibre content determined by the press method of cane analysis was compared with that determined by a conventional method. Good agreement was found between the methods applied to commercially grown varieties (r = 0.87). Increasing fibre levels were found in several recent series of selections. Use of data from the press method alone revealed a strong association between fibre content in different years as well as associations between individual replications in any one year and the average fibre content in two years. These results confirmed that selection for fibre content on the basis of the press method was relatively easy and accurate, and that screening for unacceptable fibre content might be accomplished at an early selection stage.

Maturity studies of commercial sugar cane varieties in Louisiana. B. L. Legendre. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 105 *(abstract only).* – The relative maturity of nine cane varieties was compared over five years (1974-78) in 1st ratoon crops at the U.S. Sugar Cane Field Laboratory, Houma, Louisiana. The study revealed important varietal differences in the normal juice sucrose (NJS) and purity (NJP) during the harvest period, which usually begins in October and ends in December. The early maturing, high-sucrose varieties, such as L 60-25 and, to a lesser extent, L 62-96 and L 65-69, reached standard NJS (12%) and NJP (76%) by October 15; thereafter, NJS and NJP increased slowly. Other varieties, like CP 65-357, the most important commercial variety in the state, and CP 48-103, approached standard NJS and NJP by mid-October, but continued to accumulate sucrose and mature throughout the harvest period. Usually, CP 65-357 surpassed all varieties in NJS and NJP by December 1. The late-maturing varieties CP 52068, CP 61-37, CP 67-412 and N:Co 310 had very low levels of sucrose early in the harvest season and generally did not exceed standard NJS and NJP until mid-November. The pattern of ripening in these different varieties appeared to be fairly constant, despite large variations in temperature and rainfall during the harvest period of the study duration.

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SUGAR BEET AGRONOMY

This year many a field has been disappointing! What are the reasons? W. C. von Kessel. *Die Zuckerrübe,* 1981, **30,** 180-182 *(German).* — Reasons for disappointing crops and high losses in West German beet fields in 1981 are suggested, covering both short- and long-term aspects of beet growing and particularly examining the adverse effects of inclement weather, steps taken by individual farmers to counteract these, and faulty farm practices, especially concerning seedbed preparation and fertilization.

Conservational soil treatment — a possibility in sugar beet agriculture. C. Sommer and M. Zach. *Die Zuckerrübe,* 1981, **30,** 183-185 *(German).* — To prevent soil erosion in beet fields, the authors advocate use of a soil treatment system in which plant trash is used as mulch and only light harrowing applied before sowing.

Current advice on phosphate fertilization. A. Solle. *Die Zuckerrübe,* 1981, **30,** 186-187 *(German).* — Advice is given on P application, particularly to those soils classed as having adequate P availability at the start of the growing season; for these soils, the amount applied should be 1.3-1.5 times the annual extraction. Field trials over a 20-year period have shown that maintenance of the required P level increases beet yield and reduces fluctuation in the crop results about the annual mean.

Investigation of changes in sugar beet during storage. VIII. Changes in irrigated and artificially fertilized sugar beet during storage. K. Hangyal and K. Vukov. *Cukoripar,* 1981, **34,** 92-94 *(Hungarian).* — Investigations showed that sugar losses in irrigated beet were greater than in unirrigated beet stored under identical conditions; the irrigated beet retained their modulus of elasticity better while their resistance to impact was lower than in the case of the unirrigated beet. No conclusive evidence was found regarding the effect of N fertilization on storage properties. Lowest daily losses occurred with storage at +2°C in a CO_2-enriched atmosphere.

Your harvesting campaign in 1981. A. Vigoureux. *Le Betteravier,* 1981, **15,** (157), 9, 12 *(French).* — Advice, applicable not only to 1981, is given on mechanical beet harvesting. Photographs illustrate the various points made.

Beet clamps must be covered in case of risk of frost. R. Vanstallen and L. van Steyvoort. *Le Betteravier,* 1981, **15,** (157), 11 *(French).* — How to avoid frost damage to clamped beet and when to cover the clamps are briefly discussed.

Analysis of sugar beet growth with reference to plant population and sowing time. D. Analogides, T. Ouzounides and S. Spassis. *Hellenic Sugar Ind. Quarterly Bull.,* 1981, (46), 443-477 *(Greek).* — Field experiments conducted at Xanthi and Orestias are reported. At the former site, the beets were drilled on February 26, March 23 and April 16, and plant populations of 5200 and 15,400 per ha were grown; at Orestias the sowing dates were March 15, April 1 and April 29, and the plant populations were 5400 and 15,800/ha. The crop was harvested in mid-September. Results showed that the lower populations and the earliest drilling time were best in terms of root and sugar yield; yield losses associated with late drilling were not reduced by increasing the plant population. Late drilling combined with the higher population had an adverse effect on the root:total dry matter ratio and on the sucrose proportion of root dry matter. Root dry matter yield increased at the expense of sucrose accumulation with population increase to 73,000 plants/ha, while further increase to 110,000 plants/ha caused even higher total dry matter yields but at the expense of root dry matter yield.

More than ever, watch out for frost. R. Vanstallen and L. van Steyvoort. *Le Betteravier,* 1981, **15,** (158), 1,4 *(French).* — Advice is given on protection of beet clamps against frost, and recommendations are given on harvesting to provide beet that are ideal for storage in covered clamps without risk of heat generation.

Optimization of sugar beet fertilization by means of EUF soil testing. L. Wiklicky and K. Németh. *Zuckerind.,* 1981, **106,** 982-988 *(German).* — Electro-ultrafiltration (EUF) has been used for some years at the soil testing laboratory at Tulln, in Austria, to determine the fertilizer requirements of beet crops. Ultimately a system for calculation of optimum fertilization has been developed from the routine analyses, and is now used by three sugar factories to evaluate conditions for some 25,000 ha of beet area annually. Details are given of the mathematical model and of the improvements in sugar yield and beet quality brought about in the period 1965-80 as a result of following a number of recommendations.

Investigation of changes in sugar beet during storage. IX. Configuration of the activity of invertase enzyme. K. Hangyal, P. Meresz and R. Lasztity. *Cukoripar,* 1981, **34,** 126-130 *(Hungarian).* — The effect of mineral fertilization, irrigation and variety on invertase activity in beet is discussed on the basis of investigations, and the application of changes in its activity during storage to establishment of optimum field practices, storage time and variety evaluated.

Soil treatment and basal fertilization in sugar beet cultivation. G. Clotan and S. Markus. *Prod. Veg., Cereale si Plante Tehn.,* 1981, **33,** (9), 24-30 *(Rumanian).* Various summer and autumn soil treatments and fertilizer combinations were tested at Brasov. Highest root yield was given by ploughing to a depth of 15 cm in the summer and to a depth of 25 cm in the autumn, while application of 40 tonnes.ha^{-1} farmyard manure plus 100 kg.ha^{-1} of both N and P gave both the highest root yield and the highest sugar yield by comparison with 50 kg.ha^{-1} of N and P with 20 tonnes.ha^{-1} or no farmyard manure, or farmyard manure without N and P.

Method of phosphorus fertilization for sugar beets in the Red River Valley. J. T. Moraghan and J. D. Etchevers. *J. Amer. Soc. Sugar Beet Tech.,* 1981, **21,** 103-111. Field experiments at four sites are reported in which banded application of triple superphosphate at 11 kg.ha^{-1} P had significant effect on root and sugar yield only where the available P in the soil was very low at 4 ppm, whereas there was only slight effect at a soil P

availability of 10 ppm and an adverse one at 12 ppm available P. Banded application was as effective as or better than broadcast application of up to 45 kg.ha^{-1} P. In no case did fertilization affect sucrose content or impurity index. Acetic acid-extractable phosphate-P in the beets decreased during the growing season; values below 750 ppm P (the reported critical value for P[1]) were found at all sites during part of the season.

Post-emergence weed control with combinations of herbicides in different sugar beet planting periods. L. M. Burtch and B. B. Fischer. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 112-129. – Two-year trials in the Central Valley of California are reported. Most effective against annual grasses were Poast and RO-13-8895, either on their own (at 1 lb.acre^{-1} a.i.) or with 0.65 lb.acre^{-1} a.i. Betanal or Betanex; because of their ability to control barnyard grass when beyond its seedling stage, Poast and RO-13-8895 are preferably applied after Betanal or Betanex. Dowpon, Hoelon and Nortron failed to control annual grasses. KK80 was almost as effective as Poast and RO-13-8895, while HOE 29152 was the least effective of all the post-emergence herbicides tested. The question of time of application relative to crop injury is discussed; crop injury was intensified during periods of high temperatures.

Effect of Nitrapyrin on uptake of nitrogen by sugar beet from labelled ammonium sulphate. F. J. Hills, A. Abshahi, F. E. Broadbent and G. A. Peterson. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 150-158. – The effect of Nitrapyrin [2-chloro-6-(trichloromethyl)pyridine], a nitrification inhibitor, on N uptake by beet was determined by measuring the fertilizer N concentrations in the petioles as well as the response of the beets to N, with and without Nitrapyrin application, in terms of yields, sucrose concentration, total N uptake and crop N. While fertilization increased petiole NH_4, Nitrapyrin reduced the amount of increase; on the other hand, Nitrapyrin caused an increase in root yield and a slight fall in sucrose content, although dry matter and sugar yields were little affected. There was almost no difference in the proportion of total beet N supplied by fertilizer and soil in the presence and absence of Nitrapyrin.

Prospects for improving plant establishment. M. Durrant and K. Scott. *British Sugar Beet Rev.*, 1981, **49**, (4), 25-29. – Studies aimed at improving establishment of beet plants and at accelerating the early growth of the crop are being carried out in several European countries, and the results of many such projects were discussed at the 1981 Winter Congress of the Institut International de Recherches Betteravières (IIRB). Information given at the Congress is reviewed and comparisons are made with observations and experiences in England. The main topics were: cultivation and seedbed preparation, drills and drilling, possible means of improving protection against pests and diseases, and seed crop husbandry, seed processing and treatment. It is concluded that the chances are slight of finding a novel but practical method of seedbed preparation or drilling that would guarantee a sufficiently favourable environment for at least 70% of seeds sown to grow into vigorous, healthy plants; nor will it be possible to ensure that all seeds in commercial blends will grow satisfactorily, irrespective of seedbed conditions and weather. Hence, there is still need to look for improvements by making the seedbed marginally less hostile and the seed somewhat more tolerant of prevailing conditions. Moreover, growers must appreciate the results of choosing to make the seedbed conditions worse than they need be, e.g. by applying more fertilizer or herbicide than recommended, and of ignoring advice on maintenance and use of drills. However, despite adverse seedbed and weather conditions in 1980 and 1981, establishment reached the target 70% in more fields in England than in any year during the previous decade.

Seed quality and Central Laboratory. D. Hibbert and W. Woodwark. *British Sugar Beet Rev.*, 1981, **49**, (4), 37-38. – Details are given of the procedures used at the Central Laboratory of British Sugar plc to analyse beet seed for a range of quality factors, including moisture, seed unit size (sieving test), purity, impurity content in the form of other crop seeds and weed seeds, seed units per kg and germination. Particular details are given of germination and monogermity assessment of both pelleted and unpelleted seed.

Sugar from sewage. D. Bone, R. Loveridge and B. Winfield. *British Sugar Beet Rev.*, 1981, **49**, (4), 42-44. – The use of sewage effluent in hydroponic culture systems, in which the solution is allowed to flow as a thin film down gently graded channels and supply required nutrients to plants via the roots immersed in the solution, has been investigated in the case of sugar beet. Details are given of the studies, which have shown that the foliage of the beets was more extensive and of a deeper green than for typical field-grown plants, while root size was about the same as for conventional beets and the average sugar content lower at 14.5% compared with 17.6%. Advantages and disadvantages of the system are indicated.

Cultivations for sugar beet. Anon. *British Sugar Beet Rev.*, 1981, **49**, (4), 48. – Investigations have shown that the rate of work of primary cultivation on heavy land can be increased by up to 100% by using a rotary digger instead of a plough; the digger gives a more even finish and permits a reduction in the number of spring cultivations, but is not a suitable alternative on light soil. Tandem operation of a secondary cultivator and precision drill is not satisfactory on heavy soil but could improve the work rate and enhance moisture conditions at sowing on light soil provided the drill was tractor-mounted.

Nitrogen for irrigated sandland beet. W. Cormack. *British Sugar Beet Rev.*, 1981, **49**, (4), 63-64, 66. – Irrigation x nitrogen tests in 1979 and 1980 are reported, in which it was found that irrigation did not increase the nitrogen requirement of the beet, that 125 kg.ha^{-1} N was the optimum dosage for sugar yield, with or without irrigation, in 1979 while 165 kg.ha^{-1} was the optimum in 1980 (attributed in part to leaching losses during a very wet late May/June before root systems were fully developed). There was no advantage of split application over single application. Yield differences between various times and methods of N application could be related to differences in rainfall distribution during the period from seedbed preparation until June.

Rate and timing of nitrogen on organic soils. R. Madge. *British Sugar Beet Rev.*, 1981, **49**, (4), 66-67. – Nitrogen trials on peat soils showed that 65 kg.ha^{-1} was better than 95 or 125 kg.ha^{-1} N as regards plant population, sugar content and root and sugar yields. Application of the N to the seedbed immediately after drilling was better than application at plant emergence.

[1] Ulrich *et al.*: *Cal. Agr. Expt. Sta. Bull.*, 1959, (766).

CANE SUGAR MANUFACTURE

Possibilities of Indian sugar factories co-generating electric power as in Hawaii. P. J. M. Rao. *Maharashtra Sugar,* 1981, **6,** (10), 9, 11-13, 15-19. – The author examines the possibility of Indian sugar factories generating surplus power for sale to the public grid. Major obstacles are stated to be the low demand in rural areas, the shorter crushing season in India by comparison with Hawaii, and the need to install boilers of higher pressure to replace equipment installed some 50 years ago.

Steam economy measures in sugar manufacture. D. P. Kulkarni. *Maharashtra Sugar,* 1981, **6,** (10), 21, 23-25, 27-30, 34. – Causes of increased steam consumption in sugar factories are discussed and means of reducing it are described.

Instrumentation in the sugar industry. D. P. Kulkarni. *Maharashtra Sugar,* 1981, **6,** (11), 9, 11, 13-14. – Instrumentation and automatic control in the sugar factory are discussed, and the stations for which automatic control is considered desirable are listed. Maintenance of instruments and training in their use are also considered.

The practical development and application of saccharate liming at the Pongola sugar mill. S. North-Coombes, K. Taylor and K. C. Koster. *S. African Sugar J.,* 1981, **65,** 372-373, 375. – See *I.S.J.,* 1982, **84,** 281.

The Florida raw sugar industry. General description. F. D. Yancey. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 266-270. – The history and current state of the Florida cane sugar industry are briefly recounted.

The Florida raw sugar industry. Processing. P. A. Carreño. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 276-281. – A general description is given of the processes used in Florida sugar factories.

The Florida raw sugar industry. Sugar marketing. F. R. Hill. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 287-292. – Marketing of cane raw sugar produced in Florida factories is described, and details are given of the Palm Beach terminal through which most of the sugar shipments are made.

Some microprocessor control applications in the Australian sugar industry. P. G. Wright. *Chem. Eng. in Australia,* 1979, **ChE4,** (3), 30-31, 33-34; through *S.I.A.,* 1981, **43,** Abs. 81-1434. – Cane sugar factory applications of microprocessors are described with diagrams: remote control of locomotives at Bingera factory, using their own 24 V D.C. power supply; pan control during normal operation, turn-around (i.e. discharge and restart) and cutover (of footing from other pans); and photometric measurement of the saturation temperature of molasses or syrups. The hardware of the proposed system for pan control should cost less than a third as much as a fully engineered microprocessor-based system such as the Fischer & Porter DCI-4000.

Stord presses for bagasse. Anon. *Stord Bartz Rev. 81,* 1981, **7,** 17. – A brief description is given of a prototype BS-41KB twin-scroll press designed to increase the solids content of bagasse from a diffuser to 50% and thus enhance its fuel properties. The press, of 250 tcd rated throughput, is being tested at the Moshi (Tanzania) factory of TPC Ltd. and is intended for trials in mini-plants as opposed to large-scale sugar factories.

Performances modified. P. K. More. *Indian Sugar,* 1981, **31,** 249-263. – See More: *I.S.J.,* 1982, **84,** 80.

Autolab: a progress report. S. King, E. P. East and M. Winship. *Sugar J.,* 1981, **44,** (5), 10-14. – See *I.S.J.,* 1982, **84,** 281.

Influence of the physical quality of sugar cane on the production cost of sugar. G. S. C. Rao, V. M. Murugkar and S. N. Bableshwar. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.25-A.34. – An effort is made to quantify the losses involved in crushing cane of high trash content. Observations during a 20-day period, in which leaf trash and tops were determined as two-hourly composite samples, mixed juice analysed for Brix and pol, and bagasse for pol and fibre content, showed that production costs rose by Rs.45.44 per ton of sugar for every 1% leaf trash introduced and by Rs.25.43 for every 1% tops. However, since farmers in India are paid for their cane on a weight basis, they tend to top high.

Quantification of iron dissolved during process from evaporators with brass and steel tubes. I. B. Adarakatti, G. Chakrapani and V. R. Nerli. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.1-M.7. Estimates were made of the extent of corrosion of brass tubes in a quadruple-effect evaporator and of steel tubes in a triple-effect evaporator; results showed that the steel tubes suffered much greater corrosion than the brass tubes.

Effect of TDS (total dissolved solids) on the performance of boilers and turbines. A comparative study of season 1977-78 and season 1978-79. D. S. Kewal, B. D. Bharne and P. S. Bang. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.8-M.14. – Details are given of stoppages and accidents occurring with turbines and boilers as a result of scale formation during 1977-78. Action based on the findings ensured that none of the problems arose in the following season. Regular checking of boiler feedwater for TDS and its treatment, if necessary, are recommended.

Higher operating efficiency with an improved three-boiling system. K. N. Kanawade and M. N. Kotasthane. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.15-M.18. – Modification of a 3-boiling scheme whereby B light molasses was recycled to the syrup sulphitation tank instead of going to the B massecuite pan gave the advantage of increased A massecuite and reduced B massecuite as well as a slightly increased massecuite throughput.

A short note on exhaustion of final molasses. R. K. Kulkarni, V. R. Kaledhonkar, S. N. Gajre and S. P. Kulkarni. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.19-M.24. – A higher purity

of final molasses in 1980-81 than in previous seasons was related to a lower purity drop in low-grade massecuite treatment, a reduction in the glucose:ash ratio and a C sugar of too fine a grain. Addition of condensate as movement water during building-up of grain in the C pan gave a hard grain of adequate size and improved molasses exhaustion.

Performances modified. P. K. More. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.25-M.40. – See More: *I.S.J.,* 1980, **84,** 80.

Reduced mill extraction. New concepts. P. K. More. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), M.41-M.48. – See *I.S.J.,* 1980, **82,** 253.

Sugar factory maintenance. J. S. Huja. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.1-E.12. – Planned maintenance of sugar factory equipment is discussed, and an example presented of a factory in which proper maintenance reduced total stoppages from 23.12% of available hours in 1950-51 to 3.56% in 1970-71.

Cane equalizer-kicker-chopper. T. M. Karne. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.13-E.22. – Details are given of a system developed by the author which acts as a combined knife set, leveller and kicker. Its advantages include ease of fabrication (for which a factory workshop is sufficient) and simplicity of operation.

Performance of a Wal-Konti 10DC (centrifugal) at Walchandnagar Industries Ltd. M. G. Joshi, H. R. Apte and P. B. Londhe. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.23-E.36. – The construction and performance of the Wal-Konti 10DC continuous centrifugal are described.

Performance of (an) experimental vertical stationary bagasse dryer. Anon. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.37-E.50. – A bagasse dryer is described in which the wet bagasse falls under gravity against an upward stream of boiler flue gas. Results of trials indicated a typical 2-3% reduction in moisture content from an initial content of 50%.

Some current and future trends in electronic process control instrumentation and control systems for the sugar industry. G. N. Acharya. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.51-E.78. – A survey is presented of various electronic control and measuring systems used in the cane sugar factory, with a general note on possible future trends.

An assessment of milling-cum-diffusion performance. P. T. Dalal and P. V. L. Narasimham. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), E.79-E.90. – The performance of a Saturne diffuser used in combination with cane mills is assessed, and its advantages and disadvantages are listed. Results obtained over a 5-year period are compared with those achieved at other factories in the area using only cane mills.

Development of a micro-processor cane tracker for use in South African sugar factories. E. P. East. *S. African Sugar J.,* 1981, **65,** 493, 495-496. – See *I.S.J.,* 1982, **84,** 280.

The working of a fiberizer in Vellore and Dharmapuri coop. sugar mills in Tamil Nadu. A. P. Chinnaswamy *et al. Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.1-E.21. – The role of the fiberizer in cane preparation is discussed and the performances of installations at the title factories are reported; the data indicate advantages of the fiberizer over a shredder at about the same power consumption.

Pre-charging of mill hydraulic accumulators. G. K. Chetty. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.23-E.28. Two methods of pre-charging hydraulic accumulators are described, one involving the use of a spare cylinder, the other involving filling direct from a nitrogen cylinder.

Use of screw pumps in the sugar industry. O. P. Tripathi. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.33-E.43. – The salient features of the screw pump are described and its use for transferring molasses, syrup, juice, condensate, etc. demonstrated by performance data from a number of factories. These show its advantages over other types of pump.

Device for achieving efficient maceration. G. K. Chetty. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.45-E.47. – A simple means of increasing imbibition is described which turns the bagasse mat over as it leaves the discharge roller of the mill and simultaneously applies the requisite water and/or juice. A hood over the device prevents occlusion of air by the bagasse particles.

Development of a transient heater for heating of low-grade massecuite. N. N. Joshi and R. Kumar. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.49-E.58. After some modification, the transient heater at the authors' factory[1] was tested on low-grade massecuite and raised the average temperature from 45.05°C to 55.95°C at a throughput of 6 tonnes.hr^{-1} and a retention of about 5 minutes. Molasses purity rose by only 0.5 from 32.7, while the throughput of the continuous centrifugal was substantially increased.

Fatigue in the mill roller shaft. R. B. L. Mathur. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.65-E.70. – Major factors inducing fatigue and subsequent failure in cane mill roller shafts are outlined and a number of examples cited together with causes and suggested remedial measures.

Imbibition distribution tank. G. K. Chetty. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.79-E.82. A description is given of an imbibition juice tank and distribution system.

Cane preparation is the heart of milling. S. D. Tanksale. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.83-E.94. – The importance of good cane preparation for milling is discussed and results obtained at various factories using a Sumac fiberizer are reported and compared with the performances of other means of preparation.

Bagasse drying – some considerations. A. K. Ray and N. P. Shukla. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, E.95-E.100. – Advantages and disadvantages of bagasse drying by means of flue gas are discussed.

[1] See *I.S.J.,* 1982, **84,** 116.

BEET SUGAR MANUFACTURE

Experience in reception and storage of sugar beet at Gubinikha sugar factory. E. D. Rylik *et al. Sakhar. Prom.*, 1981, (9), 17-19 *(Russian).* — Details are given of the system used at this Ukrainian sugar factory for reception, pre-treatment, storage and protection of beets. Forced ventilation reduced daily sugar losses by 60% by comparison with standard values set for unventilated piles, while spraying with a 1% solution of the sodium salt of maleic hydrazide reduced them by 20%.

Recommended for installation. N. S. Karpovich, B. A. Melent'ev and V. G. Abel'yants. *Sakhar. Prom.*, 1981, (9), 20-22 *(Russian).* — A description is given of a drum washer having specially profiled blades fixed to the inside of the drum in diagonal rows. Results of trials showed that the beets suffered no damage in their passage through the drum.

An improved scheme for raw juice purification at Georgiu-Dezhskii sugar factory. A. R. Sapronov. V. M. Fursov, V. A. Golybin and V. P. Yan'shin. *Sakhar. Prom.*, 1981, (9), 23-25 *(Russian).* — Details are given of a juice purification station installed at the title factory in 1980, which allows variation in the treatment of juice according to its quality.

The effect of 1st carbonatation mud recycling on non-sugars removal under preliming conditions. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Sakhar. Prom.*, 1981, (9), 25-28 *(Russian).* — In investigations of mud recycling to preliming, maximum non-sugars removal from poor-quality juice was achieved when a total of 2.5% CaO was added in purification and 75-100% of the carbonatation mud returned to the point in the preliming trough at which juice pH was 8-9. For normal-quality juice it was found desirable to add the mud to the raw juice at its natural pH and certainly not above pH 9.

Faults in operation of Cukroprojekt settlers and their remedy. I. G. Chugunov, K. P. Goncharova and M. A. Ryzhikov. *Sakhar. Prom.*, 1981, (9), 28-31 *(Russian).* — Design faults are blamed for the poor performance of a six-tray Cukroprojekt clarifier of Polish manufacture, whereby juice clarity gradually fell until its flow ceased altogether. Various aspects of the design are examined, and modifications are described which led to considerable improvement in performance. Of major importance was isolation of each tray from the others — lack of this in the original design caused mud to overflow into the tray below.

Undetermined sugar losses caused by the activity of micro-organisms in beet sugar manufacture. G. F. Tyazhelova. *Sakhar. Prom.*, 1981, (9), 42-44 *(Russian).* The effects of groups of micro-organisms on losses in diffusion and other processes, conditions favouring their development and activity, sources of infection within the factory and means of bacteriological control, particularly the use of formalin in diffusion, are discussed with references to the literature.

Extension of the three-product scheme for white sugar manufacture — use of raw sugar massecuite as footing for subsequent stages. K. W. R. Schoenrock. *Zuckerind.*, 1981, **106**, 885-889 *(German).* — While efforts have been made in recent years to increase white sugar yield by reducing molasses purity in the USA, limits have been reached with the 3-boiling scheme normally used, while a 4-boiling scheme would lead to poor crystal formation and very prolonged boiling because of the low purity of the syrups in the fourth strike. A system is proposed in which a high raw *B*-massecuite is used as footing together with its own green run-off syrup for an intermediate strike, this procedure being repeated for a low raw strike if desired. The size of the crystals in the intermediate strike was almost doubled in tests, while it was nearly trebled in the low raw strike by comparison with conventional boiling. The larger crystal surface at the beginning of a strike resulted in a higher crystallization rate, so that boiling time was reduced; the high purity of the intermediate raw and low raw sugar permitted melting in thick juice without need of affination.

The reliability of batch centrifugal baskets in the sugar industry. II. H. K. Maushagen and G. Schneider. *Zuckerind.*, 1981, **106**, 904-907 *(German).* — Official standard specifications for centrifugal baskets are discussed and found to be wanting in a number of aspects. As a demonstration of this, the authors compare the life expectancy of baskets based on theoretical design for creep rupture strength with the calculated life of a basket subject to corrosion. Criticism is also made of official testing instructions; those for pressure tanks are described by way of comparison. Because of the uncertainties engendered by the gaps in the official standards, the authors stress the need for regular testing of centrifugal baskets using non-destructive techniques.

The UK view of the future energy scene. B. Hutchinson. *Sucre. Belge*, 1981, **100**, 292-301. — See *I.S.J.*, 1981, **83**, 342.

Big production gains for sugar centrifuges. J. M. Dixon. *Food Eng. Int.*, 1981, **6**, (5), 55-57; through *S.I.A.*, 1981, **43**, Abs. 81-1384. — AEG Telefunken, of West Germany, have developed servo-controlled D.C. drives for batch centrifugals, with a freely programmable unit. They are stated to increased throughput by 3 charges/hr to 20/hr, and to decrease power consumption by about 50%. When installed on a 1500-kg Selwig & Lange centrifugal used for 2nd raw sugar at Lehrter Zucker AG, they improved sugar quality as well as throughput.

Treatment of waste waters containing protein and carbohydrates using activated cellulose and lignite. A. Hersiczky. *Acta Alimentaria*, 1980, **9**, (3), 237-249; through *S.I.A.*, 1981, **43**, Abs. 81-1467. — Samples tested included flume water from Matra beet sugar factory and a model solution representing beet sugar factory effluent. The polyelectrolytes Combifloc and Praestol B-714 decreased the COD from 770 to 550-565 mg.litre^{-1}. Inorganic coagulants were effective, as measured by the precipitation of cations in the upper phase. $Al_2(SO_4)_3$ gave the best results, and $Fe_2(SO_4)_3$ and $CaCl_2$ were also good; the effects varied with pH in the range 8-11.

The beet sugar industry. Anon. *Stord Bartz Rev. 81,* 1981, **7,** 1-6. – An outline is presented of beet agriculture and processing, and the part played by Stord pulp presses.

Rotary beet diffusers. Past, present and future. G. V. Genie. *Sucr. Franç.,* 1981, **122,** 411-416 *(French).* – The history of the development of the rotary beet diffuser is recounted and the advantages and disadvantages of the RT4 diffuser are discussed. Details are then given of a new design in which the screen is formed like a letter G[1].

Gases from flume-wash water and an incident involving their ignition at a sugar factory. S. Kabat. *Gaz. Cukr.,* 1981, **89,** 84-87 *(Polish).* – Mention is made of a case in which, on the 68th day of the 1979/80 campaign, the spark from an oxyacetylene burner ignited methane formed by bacterial action in the flume-wash water at the treatment plant outside a sugar factory; increase in microbial activity was attributed to the processing of thawed and infected beet. Means of preventing a recurrence of such an accident are described.

Juice purification using a settler with a filtration layer of mud for 2nd carbonatation juice. A. V. Shmygol', B. N. Moskalev and E. Ya. Goisman. *Sakhar. Prom.,* 1981, (10), 23-26 *(Russian).* – At Novoukrainka factory, six disc filters used to handle 2nd carbonatation juice are unable to effect uniformity in the density of cake (sweetened-off with 2nd carbonatation juice). However, required density is obtained by recycling the mud to the 2nd carbonatation bottom-feed rapid clarifier and treating it together with juice. The clarifier mud is recycled to progressive preliming. Replacement of three of the disc filters with the clarifier has brought a number of benefits, including reduction in lime, filter cloth and electricity consumption and in molasses sugar.

The formation of bicarbonate ions at elevated temperatures. V. S. Shterman, I. Shakhovtseva and A. R. Sapronov. *Sakhar. Prom.,* 1981, (10), 26-28 *(Russian).* It is shown, on the basis of experimental investigations, that, contrary to the belief in some quarters, 2nd carbonatation at the boiling point of the juice will increase the bicarbonate ion content rather than reduce it, so that is is better to maintain the temperature at 85-90°C.

The effect of beet freezing on its storage and processing. V. A. Knyazev. *Sakhar. Prom.,* 1981, (10), 40-42 *(Russian).* When frozen beets are piled, there is always risk that, despite low ambient temperatures, the temperature inside the pile will rise sufficiently to cause thawing and subsequent deterioration, eventually leading to problems in processing and increased losses. If harvesting starts sufficiently early to avoid the onset of severe frosts (which occur in the second half of October in the USSR), the beets will not have attained full commercial ripeness; on the other hand, if harvesting is delayed to take advantage of maximum weight and sugar content, frosts could offset any initial gain.

Orientation and dimensions of sugar beet piles in connexion with radiation heat exchange between their surfaces and the surrounding air. V. A. Knyazev, N. I. Kalinichenko and V. I. Shelul'ko. *Sakhar. Prom.,* 1981, (10), 43-45 *(Russian).* – The protection of beet piles from excessive heat caused by solar radiation is discussed. Apart from periodical spraying of the pile with water, there is the longer-term approach of positioning the pile relative to the east-west and north-south coordinates so that the intensity of the sun's heat is minimized, and reducing the top surface of the prismatic pile.

The Sh1-PAZh automatic line for determining the sugar content in pulp. A. Ya. Zagorul'ko and A. A. Lyashenko. *Sakhar. Prom.,* 1981, (10), 45-47 *(Russian).* – A description is given of an automatic unit for determination (within a maximum time of 6 min) of sugar in beet pulp by pressing it and clarifying the pressed juice with CaO and aluminium sulphate, followed by filtration and polarimetry. On the basis of the information, which is fed almost continuously to the diffusion station, decisions can be taken on measures to restrict undetermined losses in the diffuser.

More economical pulp pressing in future. Development trends in regard to mechanical and technological measures. P. Mathismoen. *Zuckerind.,* 1981, **106,** 965-968, 980-981 *(German).* – Various aspects of beet pulp pressing are discussed, including the effect of scroll profile, rotary speed and pulp throughput, feed and discharge conditions (with mention of possible modifications to the press design in order to give maximum water separation), economics and future developments. Tests at Tulln factory are reported, in which pulp from the first of two presses was held for 30 min in a hopper before being mixed with freshly treated pulp from the same press; this mixture was then pressed in a second, smaller press, giving an increase in dry solids from 22.5% with only one press to 32.5% at the same rotary speed. Further experiments, involving addition of chemicals between the two pressing stages, gave typical dry solids contents of 35%, with 40% being achieved in isolated cases; yet higher contents are thought possible. Additives that have been tested for their effect in increasing pulp pressability include calcium bisulphite (the most successful), calcium chloride and aluminium sulphate; phosphates have given excellent results but are very costly, while enzymes have failed to come up to expectation. The possibility of using a waste heat evaporator in conjunction with presses and dryers, as with fish meal and lucerne, is briefly mentioned.

A second pressing – construction and process. S. Matusch. *Zuckerind.,* 1981, **106,** 975-978, 980-981 *(German).* Various designs of multi-stage presses are briefly described, and details then given of a prototype press manufactured by Selwig & Lange GmbH in which the two horizontal shafts (one above the other) are each divided into alternate sections of scroll and scroll-less "pressure impulse zones"; tests in which the press was used for treatment of already pressed pulp showed that it increased the dry solids content by 4% (absolute) without additive, and by 7% with $CaCl_2$ as additive. The average energy consumption for the second pressing was about 180 kJ/kg of water.

Settling with the use of aids. L. Haraszti and M. Tomordi. *Cukoripar,* 1981, **34,** 153-160 *(Hungarian).* – The use of AP-30, AP-210 and AP-273 flocculants as aids in the treatment of flume-wash water was tested at a number of factories. While best results were given by AP-273, almost the same results were given by AP-30 but at lower dosage rates.

[1] See Genie: *I.S.J.,* 1981, **83,** 231-234.

LABORATORY STUDIES

Biostatistics of BOD measurements. J. P. Sullivan. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 1-26. – After a general discussion of physical and chemical phenomena observed in natural water systems, including the types and distribution of contaminants, the author examines the specific case of the New York Bight (part of the coastal area extending from Cape Cod to Cape Hatteras) and its contaminant redistribution. Some of the statistics of BOD measurements carried out at the Brooklyn sugar refinery of Revere Sugar Corporation located at the apex of this bight are reviewed, and the fate of sucrose in the marine environment is discussed. Neither sucrose nor any of its by-products have been reported to persist in natural water systems. However, measurement of the BOD of an environment subject to continual redistribution of large quantities of contaminants depends on accurate sizing of samples of intake and discharge water; but, because of the variability in substrate and test procedure, and because permits to discharge water require that an arithmetic mean be calculated from elements of a log-normal distribution, BOD data for sucrose and related chemical substances at the refinery are highly inaccurate.

Identification of biota in a natural water system by photomicrography. N. Anastasakos. *Proc. 40th Meeting Sugar Ind. Technol.,* 1981, 26-31. – The inital findings of a program to collect and identify samples of the biological communities inhabiting the ecosystem adjacent to the Brooklyn refinery of Revere Sugar Corporation are summarized, and details given of the equipment and procedures used in photomicrography which was the main technique used to identify and classify the samples.

Preparation of liquid invert sugar by acid hydrolysis. J. C. Fandialan and R. B. Aldaba. *Crystallizer,* 1981, **4,** (3), 12-13. – A brief outline is given of laboratory-scale sucrose hydrolysis using various acids.

Enzymatic browning in cane juice. P. O. Jimenez and R. L. Samaniego. *Crystallizer,* 1981, **4,** (3), 10-11, 17-19; (4), 13-16. – A review is presented of research into cane juice browning by enzymatic processes and means of preventing such colour formation.

Effect of frost on beet: revelation of modifications in sucrose distribution and membrane properties in the cells of the root. H. Barbier and F. Nalin. *Sucr. Franç.,* 1981, **122,** 399-404 *(French).* – Beet samples were exposed to a temperature of $-5^{\circ}C$ for 64 hours in an investigation of the effect of sub-zero temperatures on sucrose retention and the properties of the vacuolar membrane. Frozen root samples were sliced into 1.6 mm thick discs which were immersed in distilled water for 2 hours. Results, given mainly in graph form, showed that freezing caused a rapid and total loss of sucrose, whereas an unfrozen control retained 85% of its initial sucrose, content by the end of the experiment. However, thawing at $+4^{\circ}C$ increased sucrose retention, the moreso as the thawing time was increased; after 96 hours' thawing, retention was almost the same as in the control. Freezing also seemed to cause a weakening of the cells and vacuoles, which burst when vacuolar suspensions were being prepared from the roots and resulted in a drop in yield of the preparation by comparison with the control; this effect and a fall in the potential difference (pd) across the membrane as a result of freezing proved to be reversible, so that thawing at $+4^{\circ}C$ for 96 hours gave the same values as with the control, thus explaining why a severe frost at the beginning of November 1980 had little effect on the processing of beets stored in the open. The use of sorbitol as a buffering agent at varying concentrations showed that frozen vacuoles are more sensitive to variations in osmotic pressure and suffer a fall in resistance to osmotic shock.

A laboratory apparatus for vacuum extraction. S. Zagrodzki and H. Zaorska. *Gaz. Cukr.,* 1981, **89,** 73-75 *(Polish).* – A laboratory diffuser is described in which extraction of juice from a 1-kg cossette load in a steam-jacketed vessel is controlled on the basis of continuous measurement of the raw juice conductivity. Experimental results have proved to be in close agreement with values obtained in full-scale diffusion.

Refractometric determination of the sugar content in beets delivered to Pustkow sugar factory. H. Zaorska, S. Zagrodzki and W. Wewiorski. *Gaz. Cukr.,* 1981, **89,** 75-78 *(Polish).* – Tests were conducted on refractometric Brix measurement of press juice from 25-kg samples of beet as a measure of beet sugar content. Close agreement was found between the sugar contents established from the Brix values and polarimeter readings (a maximum difference of ± 0.3% on weight of beet). Hence, refractometric measurement is recommended as a rapid method that is much cheaper than automatic polarimetry; the only requirements are a minimum beet sample of 20 kg and calibration of the refractometer twice in every 10 days.

Pectic compounds and their effect on polarimetric measurements. H. Gruszecka. *Gaz. Cukr.,* 1981, **89,** 78-79 *(Polish).* – The pectin content in beet brei was determined by distillation in the presence of 12% HCl to give furfural which was separated and its weight multiplied by 3.7 (Silin's factor). Results showed an average pectin content in healthy beet of 7.12% on dry solids, while the average content in aqueous acetate digestions was 0.005% (0.0253% in stale beet, or 0.012% when acetate in alcohol was used for digestion). Since pectins are dextrorotatory and have an angle of specific rotation $[\alpha]_D^{20}$ ranging from 130° to 230°, even the presence of just 0.1% pectin will cause a pol measurement error of $0.13\text{-}0.23^{\circ}S$.

Collaborative study on the determination of trace elements in dried sugar beet pulp and molasses. III. Lead. P. B. Koster, P. Raats, D. Hibbert, R. T. Phillipson, H. Schiweck and G. Steinle. *Sucr. Belge,* 1981, **100,** 333-340 *(French).* – See *I.S.J.,* 1981, **83,** 291-296.

Kinetics of nucleation in sucrose solutions. M. Traore, V. I. Tuzhilkin and A. R. Sapronov. *Sakhar. Prom.,* 1981, (10), 28-30 *(Russian).* – Laboratory evaporative crystallization in a closed circuit was used to measure a number of parameters. Electrical resistance of the

refined sugar solution used in the experiments was the most sensitive of the physical parameters measured to changes in supersaturation, followed by capacitance and then temperature depression; however, the mass crystal growth rate was determined on the basis of temperature depression and purity. Limiting supersaturation, at which crystal growth is possible only by agglomeration of fine crystals, is of importance as a means of controlling the ultimate size of crystals. Values of it were obtained, and from the findings a theory of the mechanism of crystallization postulated. Change in temperature depression brought about by rise in density and fall in purity of the mother liquor causes polythermal crystallization, so that it is necessary to reduce the limiting supersaturation of the solution.

The effect of sucrose on peptization of lime salts precipitate during raw juice liming. L. D. Bobrovnik, G. P. Voloshanenko and L. V. Khorunzhaya. *Sakhar. Prom.*, 1981, (10), 30-31 *(Russian).* — Solutions of calcium lactate, tartrate and citrate were prepared and their pH_{20} adjusted to 9.5, 11, 12 and 13 using KOH in water and in a 10% sucrose solution, respectively. A cation exchange resin in Na^+ form was added in excess and equilibrium established. The residual calcium salt was then determined as % CaO. While the ion exchanger removed nearly all of the calcium in the aqueous solutions, in the sucrose solutions the residual content rose with pH; only at pH 9.5 was the CaO content almost the same for both aqueous and sucrose solutions. Measurement of conductivity of potassium salts (corresponding to the three calcium salts above) in the presence of $CaCl_2$ was used to confirm the formation of complexes. Results showed that, at the same pH, a Ca-sucrose complex was more stable than any of the complexes formed between Ca and the K salts; the stability of the Ca-sucrose complex rose with pH_{20}, and above 11 caused peptization of lime salts precipitate from raw juice.

The behaviour of the structural elements of a plant cell in an electric field. N. S. Karpovich, I. G. Bazhal, I. S. Gulyi, L. D. Bobrovnik and M. A. Totkailo. *Sakhar. Prom.*, 1981, (10), 32-35 *(Russian).* — From the root of a beet was prepared a model, comprising a cylinder having walls of beet tissue, so that the hollow interior represented a vacuole; this was filled with pressed or diffusion juice and placed in an electric field. This caused complete decolorization of the juice, while the inner surface of the cylinder (facing the negative pole) was covered with dark grey floc composed of high molecular compounds. The effect increased with increase in the dispersion of the surface material. Field voltage, temperature and pH governed the time required to decolorize the juice.

Nucleation kinetics in supersaturated solutions — a review. V. Maurandi. *Zuckerind.*, 1981, **106**, 993-998 *(German).* — The fundamentals of nucleation as described by Ostwald's theory are explained, and the equations of Thomson and Ostwald describing the role of solubility are discussed. The importance of determining the critical radius of a crystal as a means of obtaining quantitative information on formation of stable and metastable nuclei is examined, and the reliability of kinetic equations based on Thomson's equation discussed. Factors influencing the metastable zone and the marked tendency of sucrose nuclei to assume the metastable state are considered, and Ostwald's diagram for pure sucrose solutions is shown to be applicable to boiling of refined sugar strikes because of the normally very low non-sugar content (<1%). Nucleation in raw sugar syrups is then discussed.

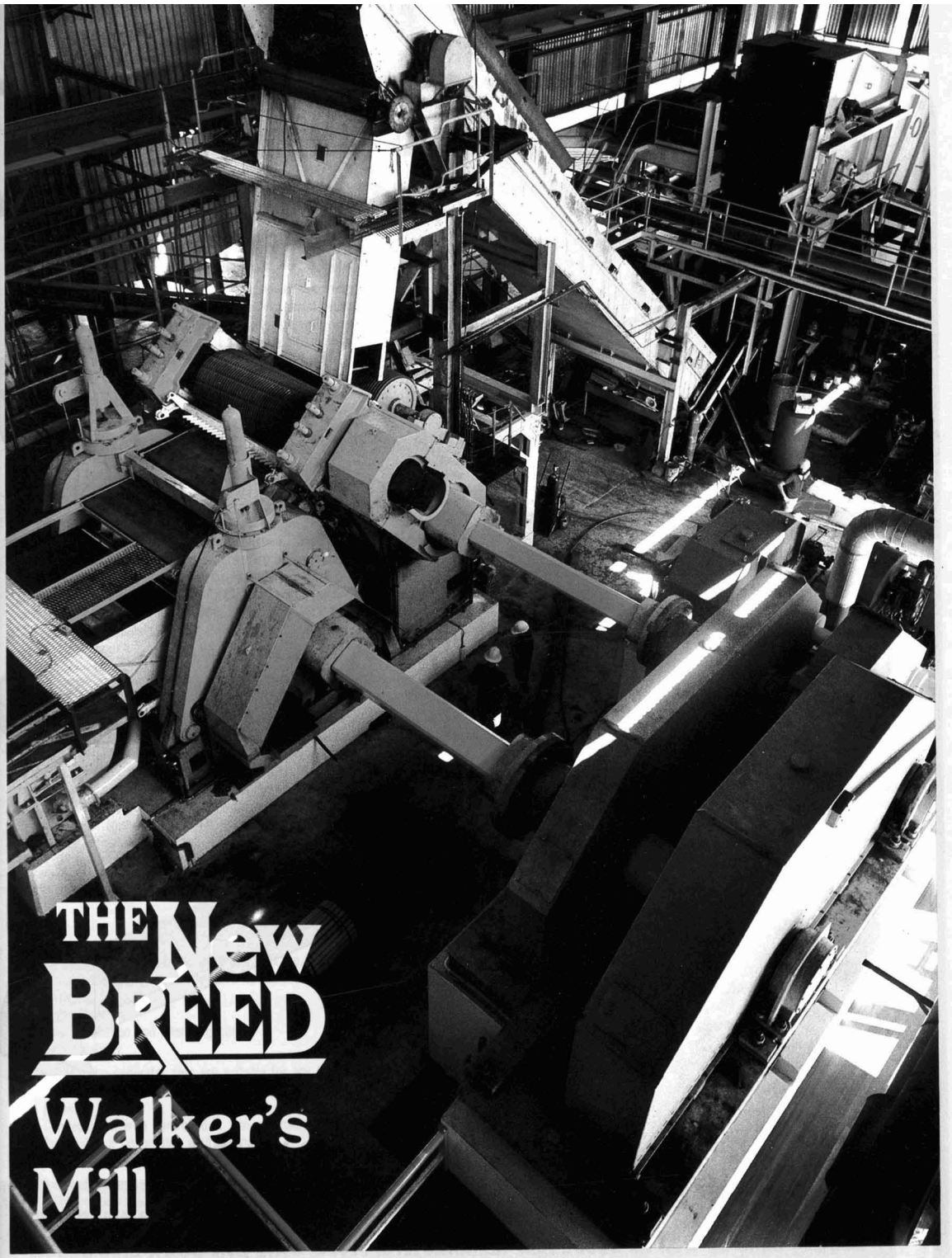
Mechanism of the Maillard reaction. F. Orsi. *Cukoripar*, 1981, **34**, 131-137 *(Hungarian).* — The mechanism of browning caused by the Maillard reaction is explained with 92 references to the literature.

The effect of sucrose on the activity coefficients of non-sugar electrolytes. V. S. Shterman, I. Shakhovtseva and A. R. Sapronov. *Sakhar. Prom.*, 1981, (11), 25-27 *(Russian).* — K^+, Ca^{++} and Cl^- ion-selective electrodes were used, with a silver chloride reference electrode, to determine the effect of varying concentrations of sucrose solution on the activity of electrolyte solutions of constant concentration. Tabulated and graphed results demonstrate the considerable influence exerted by increase in sucrose concentration, e.g. a 150-300% increase in activity coefficient in the presence of 60-65% sucrose. Such a rise is coincident with greater precipitation and scale formation.

The properties of calcium saccharates. L. D. Bobrovnik, G. P. Voloshanenko and N. V. Remeslo. *Sakhar. Prom.*, 1981, (11), 27-29 *(Russian).* — Infra-red spectrophotometry, conductimetry, cryoscopy and gel filtration were used in a study of the properties of calcium mono-, di- and tri-saccharates. Comparison was made between the optical densities of the saccharates and of the $CaCl_2$ solutions used in their preparation, and showed that greatest difference at 540 nm occurred at a sucrose: $CaCl_2$ molar ratio of 4:1. A structural formula is given for a complex of this ratio. For mono- and di-saccharate suggested formulae are: $Ca_2(C_{12}H_{20}O_{11})_2$ and $Ca_4(C_{12}H_{20}O_{11})_2$, respectively.

SO_2 determination in some sugar factory products. Application of a selective electrode. P. Devillers, J. P. Ducatillon and R. Detavernier. *Sucr. Franç.*, 1981, **122**, 439-446 *(French).* — Investigations of the use of a SO_2-selective electrode for control of sulphitation were carried out in batch and semi-continuous tests. Results showed close agreement with values obtained iodometrically for aqueous sugar solutions provided the Brix was no higher than 28.5°; otherwise the electrode method gave much higher values than the actual SO_2 contents. In the case of white sugar solution, close agreement was found between the values found with the electrode and results of determination using rosaniline, although the electrode gave slightly higher values at low concentration (particularly below 2 ppm). Where molasses is alkaline, because of its buffering capacity, 8M sulphuric acid must be added to bring the pH to a value between 0.7 and 1.2 (1 vol acid:10 vol molasses). For "total" SO_2 determination, on the other hand, alkaline pre-treatment of the molasses is needed to rupture the stable bonds between the SO_2 and aldehydes and ketones. Semi-continuous tests gave results comparable to those given by iodometry. A diagram is presented of a system for automatic SO_2 determination.

Amino-acids in beet. II. Amino-acids in sugar manufacture. R. Bretschneider, J. Copikova and P. Vratny. *Listy Cukr.*, 1981, **97**, 250-253 *(Czech).* — Quantitative analysis was conducted on the amino-acids in beet cossettes, raw juice, thin juice, pulp and molasses. Results are reported as is the balance of amino-acids during processing, particluarly glutamine and glutamic acid. The data are tabulated for the period 1972-76.



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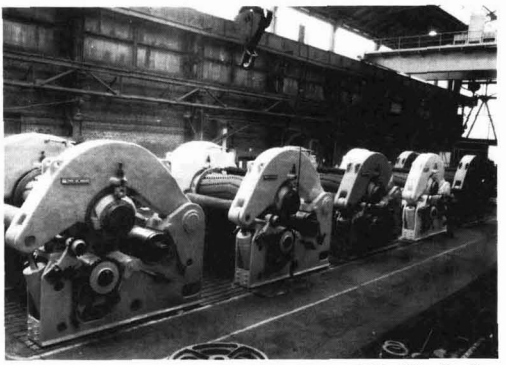

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Centrifugal station of the N'Koteng, Cameroons, cane sugar factory. In the foreground, four "COMPACT 411" centrifugals. In the background, five continuous "FC 1000" centrifugals.

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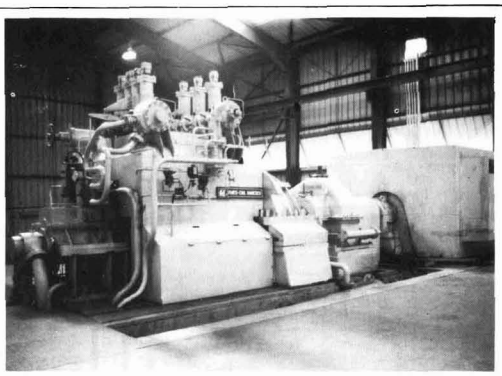

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FIVES-CAIL BABCOCK

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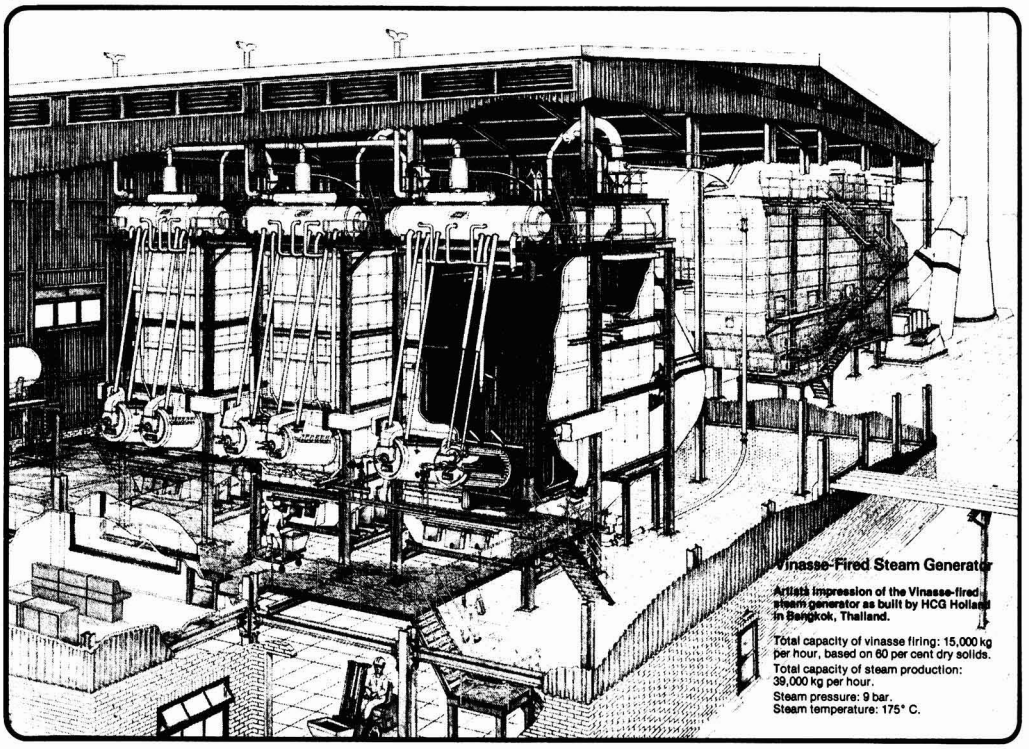
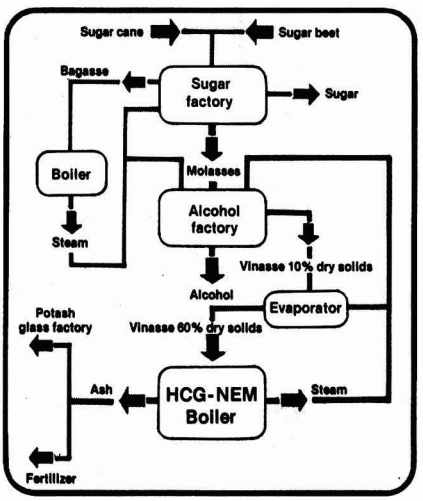
EFFLUENT TREATMENT and ENERGY SAVING through NEM VINASSE BOILER



Vinasse-Fired Steam Generator

Artist's impression of the Vinasse-fired steam generator as built by HCG Holland in Bangkok, Thailand.

Total capacity of vinasse firing: 15,000 kg per hour, based on 60 per cent dry solids.
Total capacity of steam production: 39,000 kg per hour.
Steam pressure: 9 bar.
Steam temperature: 175° C.



- During the production of power alcohol as well as industrial alcohol, vinasse is obtained as by-product. By evaporation to 60% solids concentration this vinasse becomes suitable as fuel for the HCG combustion boiler for generating process steam.
- By using vinasse as fuel, the alcohol factory can achieve savings of approximately 50% in fuel consumption.
- HCG has been involved in the development of vinasse-fired boilers for many years. Three boilers have been built while six more are under construction.

hcg hollandse constructie groep bv
nem-boilers and process equipment division
zoeterwoudseweg 1, postbox 6, 2300 AA leiden - holland
telephone 071 - 769311/769312, telex 39028 - hcg nl

TRADE NOTICES

Karl Fischer titrator. Baird & Tatlock (London) Ltd., P. O. Box 1, Romford RM1 1HA, England.

The AF3 titrator comprises two basic modules: a metering module housing the pump and liquid handling system, which automatically takes the correct volume of reagent straight from a standard 1- or 2-litre Winchester bottle, and a titration module which contains the electronics and mains controls and automatically displays the results as a digital read-out in mg of water to the nearest 0.11 mg. Apart from the major advantage of providing a direct water content display without calculation, the auto-metering system also has many other operational advantages. A standby facility enables the titrator to be kept in a "neutral" condition immediately ready to handle any sample offered to it. Sensors set up fault alarms and take appropriate action if the titration vessel becomes overfilled or reagent is spilt on the operating platform. A special timer computes metering pump operation and gives warning of need for routine replacement. A low-voltage magnetic stirrer acts at constant speed under all conditions.

Liquid level meter. Bestobell Mobrey Ltd., 190-196 Bath Rd., Slough, Berks. SL1 4DN, England.

Bestobell Mobrey's new ultrasonic liquid level meter incorporates the latest micro-processor technology. Named the Mobrey Sonapulse (MSP83), the unit is essentially an ultrasonic non-contact level meter into which a wide variety of programmable options can be keyed by means of a front-mounted numeric keyboard; this keyboard is used for initial setting up of parameters and is restricted to authorized key holders to prevent accidental changes to process values. The design of the unit is based on a 8085 processor with 8K bytes of storage; complete digital control guarantees high accuracy and reliability. The memory may be programmed to carry conversion factors. Maximum range is 8-10 m (depending on liquid surface conditions) at pressures up to 3.5 bar and temperatures up to 70°C.

Land clearing. Washburn Land Clearing, 410 Ware Blvd., Suite 305, Tampa, FL 33619, USA.

The one-pass Washburn land clearance machine can operate at the rate of ½ ha.hr^{-1} and give ultimate results better than those obtained with conventional machines making at least seven passes. It excavates to a depth of 20-25 cm, separating all the waste material into piles and sifting topsoil back onto the ground, leaving the land ready for fertilization and planting. Washburn machines have been used for 35 years to clear more than 300,000 ha of difficult Florida growth and are now available for sale where projects involve at least 2000 ha. The machine is considered highly suitable for use in cane stubble on relatively flat land, where it would be of advantage for the grower to have the dirt-free debris windrowed for easy burning on the spot or for easy haulage to the factory for use as fuel.

Slide valves. Reiss Engineering Co. Ltd., 2 Dalston Gardens, Stanmore, Middx. HA7 1BQ, England.

Wey slide valves manufactured by Reiss Engineering and originally designed for use in the paper and board industries, are being used at Newark sugar factory on pipelines carrying various products. After the end of the last campaign, the valves, of 4-20 inch bore, were inspected and found to be in good condition, the only significant changes required being the installation of blade scrapers (desirable but not essential). The valve's ability to cut through obstructing solids when closing and to maintain an efficient seal when subjected to pressure, plus its full-bore characteristics and ultra-slim body section, make it highly suitable for applications involving the control of semi-liquids or suspensions where installation space is severely restricted.

Pressing of beet trash. Stord Bartz A/S, P.O. Box 777, N-5001 Bergen, Norway.

Since 1975, when the first Stord twin-screw press was delivered for treatment of beet trash, much experience has been gained, and today Stord Bartz can offer five sizes of press in the throughput range of 1-30 tonnes.hr^{-1}, specially adapted to handling the material separated from the beet washer and flume. The press reduces the trash moisture content from approx. 90% to 80-75%, i.e. about the same level as pressed pulp, at a power consumption of about 2 kWh/tonne.

Level transmitter. Fischer & Porter Ltd., Workington, Cumbria CA14 5DS, England.

The Fischer & Porter Series 5OUS2000 ultrasonic level transmitter can measure the level of liquids or solids in the range 2-33 ft, with an output accuracy ranging from ± 1% at 2 ft to ± 0.6% at 33 ft. It comprises two units: a transmitter providing a 4-20 mA D.C. output signal, and a transponder that generates high-powered ultrasonic waves. The transmitter is easy to install and does not require precise positioning of the transponder. It incorporates digital electronic circuitry controlled by an integral micro-processor.

Vibratory feeders. Triton Engineering Co. (Sales) Ltd., Kingsnorth Industrial Estate, Wotton Rd., Ashford, Kent TN23 2LB, England.

Two synchronized TF4A electromagnetic vibrating feeders are being used, at Tate & Lyle Refineries Ltd., to feed soft brown sugar to weighing and bagging lines. Since the depth of sugar and speed of travel of the feeders are maintained constant, the quantity of sugar in transit from a feeder to a waiting sack can be calculated; electronically controlled weighers automatically stop delivery before the bag weight has been reached, "knowing" that the outstanding amount has already left the feeder. The feeders are provided with stainless steel trays and have major advantages of simplicity, instant flow rate adjustment and cut-off, low maintenance requirement and ease of cleaning. The Triton feeders were installed as part of a weighing and bagging package from Darenth Ltd.

Temperature controllers. Kent Industrial Measurements Ltd., Howard Rd., Eaton Socon, St. Neots, Huntingdon, Cambs. PE19 3EU, England.

The Clearway M140 indicating pneumatic temperature controller uses a gas expansion system to sense the temperature and provides a proportional pneumatic control signal to actuate the appropriate control valve. Four of these controllers are being used at the Spalding factory

of British Sugar plc to maintain, through regulation of steam valves, the temperatures of raw juice, diffuser supply water (at two stages of heating) and of the pre-scalded cossettes.

PUBLICATIONS RECEIVED

Furadan insecticide/nematicide. FMC Corporation, Agricultural Chemical Group, 2000 Market Street, Philadelphia, PA 19103, USA.

A 31-page brochure from FMC Corporation gives information on application of Furadan insecticide/nematicide, available in granular or flowable form, which has proved successful in the control of a number of soil and above-ground cane pests, particularly several species of nematode as well as wireworms and borers; the chemical is also effective, when applied at drilling, against the root maggot of sugar beet. The brochure describes the properties of the various formulations and offers advice on use of the pesticide.

"BMA Information". Braunschweigische Maschinenbauanstalt AG, Postf. 3225, D-3300 Braunschweig, Germany.

Amongst items in the latest edition of "BMA Information" is a description of the G 1750 batch centrifugal, the largest of its kind in the world, installed in the sugar factory of Uelzen AG to handle 1750-kg 1st white sugar massecuite charges at a total cycle time of 184 sec, equivalent to 1.6 charges per hr. Other information concerns new BMA falling-film evaporators constructed for Zeil and Warburg sugar factories; an anaerobic waste water treatment plant installed at Brühl and using the CSM Biothane process (two other sugar factories have since placed orders for similar plant); white sugar massecuite centrifugalling; continuous evapo-crystallization; a new BMA self-setting, pressure-controlled cane mill; vapour compression; features of BMA batch centrifugal design and construction; beet pulp drying; a vertical prelining tank manufactured by BMA on the principle of the Brieghel-Müller system; and various items of news demonstrating the important role being played by BMA in the world's sugar industry.

Dust control. Carter Industrial Products Ltd., Bedford Rd., Birmingham B11 1AY, England.

An interesting article on the importance of careful maintenance for efficient dust separation is available as a reprint from Carter Midac, the Environmental Engineering Division of Carter Industrial Products Ltd. Written by the Engineering Manager of Carter-Midac and originally published in "Works & Plant Maintenance", it discusses the importance of regular inspection and maintenance of fabric filters, wet collectors, cyclones, fans and motors, ducting and hooding.

Chemicals information handbook 1982. Shell International Chemical Co. Ltd., Shell Centre, London SE1 7PG, England.

The 10th Edition of the title publication provides information on the world chemical industry, on chemicals manufacture from petroleum and on the chemical interests of companies in the Royal Dutch/Shell Group. Two appendices provide details of Shell chemicals trade marks and a short bibliography of books on industrial chemicals, polymers, agro-chemicals and on general aspects of chemicals and manufacture and application. Included in the Shell products are various agro-chemicals of application in sugar beet and cane agronomy. Copies of the handbook are obtainable from Shell International Petroleum Co. Ltd. (PA/012), Shell Centre, London SE1 7NA, England.

Ion exchange resins. Duolite International Ltd., The Lawn, 100 Lampton Rd., Hounslow, Middx. TW3 4EB, England.

A 4-page brochure from Duolite International, which is part of the Diamond Shamrock Group, describes the development of ion exchange resins and the role played by the company. A list of applications demonstrates the importance of the sugar industry as a major user of ion exchangers.

Process control. Pye Unicam Ltd., Philips Industrial Automation, York St., Cambridge CB1 2PX, England.

The PCS 700 is a complete control program of sensing elements, transmitters, transmitter power supplies, function modules, control stations, recorders, indicators, output signal converters and final elements available from the Philips Group of Companies, of which Pye Unicam Ltd. is a member. This highly flexible system is fully computer-compatible for both Set Point Control and Direct Digital Control and has been designed to meet a wide range of control requirements at low cost. Details are given of the components in a brochure obtainable from the above address.

Conveyor belt cleaner report. Mechanical Handling Engineers' Association, 16 Dartmouth St., London SW1, England.

A new report from MHEA is devoted to conveyor belt cleaning devices. Generously illustrated with line drawings, the report contains information obtained from cleaner manufacturers, from research and from major users; it assesses the various types of cleaner available, their preferred locations on a conveyor, operation and maintenance. Likely future trends, and a 10-point summary of general recommendations on belt cleaning and guidance on cleaner slection are included. Copies of the report are available from MHEA at a cost of £5.

Column packing. KnitMesh Ltd., Sanderstead Station Approach, South Croydon, Surrey CR2 0YY, England.

A recent 8-page brochure from KnitMesh gives information on Multifil, Hyperfil and Variknit packing for distillation and absorption columns. The packings, almost self-supporting, are available in copper, stainless steel and nickel/copper alloys as 4-in high rolls having a diameter equal to the internal diameter of the column. Excellent liquid distribution is a feature of Hyperfil 20, while separation efficiency is not significantly affected by large variation in process conditions; the pressure drop per theoretical plate is so low that heat-sensitive, close-boiling products can be separated under vacuum without risk of decomposition of the residue.

Flowmeters. Kent Industrial Measurements Ltd., Flow Products, Oldends Lane, Stonehouse, Gloucestershire GL10 1BR, England.

Flow metering products and systems manufactured by Kent Industrial Measurements Ltd. are featured in a new brochure, covering various types of flowmeters, flow recorders, meter provers (for rapid calibration of flowmeters in pipelines) and package metering stations.

Vinasse concentration by reverse osmosis. — A Paterson Candy International reverse osmosis plant operating at a feed rate of 20 $m^3.hr^{-1}$ has been installed in Italy for the treatment of effluent from molasses fermentation. The plant uses tubular, non-cellulosic membranes to double the total solids concentration of the vinasse; the permeate stream has a COD level below 1000 $mg.litre^{-1}$.

Biomass conversion. — The French engineering group, Technip, has acquired exclusive rights to two new processes developed by the Canadian firm, Stake Technology Ltd. The first process involves continuous high-pressure steam treatment (the Stake II system) to free cellulose from its lignin shell and thus convert waste material such as cane trash to cattle fodder. The second process, for which the exclusive rights apply outside North America and Mexico, consists in using the end-products from the Stake II system as a carbon source for production, after enzymatic or acid hydrolysis, of a wide range of chemical products such as sugars, alcohols, acetic acid, furfural, etc. Two units using the Stake II system are already on stream in Florida and Minnesota.

New enzyme company. — Corning Glass Works and Genentech Inc. have announced their decision to form an industrial enzyme company, Genencor Inc., which will combine genetic engineering with enzyme immobilization to produce enzymes for the food processing and chemical industries.

Cane harvesters. — Versatile Toft harvesters in Swaziland have featured in reports of record-breaking performances. At Mhlume Sugar Co. 1236 tonnes of cane were harvested by a 6000 Series 2 machine in 12 hours; this record was broken by a similar production model, which cut 1438 tonnes in 12 hours at Tambankulu Estate. Subsequently, a Series 2 machine cut 1459 tonnes in a 12-hr trial at Simunye, while a second harvester cut 1705 tonnes during simultaneous operation in the same field. Versatile Toft Ltd. also report that, of 1797 chopper-harvesters in Australia, 1029 (57%) are V.T.L. or V.T.L.-built machines.

EEC sugar exports 1981[1]

	1981	1980	1979
	tonnes, raw value		
Afghanistan	0	1,304	449
Algeria	46,475	107,266	137,067
Angola	1,861	102	44
Austria	8	10	152
Bahamas	0	0	218
Bangladesh	34,824	13	3,998
Benin	138	6,139	3,930
Bermuda	59	25	298
Bulgaria	0	2	6,522
Burundi	2,758	888	3,883
Cameroon	1,653	4,714	16,788
Cape Verde Is.	6,415	3	14
Central African Republic	0	1,029	2,902
Chad	59	336	5,660
Chile	5,989	2,250	26,632
China	26,422	0	99,760
Comoro Is.	660	39	1,290
Congo	11,468	7,679	11,717
Cyprus	14,598	10,708	21,594
Czechoslovakia	16,463	0	0
Djibouti	29,438	793	530
Dutch Antilles	3	4	1,199
Egypt	216,101	141,979	11,010
Ethiopia	2	0	609
Finland	7,305	14,296	14,505
French Territories	8,057	6,666	7,562
Gabon	18	15	8,160
Gambia	16,473	16,064	28,387
Germany, East	22,040	7,920	0
Ghana	42,355	18,601	44,836
Gibraltar	703	813	763
Guinea	3,603	2,899	5,749
Guinea Bissau	2,400	732	168
Hong Kong	902	235	906
Hungary	0	0	272
Iceland	10,721	11,269	11,395
India	113,875	1,261	553
Indonesia	307	27	14,160
Iran	603,521	667,403	613,293
Iraq	144,353	163,258	48,460
Israel	200,750	127,628	137,587
Ivory Coast	12,421	6,968	7,382
Jordan	37,145	66,014	71,846
Kenya	3,861	1,846	30,047
Kuwait	43,755	33,870	81,170
Lebanon	83,945	25,176	92,313
Liberia	6,588	4,503	7,115
Libya	85,442	24,311	14,301
Maldives	2,610	4,946	0
Mali	17,468	4,179	6,404
Malta	6,376	17,265	17,379
Mauritania	20,210	6,485	33,374
Mexico	5	18,104	0
Morocco	40,892	64,746	57,970
New Zealand	20	36	308
Niger	6,290	6,900	5,771
Nigeria	949,045	681,539	482,598
Norway	150,497	121,500	129,706
Pakistan	3,105	31,854	878
Papua-New Guinea	6,305	9,716	7,178
Persian Gulf	120,570	65,944	69,479
Poland	119,304	26,936	2
Portugal	46,563	71,476	53,784
Rumania	49,403	2	4,587
Rwanda	4,529	13	5,343
Saudi Arabia	204,294	111,867	73,533
Senegal	18,122	91	166
Sierra Leone	15,737	14,553	25,203
Singapore	42	131	1,421
Somalia	14,429	2,129	1,348
Spain	18,087	3,813	26,866
Sri Lanka	84,704	20,737	254
Sudan	94,316	70,962	157,924
Surinam	5,600	2,652	3,479
Sweden	26,481	40,635	32,527
Switzerland	141,486	134,360	174,859
Syria	86,430	51,419	142,046
Tanzania	8,604	7,312	15,027
Togo	18,464	20,649	25,012
Tunisia	131,347	84,510	133,430
Turkey	27,539	185,256	54
Upper Volta	5,871	0	0
USA	214	1,257	830
USSR	779,820	889,860	243,745
Vietnam	0	1,325	1,583
Western Samoa	47	128	570
Yemen, North	11,856	1,129	6,552
Yemen, South	82,346	48,099	58,496
Yugoslavia	142,108	12	4
Zaire	6,199	7,590	11,861
Other countries	10,483	5,672	12,680
	5,343,752*	4,324,847	3,621,427

* Excluding UK exports, March – August.

La Sucrerie Belge. – We regret to report that this distinguished and old-established sugar publication, official organ of the Belgian Society of Sugar Technologists, is to cease publication at the end of 1982.

Record UK beet sugar campaign in prospect. – The 1982/83 beet sugar campaign in the UK started on September 20 and promises to be a record breaker. Pre-campaign tests showed that the crop, growing on 201,000 hectares, contains more sugar than at any time in the past five years and will produce more than 1,350,000 tonnes of white sugar (against some 1,100,000 tonnes in the past two campaigns). Root yield is expected to average more than 43 tonnes per hectare, as a consequence of near-perfect conditions during the crop's growth.

Pakistan sugar production 1981/82. – The 1981/82 season in Pakistan was an unusually long one and came to an end on June 23 for cane sugar factories, with the four beet processing plants continuing until July 2. The toal cane crushed amounted to 14,591,000 tonnes, against 9,140,000 tonnes in 1980/81 and yielded 1,267,758 tonnes of white sugar against 821,357 tonnes – a 54% increase. A total of 359,945 tonnes of beets were sliced and yielded 30,666 tonnes of white sugar, an average recovery of 8.53%. In addition, 2196 tonnes of white sugar was obtained by reprocessing gur and khandsari, giving a total white sugar outturn of 1,300,620 tonnes.

US sugar stabilization price. – At the beginning of September the US Department of Agriculture announced an increase in the sugar stabilization price in the US from 19.88 cents/lb to 20.73 cents, to become effective on October 1[2]. The stabilization price is used to calculate import fees; the new fees announced at the end of September were zero for raw sugar, and 1 cent/lb for refined sugar[3].

Guatemala sugar production 1981/82[4]. – The 1981/82 sugar crop has been unusually bountiful owing to good weather and an increase in plantings of about 12-13%. As a consequence sugar production is expected to reach 521,000 tonnes, raw value, according to the Guatemala Sugar Producers Association, which compares with 447,914 tonnes in 1980/81, 397,712 tonnes in 1979/80[5] and the record of 548,972 tonnes in 1975/76. In 1981 the US purchased all of Guatemala's exportable surplus but, because of the new quota system, exports to the US could shrink by half, and new export markets are being sought, with sales to Ecuador, the USSR and Venezuela. The abundance of cane – some 6,730,000 tonnes against 5,960,000 tonnes in 1980/81 – has depressed the internal price paid to cane growers, who have threatened to cut back on plantings in 1982/83.

Fiji sugar crop, 1981/82[6]. – The 1981/82 sugar crop in Fiji began on May 7 and finished on January 8, 1982. A total of 3,931,329 tonnes of cane were crushed, compared with 3,360,275 in the previous crop, and 469,972 tonnes of sugar were produced, against 396,157 tonnes in 1980 and the record 473,181 tonnes of 1979. The cane:sugar ratio was 8.37 against 8.48 in 1980 and ratios of below 8 prior to 1978. If the Lautoka/Nadi districts had not been visited by cyclone Arthur in January, the crop would undoubtedly have been a record, as a result of consistent rainfall. Exports reached 398,936 tonnes, tel quel.

1 *I.S.O. Stat. Bull.*, 1982, **41**, (7), 9-11.
2 *Public Ledger's Commodity Week*, September 4, 1982.
3 *Public Ledger*, September 25, 1982.
4 *World Sugar J.*, 1982, **5**, (1), 34-35.
5 *I.S.J.*, 1982, **84**, 127.
6 Fiji Sugar Ind., Independent Chairman's Rpt., 1981.

USSR sugar imports 1981[1]

	1981	1980
	tonnes, raw value	
Argentina	149,637	12,501
Austria	14,052	36,067
Brazil	346,612	465,653
Bulgaria	2,746	0
Canada	13,641	0
Colombia	12,000	10,826
Cuba	3,089,809	2,647,497
Czechoslovakia	0	10,824
Dominican Republic	14,478	33,449
EEC	873,107	856,370
Finland	62,157	19,085
Gabon	5,413	0
Germany, East	4,209	10,826
Guatemala	0	15,240
Hungary	0	75,806
Nicaragua	0	12,900
Peru	0	23,808
Philippines	208,889	332,787
Poland	0	3,248
Rumania	28,742	50,513
El Salvador	0	26,016
Swaziland	0	10,160
Thailand	265,552	139,654
USA	40,381	0
Yugoslavia	506	173,379
Zimbabwe	0	14,610
	5,203,931	4,981,219

Indian sugar, bagasse paper and alcohol project[2]. — Bellarpur Industries Ltd. is proposing to build a 10 million rupee complex near Dhuri, in Sangrur District, in the Punjab, which will have a cane crushing capacity of 75,000 tonnes per annum from which it will produce sugar and bagasse, the latter being used as one of the raw materials for a paper plant of 50,000 tonnes/year capacity. A distillery is also to produce 16,000,000 litres of alcohol per year from the molasses and a chemical unit for downstream utilization of the alcohol is envisaged.

Greek sugar production 1981[3]. — The factories of Hellenic Sugar Industry processed 2,559,964 tonnes of beet to produce 321,589 tonnes of sugar, white value, in the 1981 campaign. It was the best year experienced by the industry to date, with an average beet yield of 60.48 tonnes per hectare and a sugar content of 15.37%, the highest for twelve years. Production in 1982 is expected to reach 280-290,000 tonnes, white value, enough for self-sufficiency.

French credit for the Brazilian sugar industry[4]. — Crédit Agricole S.A. of Paris has said it was holding talks with the Brazilian Sugar and Alcohol Institute to provide a US $120 million credit package to aid sugar production. A spokesman said that a financial credit to Brazil of $86 million was under discussion but no conditions had been agreed. The loan would depend on Brazil's taking a $34 million export credit through the French credit agency COFACE to finance the purchase of French irrigation equipment for Brazilian sugar plantations. Crédit Agricole would also lend this second tranche.

EEC sugar production decline forecast[5]. — The 1982/83 beet sugar output is tentatively forecast by EEC officials to drop by more than 3.0 million tonnes from 15.98 (excluding cane sugar production of 347,827 tonnes, raw value) to 12.77 million tonnes. This forecast is based on plantings of 1.84 million hectares, about 9% less than 1981/82, and on the assumption that yields will average about 6.95 tonnes per hectare. The figures will be subject to revision as the season progresses, largely depending on weather conditions. There is a possibility that depressed world prices could force the Commission to consider the possiblity of trimming its sales program and carry over into the 1982/83 crop year more than the 2,977,000 tonnes, white value, now envisaged.

Alcohol from beet in West Germany[6]. — Results of research and development in respect of technology, alcohol recovery and economy have been sufficiently promising for the West German Research Ministry to provide DM 2.4 million for the construction and operation of a demonstration plant for alcohol manufacture from beet sugar waste products and from beet juice. The Ministry is also to fund the development of new biotechnical processes and of new microbial strains for alcohol manufacture, at a cost of a further DM 4 million.

Mexico sugar imports 1981[7]

	1981	1980
	tonnes, raw value	
Brazil	0	75,319
Chile	0	38,294
Cuba	232,068	382,948
EEC	0	18,062
Guatemala	16,048	0
Korea, South	0	27,933
Nicaragua	15,761	0
USA	409,139	218,187
	673,016	760,743

Barbados sugar industry loan[8]. — The Barbados government is offering a $10 million loan and a new price support system to aid the sugar industry. Output in 1982 is not expected to exceed 88,700 tonnes, the lowest since 1948, which compares with 96,000 tonnes in 1981 and 135,000 tonnes in 1980.

Cameroun sugar factory restoration[9]. — The sugar production facility at Mbandjock in Cameroun is to be rehabilitated at a cost of about $6.3 million. Work is scheduled for completion by mid-1984 and, it is hoped, will enable some 27,500 tonnes of sugar to be produced annually. Local banks will be joining with the International Finance Corporation to supply the finance required.

Poor Guyana spring crop in 1982[10]. — Guyana's first sugar crop this year produced only 86,855 tonnes, the first time since 1977 that it has totalled less than 100,000 tonnes. The Guyana Sugar Corporation president blamed the shortfall on union problems, poor weather and a shortage of foreign exchange which made it impossible to import fertilizer and materials. The target for production from both 1982 crops is 310,000 tonnes but this seems unlikely to be met.

Argentina cane area[11]. — The area of cane to be harvested in the 1982 crop is estimated at 350,300 hectares, against 351,300 ha in 1981 and an average of 320,720 ha for the past five years. All growing areas have benefited from suitable weather and are expected to show satisfactory yields.

PERSONAL NOTES

We regret to report the death of **Mr. Deon Hulett** in a fall while erecting a micro-distillery in Brazil where he had established a consultation practice. Born in South Africa, he graduated from the University of Natal in 1952 and continued engineering studies in England and the United States before returning to South Africa to work for the Hulett Group. After several management posts he became Technical Director (Development) of Huletts South African Sugar Mills and Estates Ltd. but in 1970 started his consultancy practice, transferring his activities to Brazil in 1974. He participated actively in the affairs of the sugar technologists associations of both South Africa and Brazil and had contributed papers to ISSCT Congresses.

A former Director of the Czechoslovakian Sugar Research Institute in Prague-Modrany, **Dr. Jaroslav Pucherna** died in July last at the age of 80. He had served as a sugar factory chemist, manager and director as well as government employee and had also served on the editorial board of *Listy Cukrovarnické*. He had been a Vice-President of ICUMSA and a member of the Institut International des Recherches Betteravières.

Professor Dr.-Ing. Slobodan Susic, holder of the Chair for Sugar, Starch and Vegetable Oils in the Faculty of Technology and Metallurgy in Belgrade University, retired in July. After graduating in 1940 he worked until 1948 as a laboratory chemist and process engineer in various Yugoslav sugar factories and joined the Belgrade University Faculty of Agricultural Engineering as a lecturer, later assistant Professor and from 1960 as Professor of Sugar Technology. Besides teaching, he has been a prolific researcher and author, most of his work being in Serbo-Croatian however and so little-known abroad. He is the founder and editor-in-chief of the periodical *Industrija Secera* (Sugar Industry), published twice-yearly since 1973.

1 *I.S.O. Stat. Bull.*, 1982, **41**, (8), 36.
2 *Indian Sugar*, 1982, **31**, 726.
3 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 363.
4 *Westway Newsletter*, 1982, (104), 11.
5 *World Sugar J.*, 1982, (104), 11.
6 *Starch/Stärke*, 1982, **34**, 250.
7 *I.S.O. Stat. Bull.*, 1982, **41**, (8), xv.
8 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 384.
9 C. Czarnikow Ltd., *Sugar Review*, 1982, (1606), 121.
10 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 401.
11 *S. African Sugar J.*, 1982, **66**, 165.

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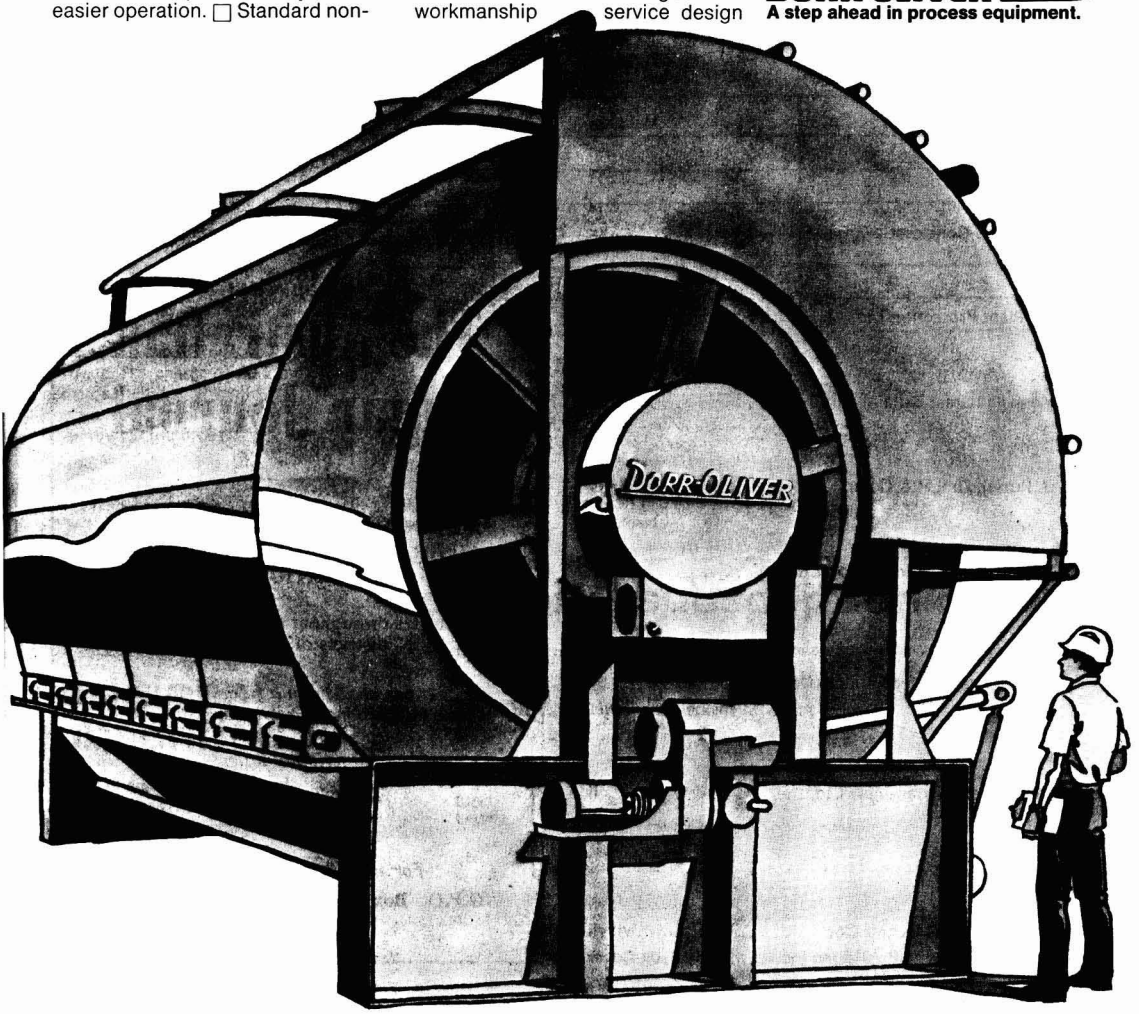

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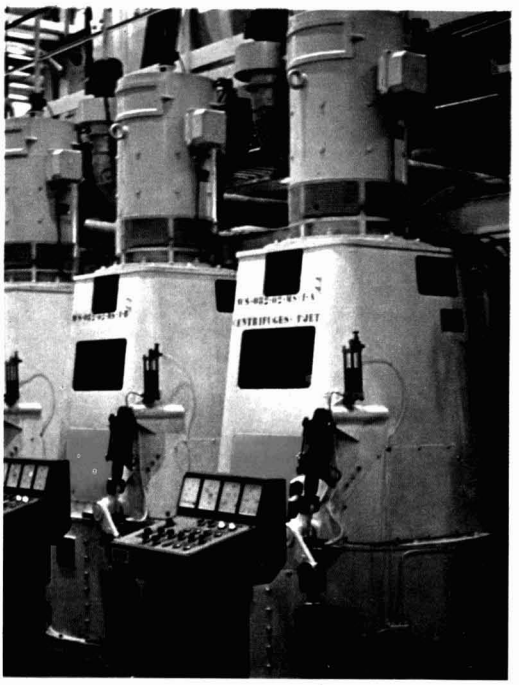

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