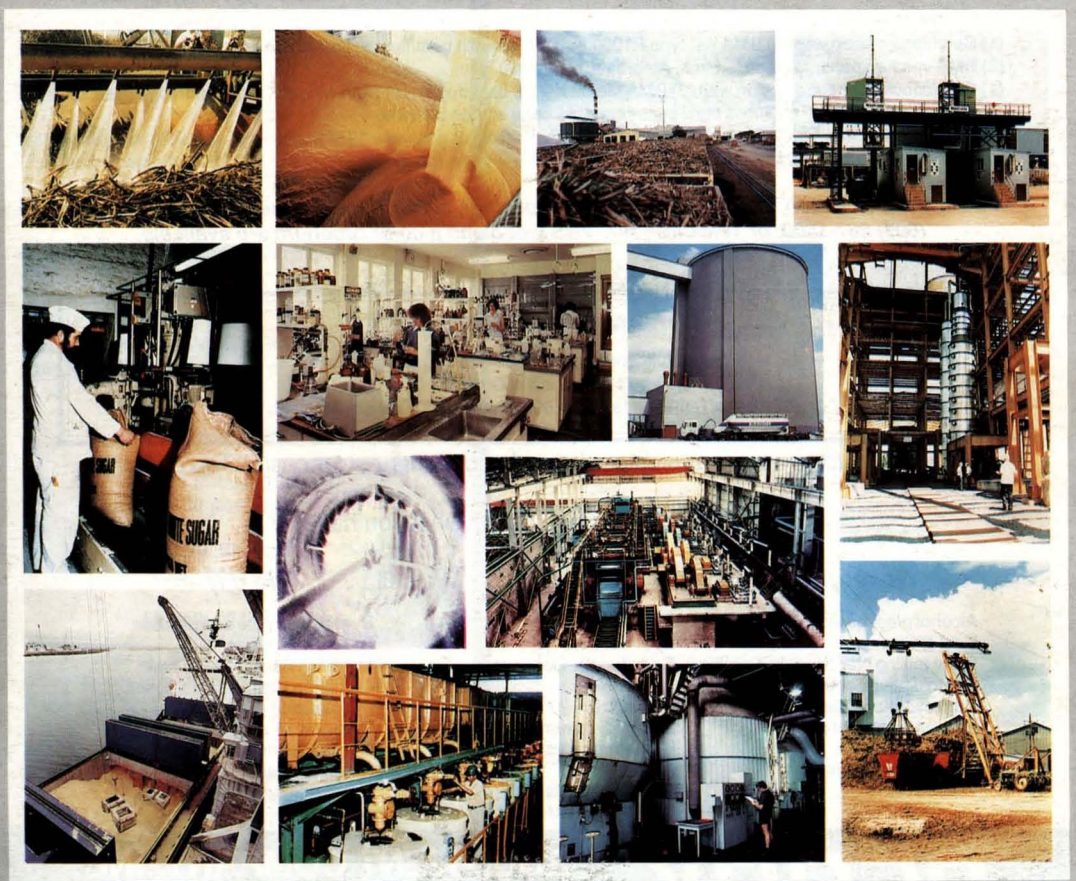
INTERNATIONAL SUGAR JOURNAL



VOLUME LXXXIX/ISSUE No. 1058 FEBRUARY 1987

FOR RELOCATION
LIQUIDATION SALE MODERN PLANT

5,000 Ton/Day Beet Sugar Factory For Sale . . .
In Entirety or by Department
at Mont Saint-Hilaire, Quebec, Canada

(1) Marcel Mouyard (new 1982) beet conveying system with 1750 ft. belt conveyor, beet receiving station, piler, stoner, weighing, with a tare house.
(2) Silver 36" "Super" beet pilers (1) new 1983.
(1) BMA-Harland beet pump with 450 HP motor, BMA stone catcher, leaf catcher, beet washer.
(4) Putsch 2200 mm dia. beet slicers.
(1) BMA vertical diffuser, rated 5,000 tons per day.
(1) Beet pulp dewatering and drying system: includes (4) Stord Bartz (2) Babbini stainless steel screw presses, (1) Stearns 10' 6" dia. × 48' dryer, (2) 150 HP CPM pellet mills.
(1) Eberhardt vertical lime kiln, rated 200 tons per day, with loader, rotary lime slaker. With stainless steel vacuum pumps for CO_2 generated gas.
(1) Lot clarification equipment: includes (1) Dorr-Oliver 1400 TPD clarifier, (1) BMA 3600 TPD clarifier, (3) BMA rotary vacuum lime mud filters, (3) Putsch and (5) BMA pressure leaf filters, (1) ion exchange system.
(1) BMA evaporation system, having (20) juice preheaters to 2000 sq.ft., and (1) 5-body, 4-effect evaporator. Stainless steel tubes. Approx. 90,000 sq.ft. evaporator surface area.
(1) Crystallizer system with (2) BMA/Silver vertical cooling crystallizers, (5) BMA horizontal type CI crystallizers, 9' dia. × 30' long.
(1) Centrifuge station with (6) BMA 44" type P1000 automatic batch centrifuges, timers and controls.
(8) BMA vacuum pans, 1200 cu.ft. each. Automatic controls.
(1) Continuous centrifuge station with (3) BMA Model K1000 centrifuges, (1) BMA Model K1100 centrifuge (new 1983) and (2) Silver 36" stainless steel centrifuges. All cone screen baskets.
(1) Keystone-Volcano 160,000 #/hr. steam boiler, 230 PSI. #6 oil /or gas (new 1982).
(1) Modern, well-equipped laboratory.

For more information, or arrangements for inspection, contact Joe Ricchini or Stan Brooks at (609) 267-1600, or Telex 84-5397. VHS video and a color brochure are available.

* * * * * * *

FOR SALE FOR RELOCATION

(3) Sugar refineries: 1300, 2000 and 600 tons per day.
(1) Cane mill 4000 TPD.
(5) Alcohol (ethanol) factories 600,000 to 3,500,000 gallons/year.

We want to buy your surplus equipment and plants . . . for cash - Top dollar!

Call Stan Brooks and tell us what you have!

We recycle sugar plant equipment . . . . We sell . . . . We buy

Alcohol plant equipment
Beet slicers
Cane milling plant and equipment
Centrifugals, Semi-automatic
Conveyors and elevators
Effluent treatment
Filters – All types
Packaging equipment
Pulverizers
Beet diffusers
Beet washers
Centrifugals, Continuous
Clarifiers
Crystallizers
Electricity generators
Heat exchangers – All types
Pellet presses
Storage vessels
Beet pulp dryers and presses
Boilers – All types
Centrifugals, Fully automatic
Complete beet sugar factories
Decolorizing plant
Evaporators and pans
Lime kilns and slaking plant
Power plants
Sugar refinery equipment

PERRY **EQUIPMENT COMPANY, INC.**
Mt. Laurel Road, Hainesport, NJ 08036, U.S.A.
Phone (609) 267-1600 Telex 84-5397 (Perry Hain)

UK ISSN 0020-8841

Annual Subscription:
£50.00 post free

Single Copies
£5.00 post free

Airmail: £24 extra

Claims for missing issues will not be allowed if received more than two months from date of mailing, plus time normally required for postal delivery of journal and claim.

Published by
International Media Ltd.,
P.O. Box 26, Port Talbot,
West Glamorgan SA13 1NX, U.K.

Tel: 0639-887498 *Telex:* 21792 REF 869

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

INTERNATIONAL SUGAR JOURNAL

Volume 89
Issue No. 1058

CONTENTS February 1987

Published by

International Media Ltd.

P.O. Box 26, Port Talbot, West Glamorgan SA13 1NX, U.K.
Telephone: 0639-887498 *Telex*: 21792 REF 869
US Office: 2790 Foster Avenue, Corning, CA 96021
Inquiries regarding advertising should be addressed to the above offices or the appropriate representative:

UK and Continental Europe, other than France and Holland	Robert Baker, P.O. Box 107, Camberley, Surrey GU17 9HN, England. *Tel:* 0276-32842. *Telex:* 858893 Fletel G.
France:	MaG-Watt International, 6 rue des Acacias, Vert-le-Grand, 91810 Essonne. *Tel:* (6) 456.00.15.
Holland:	G. Arnold Teesing B.V., Prof. Tulpstraat 17, 1018 GZ Amsterdam. *Tel:* 020-263615. *Telex:* 13133.
Japan:	Shinano International, Akasaka Kyowa Bldg., 6-14 Akasaka 1-chome, Minato-ku, Tokyo 107. *Tel:* (03) 584-6420. *Telex:* J27850
Korea:	Ace Korea Company, C.P.O. Box 9315, Seoul. *Tel:* (02) 273-7011/2 *Telex:* 23231 Mocndm Ext. 4023.

News and views

World sugar prices

The London Daily Price for raw sugar, which had risen from $149 to $156.50 between December 1 and 2, remained between $158 and $160.50 up to December 10 when a gloomy assessment of prospects by the EIU was blamed for a fall to $151. On December 15, however, the USDA announced a cut in the import quota for 1987 which was greater than had been expected, and the bearish implications for the world sugar market drove the LDP down to $147 per tonne. For the remainder of the month the price fluctuated between $143 and $147, ending the year at $145 per tonne.

White sugar values moved much in parallel with those for raw sugar, but continuing demand from India helped to raise the premium from around $24 per tonne at the beginning of the month to $28-$29 in the second half. The LDP(W), $179 on December 1, rose to $184.50 and fell to $171.50 on December 22 before finishing the month at $174.50.

US high fructose syrup economics[1]

The mainspring for the wet milling industry in the USA continues to be provided by the price support policy for sugar. In addition, raw material costs have remained low. Stocks of maize were boosted by the exceptional harvest in 1985 and hot, dry conditions last summer contributed to another very good result last autumn which is estimated at 7% lower than 1985 but still the second largest recorded crop, so that maize prices have been kept low. After averaging $2.51 per bushel in 1985, maize prices had already fallen further in the first half of 1986 and the prospect is that in 1987 they could fall to around $1.60 - $1.85.

The wet millers' net costs have been further reduced as their returns from by-product sales have improved. Gluten feed prices in particular have shown gains over a year ago as most of this product is shipped to the EEC where the strength of the German Mark and Dutch Guilder has boosted the dollar returns for gluten feed by some 36% above a year ago. Although, among the other by-products, corn oil prices have shown reductions below the corresponding levels of a year earlier, the overall income from all by-products has still improved. In deducting these from the cost of maize, the net raw material cost averaged $1.56 per bushel in 1985. The average for the first six months of last year had fallen to $1.27 and there are expectations that net costs could dip below $1.00 per bushel this year.

Differentials between sugar and HFS prices narrowed slightly over the summer months when soft drinks and ice cream consumption reached their seasonal peak and for a while demand put greater pressure on HFS availability. Since then, however, the gap has widened a little once more to show beet refined sugar in the Mid-West f.o.b. plant at 24.00 - 24.50 cents/lb against 55% HFS at 20.70 cents/lb dry weight basis.

The other development has been the announcement by one HFS producer that it intends to commence production of a dry fructose sweetener early next year. The targeted markets for this product are dry mixes, cereal products and confections and the sweetener will probably be traded in various blends with sugar. Although it is variously claimed to be some 10 to 80% sweeter than sugar, it will be priced between 35 and 60 cents/lb on a wholesale basis and it remains to be seen whether its characteristics are a sufficient attraction to compete with sugar at around 23.50 cents/lb. Whether or not this particular product becomes viable, the support price for sugar will continue to act as an umbrella for further research and development by the wet milling industry.

Europe beet sugar production, 1986/87[2]

By the beginning of December, when F. O. Licht GmbH produced their second estimate of European beet sugar production, harvests were near completion in many countries and production results have given a clearer picture of the likely final outturns, at least in Western Europe. Extremely favourable weather in the EEC gave a late recovery in sugar content, and harvesting has been carried out under almost ideal conditions. As a consequence, instead of the fall of $5^1/_2$% expected in August, sugar production is now expected to be very slightly higher than the last campaign, at 14,555,000 tonnes, raw value, against 14,502,000 tonnes. This nevertheless involves the compensation of a 600,000-tonnes increase in Italy and 275,000 tonnes in Holland, with a decrease of 740,000 tonnes in France and smaller changes elsewhere.

Since August, the crop in Yugoslavia has exceeded expectations but that in Turkey has not come up to expectations. As a result of the changes in the estimates for these countries and small changes elsewhere, the estimate for Western Europe other than the EEC is raised from 17,177,000 tonnes to 17,819,000 tonnes. Reports from Eastern Europe indicate improvements over early estimates in the USSR, East Germany, Poland, Bulgaria and Rumania, but parts of Hungary and Czechoslovakia have suffered from drought and output is set lower. The total for Eastern Europe is set at 12,879,000 against 12,738,000 tonnes and the total for Europe raised to 30,698,000 tonnes against the August estimate of 29,915,000 tonnes and the 1985/86 total of 30,932,000 tonnes.

New bid for US refiner[3]

Savannah Foods and Industries announced on November 26 their interest in certain assets of Colonial Sugars Inc. Savannah is reported to have signed a letter of intent to purchase part or all of Colonial although there is no definitive agreement yet, pending completion of a thorough examination of each segment of the Lousiana refiner before Savannah signs a firm commitment.

Colonial had previously been the subject of a possible purchase by Tate & Lyle Inc., a US subsidiary of the British

1 *Czarnikow Sugar Review*, 1986, (1754), 146.
2 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 623 - 626.
3 *Dyergram*, December 2, 1986.

parent. These negotiations, which have dragged on since January 1985, appear to be ended in the light of the recent developments with Savannah. It had been rumoured that a settlement with Tate & Lyle was pending the outcome of the Justice Department's "Operation Bittersweet" investigation involving the fraudulent use of Customs documents and drawback in the USDA's re-export program for refined sugar.

Colonial Sugars acquired the former Georgia Sugar Refinery in August 1985, thereafter closing the Georgia refinery in Mathews, Lousiana, and utilizing at Gramercy the raw sugar output of the company's cooperative members, as well as certain other assets.

US sugar imports quota, 1987

On December 15, the US Secretary of Agriculture announced that total authorized quota shipments of imported sugar for 1987 would be just over 1 millon short tons, raw value, down 41% from the 1986 quota of just over 1.7 million tons and the lowest level in nearly 100 years. For the calendar year, 25,160 short tons is established as the quota adjustment amount, 2000 tons as the speciality sugar import quota and 910,000 tons as the total base quota amount. The total import quota is the sum of these, or 937,160 short tons, raw value. In addition, the minimum quota is reduced from 12,500 to 7,500 short tons; once this figure is substituted and other adjustments made, authorized imports total 1,001,430 tons.

The sharp reduction in import requirements results from a continued increase in domestic sweetener production, including corn sweeteners, coupled with a decline in domestic consumption of sugar. These are the result of high levels of price support for sugar beets and cane mandated by the Food Security Act of 1985. "If current trends continue, in another two years the existing sugar program will make the US self-sufficient in sweetener production for the first time in history" said Mr. Lyng.

Individual quotas are given below, with comparative figures for last year.

	1987	1986
	short tons	
Argentina	39,130	73,788
Australia	75,530	142,428
Barbados	7,500	12,012
Belize	10,010	18,876
Bolivia	7,500	13,728
Brazil	131,950	248,820
Canada	10,010	18,876
Colombia	21,840	41,184
Congo	7,500	12,500
Costa Rica	17,583	34,713
Dominican Republic	160,160	302,016
Ecuador	10,010	18,876
Fiji	25,190	12,012
Gabon	7,500	12,500
Guatemala	43,680	82,368
Guyana	10,920	20,592
Haiti	7,500	12,500
Honduras	15,917.2	32,713.2
India	7,500	13,728
Ivory Coast	7,500	12,500
Jamaica	10,010	18,876
Madagascar	7,500	12,500
Malawi	9,100	17,160
Mauritius	10,920	30,592
Mexico	7,500	12,500
Mozambique	11,830	22,308
Panama	26,390	49,764
Papua New Guinea	7,500	12,500
Paraguay	7,500	12,500
Peru	37,310	70,356
Philippines	143,780	231,660
St. Kitts	7,500	12,500
Salvador	26,019.8	49,999.8
Swaziland	14,560	27,456
Taiwan	10,920	20,592
Thailand	12,740	24,024
Trinidad	7,500	12,012
Uruguay	7,500	12,500
Zimbabwe	10,920	20,592

The Adminstration recognizes the serious effects loss of outlets will have on the economies of the countries concerned and has offered compensation in the form of farm surpluses — maize, wheat, cooking oil, and the like — to some of them. These are no substitute, however, for the opportunity to earn dollars needed to pay interest on loans made by US banks.

It is expected that legislation will be proposed to reduce the US sugar loan rate over a period of four years from 18 to 12 cents a pound, with direct income payments for compensation of growers, in order to drop the high support price. However, agricultural subsidies have become increasingly unpopular and Congress may not wish to abandon the present system whereby support is provided by the consumer and not out of the budget.

Reaction from supplying countries has been predictably to condemn the cut in quotas and to contrast the effects with the fine ideals of the Caribbean Basin Initiative and promotion of economic and political stability in the Western Hemisphere. But a more serious underlying worry for sugar exporters is that the US may in the not too distant future be in the same position as the EEC with a surplus of domestic sugar; the sale last year of CCC sugar to China at well below world market prices could herald the emergence of the US as a source of subsidized competition for world markets which could complete the ruin of the economies of some countries which are virtually dependent on sugar.

Argentina crop reduction[4]

Continued depressed world sugar prices mean that Argentina's sugar production in 1986/87 will fall to 1.05 million tonnes from 1985/86's 1.1 million tonnes, according to the Argentine sugar association. Consumption is a steady 950,000 - 1,000,000 tonnes a year and exports were set at 100,000 tonnes in 1986, half to the US. Formerly, production had been 1.5 - 1.6 million tonnes and exports 500 - 600,000 tonnes. Much of the excess cane previously used to produce sugar is now being transformed into alcohol with output running at 220 - 240 million litres/year. Low oil prices and Argentina's self-sufficiency makes it unlikely that the alcohol program will be expanded, however.

Although alcohol production utilizes cane equivalent to 350,000 tonnes of sugar, large areas of cane are still left unharvested and the factories work well below capacity. Sugar production costs are estimated at around 25 cents/lb after taking into account high warehousing and financing charges. The provinces of Tucumán, Salta and Jujuy are now generally depressed with high unemployment and low wages. Zorreguieta considers a new international sugar agreement "absolutely essential" and fears that in the future the United States could become a sugar exporter.

4 *Reuter Sugar Newsletter*, October 15, 1986.

Product news

Robust temperature controller

Model CT122 digital temperature controller from Coley Thermometers has a very robust dial-type stainless steel case and features a large 20 mm liquid crystal display under a polycarbonate window so that it can be read at ten metres without ambiguity. The case is resistant not only to weather and high humidity but also aggressive chemical environments. It gives a continuous reading to 0.1°C and is accurate to 0.5°C over the range –50° to 200°C. It is available as a single or dual controller which can switch up to 1 amp at any preset temperature which can also be adjusted in service. The single contact version features a "fail-safe" safety overload. The instrument can be wall or panel mounted up to 200 metres from the sensor and is also available with a rigid stem for direct mounting. It is available for mains voltages of 240 or 110 V.

Further details:

Coley Thermometers Ltd.,
2–4 London Road,
Brentford,
Middx. TW8 8JP, U.K.

Fast-acting motor overload protection

Although they offer protection to a drive motor, conventional thermal and magnetic overload devices do not always act quickly enough to prevent damage to the driven machinery. The Fastrip V has been specially developed, by The 30-98 Company Ltd., to give this added protection, whether the overloads arise from operational problems, mechanical damage, or the intrusion of foreign matter. Electronically operated, Fastrip V is practically well suited to automatic and semi-automatic processing applications.

Using a toroidal transformer, Fastrip V monitors the current taken by the drive motor and the signal from the transformer is compared with a pre-set current level. The unit can be set to trip, virtually instantaneously, when the current exceeds the pre-set value. Fastrip V avoids repeated overloads because it must be reset, after tripping, before the driven machinery can be restarted. It is also fail-safe, as it also requires re-setting following a power supply failure.

To give maximum flexibility in operation the 30-98 unit is provided with three infintely-variable controls. A "trip" control allows for setting the level of current at which the unit will trip. A "delay" control provides for the selection of a delay time, up to thirty seconds; this allows the operator to select the time that the given overload is present before tripping. Finally, a "rate" control allows the Fastrip to be non-reactive to instantaneous current spikes.

Further details:

The 30-98 Company Ltd.,
Unit 8, Victoria Gardens,
Burgess Hill, West Sussex,
U.K.

New product literature from Permutit

The Permutit Industrial Division has produced new literature to illustrate its range of softening, deionization, filtration and reverse osmosis plant. The literature also includes individual leaflets and complementary technical information sheets to accompany the recently launched CD range of cartridge deionizers. The leaflets incorporate a general description of each plant, outline features and benefits and are complete with full specifications and technical data.

An additional colour brochure, "Permutit Water Softening", explains the causes of hard water and its adverse effects on industrial plant. It details how these may be overcome with the installation of a Permutit Water Softener and discusses typical applications. "PPM" is a new concept whereby a planned maintenance program is designed, suited to a client's specific requirements. A colour brochure outlines the comprehensive service available under this new scheme to ensure that water treatment plant is constantly operating at peak efficiency. The leaflets and brochures are available from The Permutit Industrial Division, Permutit House, 632-652 London Road, Isleworth, Middlesex, TW7 4EZ, UK.

Viscometers

A new brochure from Brookfield features their complete line of rotational viscometers and accessories (including spindles). In addition to the standard dial reading model, there are two digital models: the DV-I which has a large, easily readable display in % Brookfield scale that converts readily into centipoise units, and provides a 0 - 10 mV or 0 - 1 V output signal for connexion to a strip chart recorder, and the DFV-II which automatically calculates and displays, at a touch, viscosity in centipoises, shear stress (dynes/cm^2) or % Brookfield scale. The brochure also contains information on the Wells-Brookfield cone/plate viscometer for routine determination of the absolute viscosity of small volumes of fluids, and the Thermosel system for viscosity measurements at elevated temperatures.

Further details:

Brookfield Engineering Laboratories Inc.,
240 Cushing Street,
Stoughton, MA 02072,
USA.

Low cost electromagnetic flowmeter range...

Kent Industrial Measurements Ltd. have extended the concept of a rugged, low-cost, high performance, electromagnetic flowmeter to nominal bore sizes from 200 to 300 mm (8 to 12 in.) with the introduction of the Veriflux VUC range. Innovative design and volume production techniques have enabled a low selling price to be achieved without sacrificing accuracy. Advanced electronics, combining biopolar pulse field excitation and energy recovery techniques, ensure a stable zero, exceptional accuracy and economy. Accuracy, which is independent of liquid viscosity, density and temperature, is ±0.5% of actual flow. Power consumption is only 8 watts, ensuring very low operating costs. Output options offered are analogue current or frequency or electromechanical counter drive. *In-situ* re-ranging for any flowrate between 0.5 and 10 m/sec and replacement of

printed circuit boards can be made without affecting calibration. Three nominal bore sizes 200, 250 and 300 mm (8, 10 and 12 in) are included in the range. The standard meter lining and electrode materials are approved for use with potable water; alternative materials can be supplied. Most liquids, including acids and alkalis, having a conductivity of not less than 5 μS/cm (5 μmho/cm) can be metered. Process connexions are made via BS4504 flanges which can mate with flanges to DIN, AFNOR and UNI standards up to 16 bar rating and ANSI B16.5 Class 150 flanges.

"... and electrodes"

Kent Industrial Measurements Ltd. has produced a new full-colour brochure detailing the extensive range of pH, ion-selective, redox and gas-sensing electrodes available from the company. Details include brief specifications, descriptions of services available and a short guide to applications.

Further details:

Kent Industrial Measurements Ltd.,
Oldends Lane,
Stonehouse,
Glos, U.K.

Flowmeters

Literature available from Manning Technologies Inc. describes their axial transmission Doppler flowmeters, the Manning-Danfoss Magflo magnetic flowmeters and the transit-time Model 680 ultrasonic flowmeter as well as portable level and flow recorders and samplers.

Further details:

Manning Technologies Inc.,
P.O. Box 66350,
Scotts Valley, CA 95066-0350,
USA.

Flowmeters and switches

Brochures available from Kobold Messring GmbH describe various types of flowmeters and switches, including float-type units for operation at high pressures (up to 1000 bar), types that can be mounted in any position for pressures up to 1000 bar, units with and without analogue output independent of viscosity and mounting position, a flow controller with analogue output, flowmeters and flow switches for very low flows, flow indicators and switches with paddle and bellows, electronic flow switches, an automatic flow regulating valve for constant liquid flow, a flow indicator with plastic rotor in a transparent cylinder which is self-cleaning to afford all-round indication, and a flow indicator with rotor made of PTFE (polytetrafluoroethylene).

Further details:

Kobold Messring GmbH,
Postfach 20523,
D-6233 Kelkheim,
Germany.

SSP offer a new range of CIP and control options

Design advances embodied in the new, integral Series B valves from SSP Pumps Ltd. bring users a wide range of options and control modes. A new facility for pneumatic and hydraulic override of relief valve operation offers particular benefits where CIP systems are in use for processing plants. Valves with this features can be opened for CIP fluid by-pass, avoiding the need for external by-pass pipework and valves, thereby saving time, cost and space.

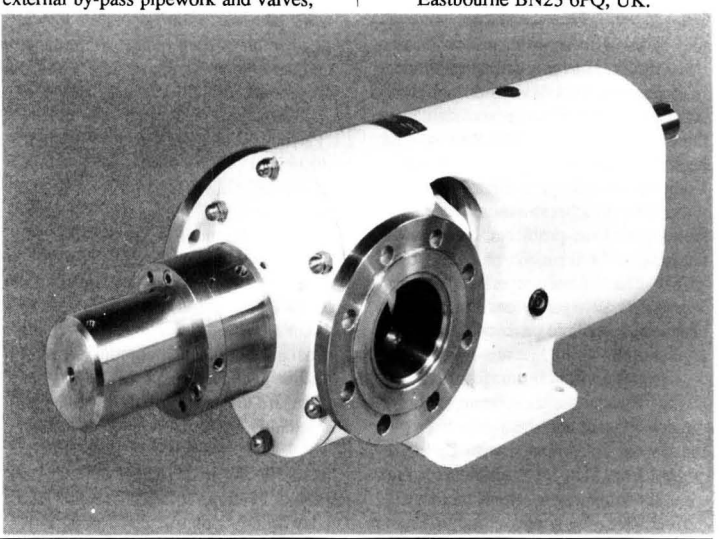
The capability to regulate pump discharge pressure or flow rate automatically, by means of pneumatic or hydraulic input, introduces a practical range of control possibilities for the process engineer.

The series B range of valves are bi-directional, designed for use with low and medium viscosity liquids and are suitable for pump discharge pressures up to 10 bar (150 p.s.i.). Pressure relief versions operate in response to changes of system pressure. The valves are designed for use with hygiene conscious processes but are equally suited to duty with corrosive liquids as the valve mechanism is isolated from the pumped medium.

Particular care has been taken in avoiding any product retaining zones and ensuring smooth flow through the valve. Materials of construction for the product parts are 316 type stainless steel for valve body and piston and Nitrile, EP, Viton or PTFE elastomers. Non product wetted parts comprise bronze pneumatic or hydraulic pistons, stainless steel springs and Nitrile elastomers.

Further details:

SSP Pumps Ltd.,
Lottbridge Drove,
Eastbourne BN23 6PQ, UK.



PR-1 digital Brix meter

The PR-1 is a battery-operated digital refractometer with internal microcomputer control which is accurate to within ± 0.2°Brix and has an indicating range from 0.1 to 32°Bx at a temperature in the range 10 - 35°C with automatic temperature compensation. It automatically measures the Brix of a sample as small as 0.1 ml on a stainless steel sample stage and provides an easy-to-read liquid crystal display within 3 seconds. The model weighs only 285 grams and measures 68 × 170 × 46 mm.

Further details:
Atago Co. Ltd.,
32-10 Honcho,
Itabashi-ku,
Tokyo 173,
Japan.

Hägglunds acquisition extends its hydraulics range

AB Hägglund & Söner, Örnsköldsvik, Sweden, an Asea Group company, has reached an agreement with Pneumo Abex Corp., of the United States, under which Hägglunds is to acquire the Abex Denison Group. Denison, one of the world's larger hydraulics companies, has production and marketing units in the United States, Great Britain, France and West Germany, as well as sales companies in Italy, Holland, Switzerland, Austria, Denmark and Sweden.

"Denison's products complement those of Hägglunds, which means that we can now offer our customers a complete line of hydraulic equipment," comments Bo Södersten, Hägglunds' President. "This merger also gives us a strong sales organization in all important markets. Overall, this will mean a positive development for the sales of both Denison and Hägglunds."

Denison's program comprises hydraulic products such as piston pumps and motors, vane pumps and motors, flow and pressure control valves, etc. Their line of products is adapted for use together with state-of-the-art electronic control systems.

Hägglunds, one of the larger subsidiaries in the Asea Group, manufactures hydrostatic drives, electrohydraulic cranes, winches and cargo handling systems, etc.

ABAY consulting success in Italy

ABAY-Consult, which has for many years specialized in engineering within the sugar industry, has just been awarded a third study contract in Italy in less than a year. Experts know that many Italian sugar factories are in urgent need of re-organization and that a semi-public body called RIBS has been set up to finance and manage this operation. With the full approval of RIBS, ABAY obtained an initial contract to define the re-organization of the Celano factory. This was followed by a second contract for the implementation of the studies and for the supervision of the works to be carried out in the Celano factory. As a result of the above, ABAY-Consult was awarded a contract in October to study and examine the reorganization of the Strongoli factory.

These repeated successes, together with those recently achieved in Belgium and abroad, bear witness once again to the high quality of the services rendered by ABAY-Consult, in a sector of industry where energy conservation, increased efficiency and plant automation are of the utmost importance.

New silent air nozzles

Spraytec Engineering Ltd. have introduced a new air blow-off nozzle for all applications where dust or other particles have to be removed from components, products moved by means of an air jet or surfaces dried with a low-pressure air stream. The main advantages of the "Whisperblast" are high blowing power, extremely low noise level (up to 12 dB lower than a single-hole nozzle of equivalent capacity), low air consumption, resistance to fuel oil, mineral oil, lubricants and common solvents, and temperature resistance from – 40°C to 90°C. The valve is usable at 0.2 bar (3 psig) to 5 bar (75 psig) and is available with a $^1/_4$-in BSPT thread, 8 mm or $^5/_{16}$-in hose connexion and clamping tube.

Further information:
Spraytec Engineering Ltd.,
160 Matilda Street,
Sheffield S1 4QG,
UK.

Process control and instruments catalogue

A free 100-page comprehensive illustrated catalogue of process control equipment has been published by Flowbits, with versions in English, French and German. This contains technical details and prices of a vast range of meters, pumps, valves, instruments and transducers, etc., available ex stock in the UK, France and Germany. Every item is excellently illustrated and clearly described, with both photographs and line drawings. Copies are available from Platon Flowbits Ltd., Basingstoke, Hants. RG22 4PS, UK; Flowbits S.A., 73 rue de la Course, 33000 Bordeaux, France, or Platon Flowbits GmbH, Wiesenbacherstr. 65-69, D-6903 Neckargemünd 1, Germany.

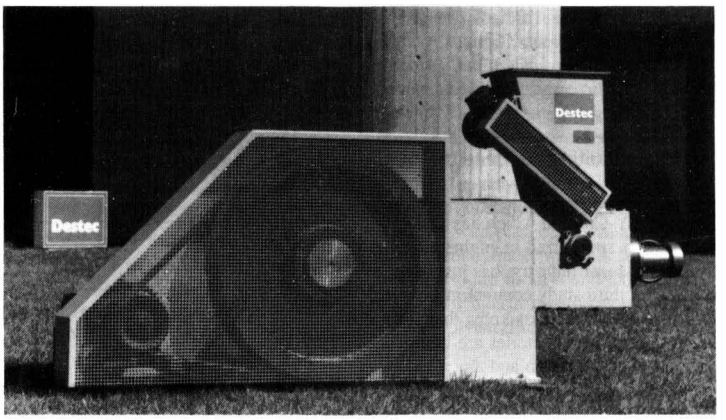
Quicker mixers

Following introduction of new computerized production control and CAD/CAM systems, Ekato has cut delivery times on its agitator units. Computerized information about stocks of component parts enables project engineers to minimize lead times whilst retaining individual designs to customer requirements.

Further details:
Ekato Rühr- u. Mischtechnik GmbH,
Postfach 1110/20,
D-7860 Schopfheim,
Germany.

Briquetting presses for bagasse and beet pulp

The Destec company specializes in presses for briquetting of agricultural



waste products and have experience with both bagasse and beet pulp. They have developed complete plants which can produce a 10-20 times compression of the original raw material, increasing its density and simplifying storage, handling and distribution. The Model FP150 press above has a capacity of 450 - 900 kg/hr, depending on the raw material, and requires a main motor of 18.5 kW. It is fitted with one set of 55 mm dies, whereas the Model FP3 has two sets; this press has a capacity of 900 - 2000 kg/hr and requires a main motor of 45.0 kW. Both presses are easy to maintain and are designed with an integrated lubrication system. For bagasse briquetting the raw material should be dried to 16 - 18% moisture content and chopped before briquetting. Chemically treated bagasse can be incorporated with other materials as roughage in cattle feed, while briquetted beet pulp is used for the same purpose.

Further details:

Destec A/S.,
P.O. Box 127,
Tagholm 1,
DK-9400 Nørresundby,
Denmark.

New improved metric diverter valve

Kerry Handling have produced a new and improved diverter valve for insertion in bulk pneumatic feed lines at the top of mixers and weigh hoppers. The valve is utilized as a combined feeding and venting valve and is available in two types DVF 80 and DVF 100. The valve is manufactured in rigid close grain cast iron with side plates and precision machined rotating block for port selection. It is suitable for most material on applications in pneumatic systems for in-flow diversion to bulk storage weighing hoppers and mixers, especially for powders and granules in the food and other industries.

The valve is fitted with a reliable pneumatic actuator which can be mounted on either side of the valve and is interchangeable on the shaft. To ensure its reliability every single valve is bench tested and run for a number of hours prior to despatch.

Further details:

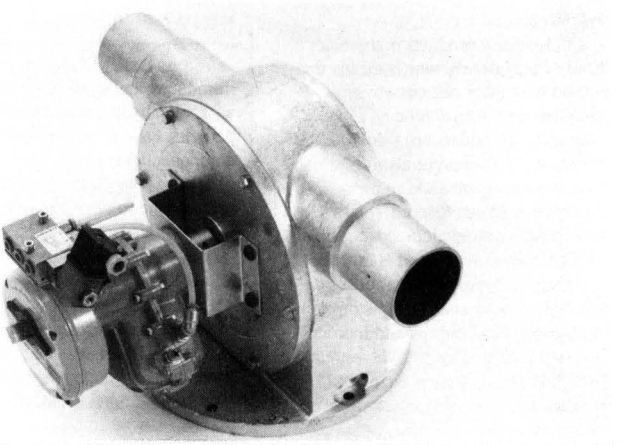
Kerry Handling Limited,
Kerry House,
High Street,
East Grinstead,
West Sussex, UK.

Powell Bailing Systems join forces with Northern Conveyors Ltd.

Northern Conveyors Ltd., the Haydock based mechanical engineering company, have recently acquired Powell Bailing Systems from Motherwell Bridge Tacol Ltd. Powell products, including baling machines, compactors, bale breakers, shredders and reel splitters, will now be manufactured at the Northern Conveyors Ltd. factory in Haydock. Powell's have over 50 years experience of designing and manufacturing equipment for the paper and sugar industry, both in the United Kingdom and overseas. The acquisition by Northern Conveyors Ltd. will result in Powell Bailing Systems being able to offer in the near future a more competitively priced and increased product range.

Further information:

Powell Bailing Systems,
Haydock Lane,
Haydock, WA11 0UU,
UK.



Inter-American Sugar Cane seminar on energy and by-products

On September 24, 327 participants, from 23 countries and 10 US states, were welcomed by the Seminar President, Mr. Diego R. Suárez, to the 1986 Inter-American Sugar Cane seminar on "Energy and by-products from sugar cane", held at the Miami Convention Center. Mr. Suárez referred to the economic importance of sugar cane by-products during times of crisis, citing examples in Cuba, Mexico and Haiti.

The Mayor of the City of Miami officially declared the 1986 Seminar open and briefly referred to the importance of proper technology in this interesting field. Dr. Robert N. Falgout, Head of the Agricultural Department of Nicholls State University in Louisiana, on behalf of all co-sponsors, praised the importance of these seminars and specifically mentioned the influence of these events upon invited and visiting students. Dr. Alfonso L. Fors, Chairman of the Organizing Committee, then made several announcements concerning the technical sessions.

In the first working session, moderated by Dr. J. D. Miller, Research Leader of the Canal Point USDA Field Station, Dr. Nicolas Rivero of the Organization of American States gave an interesting talk on the importance of the sugar industry in the countries of the Caribbean Basin. Other authorities from the Dominican Republic, Venezuela and Mexico also contemplated the social and economic aspects of the sugar industry's by-products.

The second session, moderated by Dr. Van H. Waddill, Director of the EREC Experiment Station in Belle Glade, dealt primarily with energy, both in the factory and in the field. Among the speakers in this session was Dr. Alex G. Alexander, author of the book "Sugar cane for energy".

Dr. Fred A. Martin, of Louisiana State University, moderated the third session, basically concerned with alcohol production. Mr. Olmar C. Lopez, from Puerto Rico, presented an original paper on rum production. Technical activities were ended the first day with a paper by Douglas Urdaneta and Simon Parisca of Venezuela on improvement of continuous syrup fermentation through yeast and vinasse recycling.

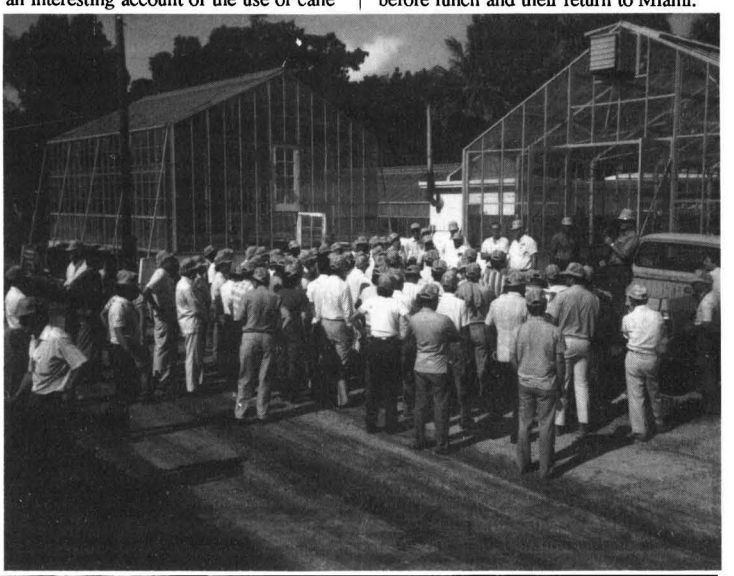
The seminar continued on September 25 with the fourth working session, moderated by Dr. Gary J. Gascho of the University of Georgia, in which bagasse was extensively discussed both as a raw material for chemical products and as a source of paper pulp. Disposal and uses of filter muds were discussed in Session 5, moderated by Dr. David L. Anderson of the University of Florida. Dr. Alfonso L. Fors opened the session with an overall account of filter mud production. This session ended with an interesting paper by Herwig Tretter from Australia, who discussed muds and slurry disposal.

The last technical session was moderated by Dr. Robert N. Falgout of Nicholls State University. The first paper was by Dr. Findlay M. Pate, of the University of Florida, on feeding of cane and its by-products to cattle; this was followed by an account of research on cattle feeding in Guatemala, presented by Julio R. Tejada and Mario R. Bouscayrol, which obtained the Award for the seminar's best paper, as judged by the participants.

The final paper to be presented was an interesting account of the use of cane trash for energy and furfural production in Central Romana, by Pedro A. López, of the Dominican Republic. It is hoped to publish abstracts of the papers in due course.

At the closing ceremony, Mr. Suárez presented Plaques of appreciation to speakers, moderates and members of the Organizing Comittee. Mr. Mario A. Mascaró, the internationally known sugar technologist, was honoured with a special Plaque in honour of his dedicated work during more than half a century and specifically for his contributions in the field of by-products. The Seminar Award was then presented to the authors of the best paper, and the day closed with an informal reception offered by Inter-American Sugar Cane Transport Co., sponsors of the seminar.

On the final day, participants were taken to the USDA Sugarcane Field Station in Canal Point where they were welcomed by Dr. J. D. Miller (below) and taken in groups to tour the station before continuing to the Everglades Research and Education Center in Belle Glade where, after a welcome by the Director, Dr. Van H. Waddill, they were able to both watch a film and see for themselves the activities of the Center before lunch and their return to Miami.



Experience with continuous vacuum pans in Tongaat-Hulett Sugar*

By Dr. P. W. Rein
(Tongaat–Hulett Sugar Ltd., South Africa)

Introduction

As one of the last remaining batch operations in sugar processing, pan boiling has received considerable attention in an effort to realise some of the advantages of continuous processing over batch processing. In general, the advantages of continuous processes have been established as better utilization of plant, higher operating efficiencies and better process control. In the specific case of vacuum crystallization, it was also expected that further process advantages could be obtained through the attainment of more uniform crystallization conditions and improved thermal economy by the nature of the continuous process and because of the possibility of using lower quality vapours as the heating medium.

Low-grade continuous pan boiling is now well established in the South African sugar industry. Within Tongaat-Hulett Sugar Ltd. a considerable amount of development work has taken place in continuous pan boiling, which has culminated in a new design of continuous vacuum pan used in high- as well as low-grade boilings. The purpose of this paper is to trace this development and relate the operating experience which has been obtained with these pans.

The first continuous pan installation in South Africa

Tongaat-Hulett Sugar was looking to expand the pan floor capacity of its Maidstone factory in 1976. At that time, Fives-Cail Babcock (FCB) were most advanced in continuous pan boiling and it was a logical decision to install one of these pans as a *C*-massecuite pan. This was a 64 m³ unit, at that time the largest continuous pan available.

The results and operating experiences with this unit have been published previously[1]. In essence, the installation was marked by the ease with which the pan was commissioned, and proved conclusively that this type of operation was viable for raw sugar mills on low-grade massecuite. However, because of the high viscosity of low-grade massecuites in South Africa, a number of modifications had to be made

P. W. Rein

to the pan. The most significant of these was the fact that it was essential to make use of circulating steam, fed in under the calandria, to promote circulation. This is known as jigger steam and is used widely in South African batch *C*-massecuite pans as well. Subsequently, all FCB continuous pans were provided with jigger steam facilities.

Even with these modifications, it was not possible to achieve the design massecuite throughput. Improved throughputs were obtained with the use of jigger steam and with calandria steam pressures of about 50 kPa gauge. The additional factors affecting throughput were found to be massecuite level in the pan and the Brix profile[2]. This pan was fitted with vertical plate elements as a calandria and heat transfer performance was disappointing. An average specific evaporation rate of approximately 5kg/hr/m² and a heat transfer coefficient of about 75 W/m²/°C was achieved.

One of the positive outcomes of this installation was the fact that it was established that a conductivity control loop on each compartment was a satisfactory way of controlling the operation of the pan. The mode of control is shown in Figure 1 and this approach has subsequently been adopted on all other continuous pan installations in South Africa.

Experience with converted batch pans

For several years no expansion was envisaged which could justify the installation of new pans. However, it was considered that if batch pans could be modified to operate continuously, then some of the advantages of the continuous operations could be achieved at minimum cost. With this in mind, a batch *C*-massecuite pan at the Mount Edgecombe factory was modified by the installation of radial baffles within the batch pan, dividing the pan into 6 equal-sized compartments. This was operated as a continuous pan by pumping seed into the first compartment and withdrawing massecuite out of the sixth compartment, via an overflow weir and a seal leg, into the crystallizers.

* *Paper presented at the 60th Conf. S. African Sugar Tech. Assoc.*, 1986.

1 Graham & Radford: *Proc S. African Sugar Tech Assoc.*, 1977, **51**, 107.

2 Matthesius *et al.*: *ibid.*, 1978, **52**, 89 - 92.

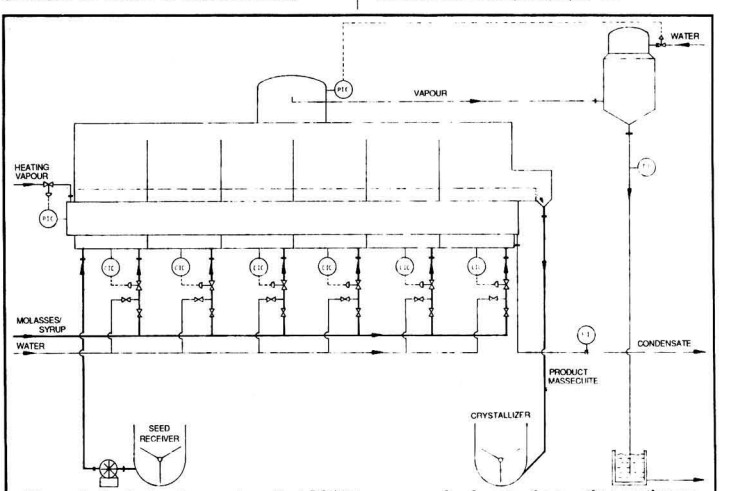


Figure 1. Control system used on first Maidstone pan and subsequently on other continuous pans (Note: only 6 compartments are shown)

Suma Products

VACUUM PAN CONTROL

The redesigned **CUITOMETER** type H incorporates solid state electronics. Three d.c. outputs are now provided so that the unit can be used either for manual or semi-automatic control. Provision for testing the instrument during operation is provided so that a greater degree of control is now available. A special sensitivity control device is incorporated so that the high purity syrups can also be controlled as well as low product boilings, thus increasing the scope of the instrument. A further modification lies in the fact that the instrument will now operate either from a 50 or 60 Hz supply single phase A.C. 110/125 or 220/240 V.

The **CRYSTALOSCOPE** crystal projection instrument enables the pan operator to view the crystal growth throughout the boiling cycle. The $8\frac{1}{2}$" diameter observation screen is fitted with a squared graticule each side of which represents 0.5mm. on the crystal surface. The instrument will fit into an aperture of $6\frac{1}{2}$" diam. in the pan wall and is held in position by 8 equally spaced $\frac{5}{8}$" diam. bolts on $8\frac{3}{4}$" P.C.D. The magnification is ×30. Provision is made for the alteration in gap between the two observation ports and for focussing the crystals on the screen to give a sharp image over the entire screen area which is evenly illuminated. Operation is from a single phase A.C. 110/125 or 220/240V supply.

Write now for details of our complete range of factory and laboratory equipment.

The Sugar Manufacturers' Supply Co. Ltd.

18 CITY ROAD, LONDON, ENGLAND EC1Y 2AP

Telephone: 01-638 9331. *Cables: Vairon, London, Telex* *Telex: 886945*

This arrangement worked very well. The massecuite level was kept about 500 mm above the top tube plate, so that only 16 m³ of the 28 m³ of the pan was utillized. Even so, the exhaustion in this pan was as good as, or better than, that achieved in similar batch pans and conductivity control of each compartment again proved to be successful.

Of interest was the fact that very much higher evaporation rates were obtained by comparision with the pan at Maidstone. The specific evaporation rate averaged about 9 kg/hr/m², but was affected by massecuite boiling level. In this pan, the highest rate occurred with a level about 400 mm above the top tube plate. In general, evaporation rates comparable to those achieved in batch boilings were obtained.

Considerable thought was given to the massecuite flow in this pan. This is an important area and in the past the conversion of the other items of process plant from batch to continuous operation has failed because inadequate attention was given to the attainment of plug-flow conditions. In the Mount Edgecombe pan, cross-over ports were located above the calandria, with a baffle on the downstream side of the cut-over port. With this arrangement, it was expected that short-circuiting would be eliminated. Tracer tests were undertaken on this pan to evaluate the flow characteristics of the system. It was found that this 6-compartment pan could be represented by a flow model comprising 9 perfectly mixed tanks-in-series. By comparison, the 15-compartment FCB pan at Maidstone was also found to be equivalent to a flow system consisting of 9 tanks-in-series. Clearly, in the latter case, a poor approach to plug flow is obtained, with evidence of short-circuiting through compartments[3].

At this stage, the prospect of Tongaat-Hulett Sugar building a new mill at Felixton was becoming a reality. Although it appeared that continuous pan boiling for low-grade massecuites was a practical proposition, nowhere had a continuous pan been operated on high-grade *A*-massecuites. It was decided, therefore, to convert a batch 85 m³ *A*-pan at Amatikulu in a similar way to the Mount Edgecombe conversion. This installation was not successful owing to the encrustation of the heating surfaces, which meant that the pan could not be operated for more than a few days without having to take it off and boil it out. It was subsequently established that this was due to the poor circulation ratio (ratio of tube cross-sectional area/downtake area). The additional resistance which the baffle plates afforded the massecuite in the downtake meant that some massecuite was trying to find its way down some of the tubes close to the downtake and in this area encrustation was particularly severe.

However, this trial was not in vain. It established that conductivity control of continuous *A*-boilings was a feasible proposition, although encrustation of the conductivity probes meant that they had to be cleaned on a regular basis. The sugar quality and size distribution were good and some very high specific evaporation rates of around 40 kg/hr/m² were measured. The excellent circulation achieved with these high evaporation rates was confirmed by visual observation.

These experiments also provided data which was used to develop a computer model of continuous pan boiling[4], which has subsequently been used for design and optimization purposes.

The prototype Tongaat–Hulett Sugar continuous pan at Maidstone

The poor massecuite flow characteristics and low heat transfer rates achieved in continuous pans in the South African industry led to the development of a new design of pan which would overcome these drawbacks. Since Maidstone Mill again needed to expand the capacity of the pan floor, a 110 m³ continuous pan of the new design was installed. Although initially planned as a *B*-massecuite pan, provision was made to run the pan on *A*-, *B*-, and *C*-massecuites for test purposes.

In theory, a true plug-flow system is ideal in that it provides for identical residence time for all crystals in the system. In practice, this system can be very hard to control, particularly if changes in throughput rate are envisaged. It was decided, therefore, to pursue the approach of a continuous system divided into a number of compartments, with control of feed into each compartment. This system with careful design can give a close enough approach to plug-flow for all practical purposes and this has subsequently been confirmed by an exhaustive series of tracer tests.

The main features of this pan were the incorporation of a vertical tube calandria to achieve better heat transfer and circulation rates and a "clean" circulation path. The pan was divided into 12 compartments, with the calandria in the centre of the pan. A plan view of this pan is shown in Figure 2. A variable-height offtake weir is incorporated which determines the boiling massecuite level. The calandria

3 Rein *et al.*: *ibid.*, 1985, 59, 58 - 67.
4 Hoekstra: *ibid.*, 48 - 57.

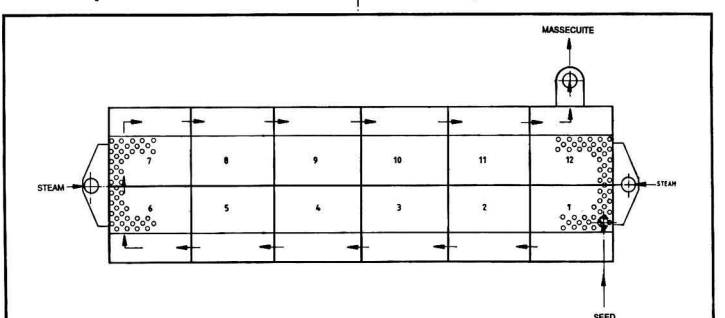


Figure 2. Plan view of the first Tongaat-Hulett pan installed at Maidstone

and the shape of the pan around the calandria was designed so that the massecuite circulation is similar to what is currently achieved in batch pans. The tubes are also 100 mm in diameter, but at 1.5 m are slightly longer than currently used in batch pans, in order to achieve a pan of manageable proportions.

As a result, the circulation ratio is improved considerably from a figure of 2.5 in our standard batch pans, to around 1.0. Molasses or syrup is fed into each compartment under the calandria, as is jigger steam which is manually controlled to each compartment.

The results of the early experimentation on this pan have been reported by Kruger[5]. The pan has been able to operate satisfactorily on all grades of massecuite and is currently in use as an *A*-massecuite pan. The quality of sugar crystal produced by the pan is good, evaporation rates and circulation rates are high and the pan is able to operate with subatmospheric vapour in the calandria. In addition, tracer tests showed that the approach to plug flow in the pan is excellent[3]. The results of this series of tests were sufficiently convincing to allow us to proceed with the design of *A*-, *B*- and *C*-massecuite continuous pans for the new Felixton Mill.

Continuous pan boiling at Felixton Mill

After the successful development work at Maidstone, it was decided to install continuous pans on *A*-, *B*- and *C*-massecuites in the new Felixton Mill. The new factory replaced two older ones which were shut-down and has a crushing capacity of 600 tonnes of cane per hour. It was commissioned at the beginning of 1984, so the continuous pans have now been in operation for two seasons. Two *A*-pans, each of 120 m³ and 4 pans of 76 m³ for *B*- and *C*-massecuites were installed. All 6 pans have 12 compartments and further details of the Felixton pan floor can be found elsewhere[6].

The design of the pans is essentially the same as that of the Maidstone pan. Some slight modifications were made, the main one being that the tube length were reduced from 1.5 m in the Maidstone pan, to 1.45 m in the *B*- and *C*-pans and 1.3 m in the *A*-pan. The major difference was the incorporation of an entrainment separator and condenser as an integral part of the pan. This has the advantage of eliminating long lengths of large diameter vapour piping and the need for support steelwork for an external condenser. A cross-sectional view of one of these pans is shown in Figure 3.

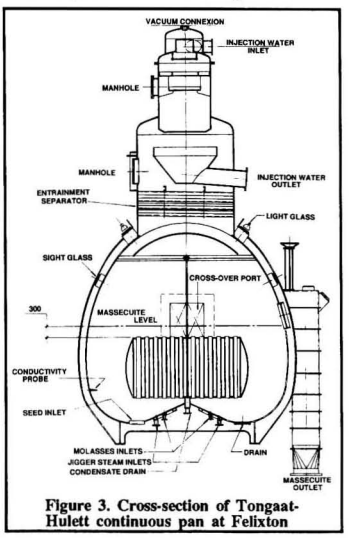


Figure 3. Cross-section of Tongaat-Hulett continuous pan at Felixton

Massecuite flow between compartments is via cut-over ports positioned immediately above the calandria. Baffles are installed on both sides of the port to eliminate short-circuiting and promote plug flow. This arrangement has the advantage that the opening is kept clean and free of encrustration by the vigorous boiling just above the calandria and there is virtually no hydraulic gradient from the first to the last compartment.

Commissioning of the *B*- and *C*-pans proceeded without any hitch and these pans have continued to operate without any serious problems. The operation of the *A*-pan was affected by control problems, and conductivity, capacitance and boiling point elevation have been used to control massecuite condition. In spite of control problems the new mill has always been able to meet sugar quality specifications for VHP sugar, even towards the end of the first season when mixed juice purities dropped as low as 76 owing to the influence of climatic conditions on cane quality.

The *A*-pans have been emptied every two weeks and boiled-out with water to remove encrustation. The process of emptying the pan, boiling-out with water and initiating continuous boiling again can be easily and conveniently done utilizing the drain valves in the bottom of the pan. Massecuite from the last few compartments is struck into a crystallizer and the massecuite from the first few compartments is cut-over into a seed receiver. On starting-up again, the massecuite in the seed receiver is cut-over to the last few compartments of the pan and the first few compartments are filled with seed cut-over from a batch pan.

Heat transfer measurements on the Felixton pans have confirmed the design figures obtained from Maidstone trials. Operation has confirmed also that calandria pressures can be kept low, at times sub-atmospheric, and that high massecuite Brixes can be achieved.

Operating experience

In general, it has been proved that continuous pans are easier to operate than batch pans and require less operator attention. Some re-education of pan boilers has been necessary, particularly to get them to accept that continuous pans should be run as steadily as possible, with a minimum of changes. Steadier and more efficient operation is achieved if the molasses or syrup feed is controlled at a constant Brix and temperature and if the seed quality fed into the pan is consistent.

Perhaps the major problem experienced with these pans has been the control of massecuite Brix in high-grade pans. This problem has been overcome through the use of specially developed transmitters, measuring electrical

5 *ibid.*, 1983, **57**, 46 - 51.
6 Rein: *Rpts. Hawaiian Sugar Tech. Conf.*, 1984.

ISJ Abstracts

Cane sugar manufacture

Quantitative studies on the phenolics in the sugar manufacturing process

O. P. Sharma and S. S. Srivatsa. *Proc. 48th Ann. Conv. Sugar Tech. Assoc. India*, 1984, M.81 - M.88.

The total polyphenol content was determined in mixed and clear juice, unsulphited syrup, massecuite, final molasses and white sugar samples at a carbonatation factory. The values are tabulated and observations discussed, including a correlation between the amount of phenolic material removed by clarification and the colour of the clear juice, and the fact that larger sugar crystals contained more colour and phenolics than smaller ones.

Aloe vera – a new flocculant substitute

P. Thangamuthu and N. R. Krishnamohan. *Proc. 48th Ann. Conv. Sugar Tech. Assoc. India*, 1984, M.95 - M.103.

Experiments on the use of *A. vera* (the common aloe) extract as flocculant in the clarification of limed laboratory crusher juice are reported which showed that, at an optimum dosage of 3 ppm, it gave a much smaller volume of mud than without the use of a flocculant and proved slightly better in this respect than Magnafloc LT27 at 1 ppm; it also gave a faster settling rate and a supernatant juice that was brilliant and golden yellow, and had a bleaching effect similar to or even better than that of sulphitation. The extract was also effective in the treatment of evaporator syrup, boiler feed water and effluent.

Semi-automatic vacuum pan boiling

V. S. Bagi. *Proc. 48th Ann. Conv. Sugar Tech. Assoc. India*, 1984, M.105 - M.109.

A semi-automatic vacuum pan is described that operates on the basis of conductivity as supersaturation control parameter and has proved better than low-grade batch pans in regard to lower molasses purities as a result of eliminating crystal dissolution.

A method of quick evaluation of sugar mill performance results

T. T. Oommen. *Proc. 48th Ann. Conv. Sugar Tech. Assoc. India*, 1984, C.1 - C.7.

The possibility of manipulating calculated cane, mixed juice and bagasse pol values so as to indicate total losses that are lower than the true values is discussed (mainly for the sake of non-technical managers). To avoid deception, the author suggests a simple formula in which pol % cane is given by (100 - 1.25 fibre) × pol % primary juice, and explains the significance of the Java Ratio.

Methods of improving mill extraction

K. Satyanarayana. *Bharatiya Sugar*, 1986, **11**, (4), 9 - 11.

General ways in which extraction may be improved are briefly discussed, covering field operations, cane handling at the factory, cane preparation and cane mill operation.

Amino-acid contents of plantation white sugar

D. B. Ghule, R. B. Natu and S. J. Jadhav. *Bharatiya Sugar*, 1986, **11**, (4), 43 - 46.

The total amino-acid contents in plantation white sugar produced by cooperative sugar factories in Maharashtra during 1984/85 were determined by the ninhydrin method and found to range from 31 to 186 ppm (average 73 ppm) in M-30 sugar and from 26 to 132 ppm (average 55 ppm) in S-30 sugar. The role of amino-acids in sugar quality, particularly colour formation during storage, is briefly discussed.

Control of undetermined loss of sugar due to inversion in plantation white sugar manufacture

D. S. Lande and A. R. Patil. *Indian Sugar*, 1985, **35**, 493 - 501.

See *I.S.J.*, 1986, **88**, 125A.

The Dominican Republic sugar industry - a struggle for survival

A. Goedhart. *Zuckerind.*, 1986, **111**, 484 - 486.

A survey is presented of the sugar industry of the Dominican Republic, with a map showing the locations of the 15 sugar factories (of which 12 are operated by the state-owned Consejo Estatal del Azúcar) and their estates. Information is given on the diversification program that has been undertaken to remedy the worsening situation created by the cut in the US import quota and the falling world price (since only a small proportion of the sugar produced in the country is consumed domestically).

Indian sugar technology – take-off into the 21st Century

M. Anand. *Bharatiya Sugar*, 1986, **11**, (5), 9 - 11, 13 - 16.

The lines along which cane preparation and milling are likely to progress in India are surveyed, and mention is made of boiler capacity and fuel economy.

A practical method to assess factory performance

S. Srinivasan. *Bharatiya Sugar*, 1986, **11**, (5), 31, 33 - 38.

Because of difficulty in obtaining a truly representative sample of bagasse, the pol lost in bagasse cannot be determined accurately. Instead, for assessment of factory performance, three methods for cross-checking reported losses are examined: (1) that of Anand in which pol % cane = (100 - 1.25 fibre) × pol % 1st expressed juice, (2) the Java Ratio, and (3) the ratio of sugar recovered % cane/pol % 1st expressed juice, which is termed the efficiency factor. The three formulae were applied to reported data from a number of sugar factories over the past seven years to decide how much

reliance could be placed on the reported results. The effect of the position of juice screens (before or after the 1st mill) on the use of method (1) is discussed.

Some aspects of reduction of the steam demand for a sugar factory by adoption of hot water imbibition

P. K. Shewale and A. R. Patil. *Sugar Scene*, 1986, **4**, (5), 9.

The use of hot imbibition is briefly discussed and its major advantages given as: steam economy in heating mixed juice (of e.g. 5 - 6°C) to 70°C by comparison with cold juice, a slight increase in the amount of moisture evaporated from the warmer final bagasse used as fuel, and reduction in bacterial activity and hence lower losses. Mill slippage as a side effect of hot imbibition is overcome by modern roller surface treatment.

Methods of improving mill extraction

A. Ramamoorthy. *Bharatiya Sugar*, 1986, **11**, (6), 9 - 11, 13 - 16, 19, 21, 23 - 26, 31 - 32.

Cane milling is discussed in all of its major aspects, including calculation of extraction performance and of the reabsorption factor, and details are given of changes made to the system at the author's factory where reduced extraction of the 4-mill tandem in 1984/85 was 96.64% compared with 94.76% in the previous season. The modifications included reversing the direction of the cane leveller and cane knives (giving a Preparation Index of >85), altering the angle of the grooves in the feed roller of the No. 1 mill from 40° to 35°, elimination of chevron grooves so as to provide a greater area for compression, arcing of the top and discharge rollers, adoption of improved mill settings, removal of the pinions of the discharge rollers on the first and last mills, and use of a new compound imbibition scheme in which screened juice from the 3rd and 4th mills is sprayed onto the bagasse as it is discharged from the 1st and 2nd mills and is also sprayed onto the bottom of the bagasse blanket.

Reduction of final molasses purity by addition of phosphoric acid to *C*-massecuite

N. R. Tagore. *Bharatiya Sugar*, 1986, **11**, (6), 33 - 35.

Addition of 2 litres of phosphoric acid per 40 tonnes of low-grade massecuite in the pan reduced the molasses purity from 35.06 - 35.79 in 1981/84 to 31.69 in 1984/85 and eased purging of the massecuite, whereas previously difficulties had occurred when the purity fell below 60.

Impact and implementation of new sugar grades in South Indian sugar factories

K. N. Kannan. *Bharatiya Sugar*, 1986, **11**, (6), 57 - 59.

The official sugar grades were reduced in number from ten to six, i.e. three per colour series (29 and 30) with effect from the 1984/85 season, and the author makes a critical appraisal of the new system and discusses its repercussions on manufacturers.

The impact of the new sugar standards

R. Ramamurti. *Bharatiya Sugar*, 1986, **11**, (6), 61 - 64.

The new sugar standards (see previous abstract) are discussed and the benefits to the steam economy of a factory producing smaller grain indicated.The author questions the wisdom of abolishing the previous D grade (which represented 52.6% of all the standard sugar produced in India and was mostly manufactured by the southern states), but considers that the final outcome will be to the good of the industry; he even advocates reducing the system to only two standard sizes: 1.18 and 0.60 mm or merely one size of 0.75 mm.

Sugar cane juice concentration by reverse osmosis

V. J. Shah, R. M. Kava, N. V. Desai and A. V. Rao. *Indian Sugar*, 1986, **35**, 593 - 597.

Trials are reported in which the Brix of cane juice was raised from 15 - 17° to 24 - 26° by reverse osmosis in two pressure vessels each provided with four spiral cellulose acetate membranes. Results of the 31 experiments conducted over one month showed that at a feed rate of 10 litres/min (the maximum possible under the conditions) the permeate flux rose with increase in pressure from 600 to 1000 psi and with rise in feed temperature in the initial tests (gradual deposition on the membrane surface reducing the permeation rate and necessitating washing of the membranes at, preferably, 8-hour intervals). Optimum conditions are given as 800 - 1000 psi and 60 - 65°C (depending on membrane life at this temperature level).

Testing for abnormal fibre properties

A. Brotherton. *BSES Bull.*, 1986, (14), 22.

While a small-scale impact test had identified cane varieties that could cause milling problems because of their fibre properties, it was somewhat empirical, although a significant relationship was found between the results and tensile strength of the vascular bundles. However, the procedures used for tensile strength measurement were sufficiently involved to question justifiability of the expense relative to the possible results. A method was developed at the Sugar Research Institute in which the maximum shear strength of a block of shredded cane compressed to a standard density was measured; the block of cane was held between two spiked horizontal plates, and the force required to shear it when the upper plate was pulled horizontally was found to be related to many of the milling problems reported by factories. Both this and the impact test were applied to a selection of 50 experimental and commercial cane varieties and gave generally similar results, but with some obvious

differences; while three varieties that have proved troublesome in processing were placed at the extremes of the range by measurement of the shear strength, the impact test indicated some experimental varieties that could be even more troublesome. Since the only means of confirming this would be to carry out full-scale milling tests (requiring several farm blocks of at least 100 tonnes each), it is suggested that the two tests should be applied to all cane varieties due for release and full-scale trials arranged for any variety exhibiting extreme properties.

Factors affecting the levels of colour entering a sugar mill

P. E. Abernethy and A. T. Aitken. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 1 - 7.

Studies demonstrated the validity of 1st expressed juice colour, phenols and amino-N analysis as a means of establishing the levels of colour and colour precursors in mixed juice. The colour and phenols levels were much greater in mixed juice than in 1st expressed juice, indicating greater extraction in the 2nd and subsequent mills, while the amino-N contents in both juices were similar. The quantities of impurities such as colour and ash expressed on a unit impurity basis were found to be preferable to use of Brix and pol as basis. Cane variety had a significant effect on juice colour, so that breeding is seen as a possible means of reducing the amount of colour that enters a factory.

Information and communications in the Australian sugar industry

J. R. Allen. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 9 - 16.

From examination of technical aspects of general communications and dissemination of information within the Australian sugar industry, it is considered that wider use could be made of computers and microprocessors; installation of a terminal and modem at each factory would allow information to be sent and provide access to data from other factories within the network and to the computer facilities of the Sugar Research Institute.

Development of test methods to predict the handling characteristics of cane fibre during the milling process

G. A. Brotherton, K. W. V. Cross and P. N. Stewart. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 17 - 24.

See Brotherton: *I.S.J.*, 1987, **89**, 13A.

The press method of sugar cane analysis

A. P. Saranin. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 33 - 41.

Analysis of experimental data obtained in four studies on the use of a hydraulic press for cane analysis (as a possible alternative to a wet disintegrator which, although having a number of technically attractive features, was considered too expensive to operate for routine purposes) showed that there is a practical compressibility limit for commercial canes which is, at approx. 50% fibre per plug mass, reproducible to within ± 2.5 units; this limit is the "fibre limit" for efficient milling. A consistently high fibre-dependent correlation was also found between the Brix and pol of the press juice on the one hand and absolute juice in cane on the other. These findings indicate the suitability of the press method for Australian conditions in combination with direct sampling of cane.

The core-press system of sugar cane quality determination

A. P. Saranin. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 43 - 47.

In the system described, cane consignments are taken by a core sampler at the receival station independently of the yard and milling operations, and the composite samples are analysed for fibre, Brix, and pol by the press method. Recoverable sugar in cane (r.c.s.) is calculated by a formula based on the analytical results from the press method and on the current milling efficiency in Queensland: r.c.s. = (1 – 1.4F) (1.4P – 0.4B), where F = fibre per unit cane, and P and B are respectively pol and Brix % expressed juice. Comparison of recoverable sugar predicted by the c.c.s and r.c.s. formulae for the 1980/84 seasons showed that the latter formula was more accurate (the c.c.s. formula under-estimating the average for the state) and gave values that were regionally more consistent. The advantages of the core-press method are listed.

Power consumption in continuous centrifugals

C. R. Greig, E. T. White and L. K. Kirby. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 173 - 178.

Analysis of the steady-state power consumption of a continuous centrifugal showed that the power loss in bearings was dominated by viscous friction in the lubricant and was independent of applied load; it was typically 3 - 10% of the total operating power, depending on lubrication method, bearing arrangement and rotary speed. A more significant loss was due to windage and represented 10 - 40% of the total power usage; windage was not governed by applied load but by basket type and diameter as well as rotary speed. Total energy analysis was used to evaluate the power requirement for massecuite processing and provided a rapid, accurate estimate of the power needed to accelerate and separate the molasses and sugar. The power requirement depended on product flow rate and discharge points as well as speed and was usually at least half of the total power consumption, although molasses flowback could increase it by up to 50%. A predictive model embodying the various contributions to the overall power consumption agreed favourably with previously reported data.

The teapot effect and remixing in continuous centrifugals

L. K. Kirby and C. R. Greig. *Proc. Australian Soc. Sugar Cane Tech.*,

1986, 179 - 183.

The teapot effect is the tendency of a flowing liquid to attach itself to the outside of the vessel from which it is being discharged, rather than fly off tangentially. Hence, molasses travels to the top of the basket of a centrifugal and rejoins the sugar stream in the sugar compartment; this flowback adds to the basket load in high stress areas, reduces the purging efficiency and increases power consumption. Crystal breakage is also significantly lower in sugar not affected by remixing. The phenomenon is thought to be the cause of a semi-liquid stream of sugar that has been observed frequently in continuous centrifugals and which usually follows the walls of the inner housing of the sugar discharge hopper. It is recommended that centrifugals be tested with water after slack-season maintenance and reassembly to check for backflow, and corrective measures adopted such as modification to windage patterns and possible correction of the internal baffle arrangements. A solution has been developed for which patent application has been made.

Pan overstirrer evaluation at Rocky Point

K. F. Miller, P. G. Wright and A. B. Ruddy. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 185 - 191.

Details are given of an impeller mounted above the top tube plate of a 36 m^3 floating calandria pan for the 1985 season and which was tested on *B*-strikes at various speeds and blade angles. Results showed up to 20% increase in the heat transfer coefficient at 32 - 36 rpm and a motor power input of 24 - 35 kW, and improvement in massecuite circulation and exhaustion. Smoothest operation was obtained with impeller blades set at a fine pitch, i.e. with shallowest angle at the blade tip.

Aspect of rotary vacuum filter design and operation

D. J. Hale, O. L. Crees, E. Whayman and A. L. Willersdorf. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 201 - 208.

Details are given of a 170 m^2 filter at Mossman; its design was the result of collaboration between the Sugar Research Institute and the manufacturer. The aim was to eliminate two defects commonly found in large filters: delay in the change from low to high vacuum which usually occurs only when the screens are above the horizontal axis, so that much of the time available for cake washing and drying may not be fully utilized, and spillage of large volumes of filtrate with the cake at discharge, which increases cake losses. The design modifications resulted in a marked reduction in losses at high solids loadings. Calcium saccharate addition to primary mud and dilution with wash filtrate improved cake permeability and contributed to a reduction in mud pol.

Pilot scale ultrafiltration of clarified juice

O. L. Crees. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 209 - 213.

A small pilot plant constructed by the Sugar Research Institute and operated continuously at a sugar factory for most of the 1985 season contained 12 mm diameter tubular membranes manufactured by Paterson Candy International Ltd. The membranes were fitted into perforated stainless steel supports arranged in bundles of 18 per module in a configuration similar to that of a tubular juice heater; juice was pumped through the tubes and filtrate collected in the outer shell. The plant comprised four 2.6 m^2 modules in series, each fed by a separate pump from a common manifold at 4 m^3/hr, 800 kPa and 70°C. A programmable controller and a microcomputer were used for plant automation. BX1, BX6 and FP10 membranes were each fitted into a module for comparison of their rejection characteristics over a number of cycles; composite samples of feed and permeate were collected and analysed for pH, Brix, colour, starch and dextran. All three membranes gave similar rejection results: >98% starch, 100% dextran, 50% colour (52% in the case of BX1) and 100% turbidity. Steady state conditions were established within 30 minutes of the start of each juice cycle. Flux was much lower than expected, and the major operating limitations were almost all associated with the cleaning cycle; 0.25% NaOH at 70°C was the most effective cleaning solution, but it was not possible to restore the flux to its original value. Despite the positive results obtained in clarification, the capital and operating costs of the plant are so high that the process cannot be considered economically viable; for a factory processing 500 m^3 of juice per hour and requiring a total membrane area of some 13,500 m^2, the installed cost of the plant would be about $A 20 million; operating costs are calculated at $A 4.75 per tonne of sugar (not allowing for sugar losses and assuming a power consumption of 63 kWh, use of NaOH at 0.6 kg and a membrane life of four seasons). The treatment should give lower massecuite viscosities with consequent benefit to boiling, crystallization and centrifugation, which could partly offset the operating costs.

Bagsse moisture determination by microwave drying

P. G. Everitt. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 215 - 221.

In an attempt to develop an automatic drying system for bagasse samples using a microwave oven, it proved impossible to eliminate the risk of charring of samples weighing at least 200 g initially, and this risk increased with the sample size because of uneven heating and cooling, implying that the technique would succeed only with thinly spread, small samples (weighing no more than 100 g), a conclusion reached by other authors. An automatic system was developed for drying 200 g samples where great precision was not necessary, but there was still risk of charring as well as a time-dependent variation in the exhaust temperature of the cooling air.

Performance of the new Fairymead evaporator

L. J. Watson. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 223 - 230.

Investigations of the effect of the multiple downtakes on heat transfer in the 5100 m^2 evaporator vessel[1] showed that they caused a significant reduction in the amount of juice collecting above the tube plate; since juice above the top of the calandria in an evaporator increases the boiling point of the juice at the heating surface and places it at a higher pressure (boiling point elevation due to submergence), so that the available temperature difference for evaporative heat transfer and hence the overall heat transfer coefficient are lowered, operation at an optimum level with no juice above the top tube plate will have a positive effect. Measurements showed that the downtakes raised the heat transfer coefficient by about 7.5% ± 5%, with optimum operating levels in the range 16 - 24% of tube height, depending on the nature of the juice and evaporation rate.

The care and maintenance of stainless steel in the sugar industry

T. Hadfield and D. R. Hargreaves. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 231 - 235.

Advice is given on: treatment of stainless steel with nitric acid for removal of iron contamination and reinforcement of the passive film; prevention of localized (pitting or crevice) corrosion, particularly that caused by Cl^- and reducing agents; cleaning; and welding. Common sources of iron contamination and its detection are described, and some case histories presented of pitting corrosion in juice heater and evaporator tubes and of fatigue in juice heater tubes.

A microcomputer implementation of a maintenance management and control program

R. Newdick and D. M. Jenkins. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 237 - 243.

Details are given of a computerized maintenance planning and control (MAINPAC) system designed for industry generally and built around a central relational database with interrelated functions. Seven modules (one of which is the database) are incorporated in the program structure, and some of the major features of these modules and the functions they perform are described in detail.

Management of large reconstruction and retrofit projects

P. J. Noble and E. G. Williams. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 261 - 268.

Factors contributing to successful completion of projects are discussed. Small projects are often handled in-house or by a single contractor, while large projects are usually best done by specialist contractors controlled by a project management team typically consisting of a consulting engineer and his client. The principles and practices of this type of project management are explained with the aid of case histories of recent reconstruction and retrofit projects. The benefits of such a scheme for a sugar factory are listed.

The application of high torque - low speed hydraulic motors in the sugar industry

G. M. Jorgensen, J. A. Johnstone and C. C. Cant. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 269 - 278.

The basic features of the high torque-low speed hydraulic motor (generally of the radial piston type) are described, with mention of their use as cane mill drives and details of applications at Mossman factory: as drives for a 10-tonne cane bin pusher indexer (to push the bins onto the weighbridge), as an intermediate carrier drive and as a variable-speed unit for the coil in a low-grade crystallizer.

Reducing failures and wear of mill plant by effective lubrication

W. Scott. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 279 - 284.

Factors influencing wear are considered under two main groups: bulk material properties and surface properties, and basic means of controlling it are listed, including lubrication. Development of a lubrication system is described, with mention of the main problem associated with sugar factory applications, namely the possible contamination of the lubricant with juice. The three major types of lubrication (boundary, fluid film and mixed) are explained as well as lubricant selection, means of application and the amount required. Two case histories are recounted.

Bagasse swirl burner development

T. F. Dixon, C. Palmer and S. D. Domanti. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 295 - 302.

Details are given of an experimental model bagasse furnace and swirl burner system designed and constructed at the Sugar Research Institute for use in investigation and development of a suitable factory-scale swirl burner. The 1:4 scale model carries out all the aerodynamic, combustion and heat transfer processes that occur in a full-scale burner, and has permitted identification of two distinct types of flame, an attached and a detached type. Stable operating limits for the two flames have been determined for varying bagasse moisture contents and particle size distributions. Measurement of temperature contours has demonstrated the substantially different structures of the two flames; measured data agreed qualitatively with visual observations of flame shape and position of the flame front. It is suggested that the detached flame, which has superior bagasse moisture tolerance, represents a stable burner configuration for bagasse combustion by the swirl burner technique.

1 Quinan *et al.*: *I.S.J.*, 1986, **88**, 45A.

Beet sugar manufacture

Sucrose adsorption by cation exchange resin in salt form

S. S. Fil'chashkin, S. P. Vycherova and A. N. Timonin. *Rpt. Kiev Polytech. Inst.*, 1985, 6pp; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (7), Abs. 7 R436.

To investigate the possibilities of improving beet syrup treatment by ion exchange, balances were obtained for sucrose adsorption by KU-2 cation exchange resin of varying degrees of cross-linkage in Na^+, K^+, Mg^{++} and Ca^{++} form as well as by KB×2 and KB×4 cation exchangers; 65% sucrose solutions were used at 70 - 75°C. It was found that sucrose adsorption fell with increase in the degree of cross-linkage and depended on the degree of swelling of the resins. For each salt form at constant cross-linkage, adsorption by the KB carboxylic resins was 200 - 300% greater than for the KU-2 resins.

Double carbonatation-single phosphatation along with modified SO_2 treatment of diffuser juice and control of temperatures at various stations of juice treatment for manufacturing pharmaceutical-grade sugar and a superior quality of beet molasses

B. K. Gupta and V. K. Sharma. *Proc. 48th Ann. Conv. Sugar Tech. Assoc. India*, 1984, M.111 - M. 123.

A process for raw juice clarification to yield sugar suitable for the pharmaceutical and beverage, food preserving and canning industries is described; the molassses is also intended for use in the manufacture of the Vitamin B complex. Both sugar and molasses from Ganganar Sugar Mills Ltd. had been found to deteriorate in storage as a consequence of a high SO_2 content, while a high MgO content in the sugar caused haze in solution. In the new process, the pH of unfiltered 2nd carbonatation juice is adjusted to 8 by adding 400 ppm phosphoric acid instead of sulphitation. The pH in diffusion is maintained at 5.2 - 5.6 instead of 6 by gassing with SO_2 to harden the pulp and reduce colour formation, while a temperature of 70°C instead of 80°C inhibits bacterial growth and reduces inversion; 1st and 2nd carbonatation juices are maintained at 60 - 65°C and 75°C, respectively.

The 1985 campaign (in West Germany)

E. Reinefeld. *Zuckerind.*, 1986, **111**, 303 - 314 (*German*).

A survey is presented of the 1985/86 campaign, including beet growing conditions and harvesting; beet area, yields and sugar production; beet and juice quality (which was sufficiently high to cause no particular processing problems); diffusion and pulp pressing, including the effect of permitted microbial infection during diffusion combined with the addition of calcium compounds; juice purification, including the optimum temperature of cold preliming (found to be highly effective in regard to juice colour provided the juice residence time is not excessive); and the benefits in respect of steam economy of a falling-film evaporator heated by pan vapour and installed after an evaporator or between the 3rd and 4th effects. With the use of crystal footing, if the Brix of the syrup feed is above the required 75°, flash evaporation can lead to a supersaturation (1.2) that is sufficient for secondary nucleation to take place; to prevent this, a thick juice conditioning system is proposed whereby flash evaporation and cooling occur in a tank installed between the evaporator and the syrup feed tank, and the Brix is kept at the required level by dilution with thin juice or water where necessary. Details are given of a 3-massecuite scheme in which white sugar is boiled on a raw sugar footing, and mention is made of the introduction of ten new Braunschweig Institute crystal footing plants at seven factories. Results obtained with various continuous boiling systems, particularly the evaporative crystallization tower (four of which were in operation during the campaign) and the Fives-Cail Babcock (FCB) horizontal pan are mentioned as is a Béghin-Say two-stage flash evaporation/cooling crystallization system installed as a "semi-crystallization stage" after the FCB pan at Elsdorf to replace raw sugar massecuite boiling; the resultant sugar is melted for use in candy sugar crystallization and for refined sugar manufacture. Reference is made to the importance of crystal size distribution in establishing the optimum number of chambers in continuous pans. The question of whether to use crystallization by cooling or by flash evaporation is examined; for the same massecuite, cooling must be to a lower final temperature than with flash evaporation to give the same crystal growth. The performance of a Selwig + Lange vertical crystallizer is discussed, as is crystal damage in continuous raw sugar centrifugals. Pilot plant trials at Appeldorn demonstrated the feasibility of biogas production from beet pieces and trash. Effluent treatment and the question of gaseous emissions from boilers and pulp dryers are briefly discussed as well as the law relating to them.

Process automation and data handling with the new DCI system at the Plattling factory of Süddeutsche Zucker-AG

P. Mosel, P. Peters, H. R. Kemter and H. Kemter. *Zuckerind.*, 1986, **111**, 321 - 328 (*German*).

The Fischer & Porter DCI distributed hierarchical process control and data handling system is a development of the DCI-4000 system first introduced for process automation in the sugar industry in 1978. While retaining the basic features of the DCI-4000, the new system is of considerably expanded capacity and communications potential; its salient features are described. The system was installed at Plattling for automatic control of diffusion, anaerobic treatment of effluent and boiling on a crystal footing. Details are given as well as the advantages of the system.

An experimental silo for

prewashed and actively protected beet at Smirice sugar factory

J. Zahradnicek *et al. Listy Cukr.*, 1986, **102,** 73 - 80 (*Czech*).

Three-year trials of an experimental beet storage system of 25,000 tonnes capacity are reported; various treatment combinations were tested, including prewashing, forced ventilation, milk of lime and treatment with Fundazol. Lowest losses occurred where the beets were prewashed, treated with Fundazol of 0.3% concentration and force-ventilated, while poorest results were obtained when the beet was prewashed without any subsequent chemical treatment or forced ventilation.

Influence of beet tare on storage losses

Anon. *Sucr. Franç.*, 1986, **103,** 99 - 100 (*French*).

Beets stored in a clamp for 46 days and containing 64% dirt tare showed much greater sugar losses than did beets stored in the same field but containing only 17% dirt. The average temperature in the former clamp was 6.5°C against 4.2°C in the latter.

Evaporator station control

Anon. *Sucr. Franç.*, 1986, **103,** 105 (*French*).

A model of an evaporator has been constructed to act as basis for the design of an automatic control system; for its construction, data were measured every 30 seconds over 5-hour stretches at Lillers sugar factory. Various control algorithms were to be tested on the model and on an industrial scale.

Waste water treatment

Anon. *Sucr. Franç.*, 1986, **103,** 108 - 109 (*French*).

After a review of research conducted by IRIS on effluent treatment, particularly using anaerobic methods as at Thumeries and Aulnois-sous-Laon, studies are reported on treatment of waste water containing nitrogen, for which anaerobic treatment is ineffective. Pilot plant trials showed that it was possible to treat up to 1.5 kg N per m³/day, corresponding to a residence time of about 1 hour; two methods selected are based on surfaces to which the nitrifying bacteria are attached. In experiments on maintenance of the nitrifying activity during the post-campaign period, a method was devised in which the bacterial supports were drained and dried so as to stop further microbial activity, and then stored in the open. By this means, 35% of the initial activity of the bacteria was safeguarded, and the normal levels of performance were attained within 20 - 25 days of resuming effluent treatment. Relative humidity and temperature were found to govern the survival of the bacteria, and the loss of activity "at rest" was not caused by destruction of the beds but was a result of dormancy, explaining the latent period before re-establishment of normal performance. Other factors affecting the behaviour of the microbes during storage and re-use included CO_2 pressure, hydroxylamine content and pH.

On-line purity meter

Anon. *Sucr. Franç.*, 1986, **103,** 112 (*French*).

See Windal *et al.*: *I.S.J.*, 1985, **87,** 125A.

Application of the CHEOPS process to the boiling house

Anon. *Sucr. Franç.*, 1986, **103,** 113 (*French*).

See Windal & Deleurence: *I.S.J.*, 1982, **84,** 305.

A new continuous evapo-crystallization tower for white sugar and low raw products

E. D. Bosse. *Sugar y Azúcar*, 1986, **81,** (5), 33, 36 - 37, 40, 42, 46, 48, 50, 53, 56.

Details are given of the BMA evapo-crystallization tower and of the massecuite pump developed to transfer the final product from the bottom chamber to a holding mixer. The advantages of the unit in regard to steam economy, seeding, ease of operation, good crystal quality at a higher sugar yield, negligible scale formation, etc., are indicated, and details given of the cleaning process used for the individual chambers without interrupting operation; the automatic controls are also described.

Investigations on undetermined sugar losses in Finnish beet sugar factories

H. Hallanoro. *Zuckerind.*, 1986, **111,** 480 - 483 (*German*).

Undetermined and apparent losses at four Finnish sugar factories established over five campaigns (1980/84) constituted an average of 0.75% on beet (0.59% without apparent losses, which made up 20 - 30% of the unknown losses and arose mostly as a result of polarimetric error in beet brei analysis). Some 50 - 60% of the unknown losses occurred in the beet yard.

Investigation of the effect of basic factors on non-sugars transfer from beet cossettes during diffusion

S. P. Olyanskaya, L. I. Zagorodnyaya and N. A. Arkhipovich. *Sakhar. Prom.*, 1986, (5), 21 - 25 (*Russian*).

Investigations are reported on the effect of pH (4.0 - 8.5), temperature (20 - 80°C) and residence time (30 - 120 minutes) on non-sugars extraction from pre-dried and pre-desugared cossettes using distilled water adjusted to a required pH at a cossettes:water ratio of 1:1.2 in flasks with reflux coolers. Graphed results showed that, at 20° and 80°C, colloid extraction was minimum at pH 5 and pH 6.6, respectively, and that at 20°, 60° and 80°C pectin extraction was minimum at pH 5, pH 5 and pH 6.6, respectively. In all cases, extraction rose with increase in residence time. At 20°, 60° and 80°C, Ca^{++} and Na^{+} extraction was practically unaffected by residence time and temperature at a given pH, more Na^{+} being extracted than Ca^{++}. K^{+} extraction was far

greater, and rose with residence time and temperature at each pH. For all three cations, the pH should not exceed 6.6, as demonstrated by results obtained in tests with a tower, drum and inclined-trough diffuser; a residence time no longer than 60 minutes was also advisable, but a temperature no higher than 60°C would not allow complete salting-out.

The optimum temperature and duration of 2nd carbonatation

K. P. Zakharov *et al. Sakhar. Prom.*, 1986, (5), 25 - 29 (*Russian*).

The effect of temperature (65 - 100°C) and duration (1 - 15 minutes) on filtration and the filtrate lime salts content were studied where liming preceded 2nd carbonatation. Results showed a negligible effect of temperature where the raw juice was extracted from good quality beets, but the lime salts rose with pH. With poor quality beets, lime salts rose in the filtered juice with rise in temperature, while increase in the amount of lime added before 2nd carbonatation had a positive effect on lime salts adsorption as a result of the greater amount of calcium carbonate formed. The optimum duration of 2nd carbonatation was 7 minutes for good quality juice and 11 minutes for low quality juice; 10 minutes is considered suitable with modern vessel designs. The filtration velocity fell with reduction in 2nd carbonatation temperature.

Removal of colouring matter during carbonatation of sugar solutions

I. F. Bugaenko and E. P. Ishina. *Sakhar. Prom*, 1986, (5), 29 - 31 (*Russian*).

The amount of colouring matter removed by calcium carbonate from limed and gassed low-grade sugar melt rose with increase in the initial colour content at a constant Brix, while increase in the sugar content caused a fall in adsorption. Despite an almost 100% increase in the colouring matter concentration brought about by evaporation of a 15% limed solution on a water bath for 7 hours, the final colour concentration was lower than for a solution of the same Brix which had been carbonatated.

Electrochemical protection of underground installations at sugar factories

V. V. Vasil'ev, V. V. Litvinenko and A. N. Antonenko. *Sakhar. Prom.*, 1986, (5), 32 - 34 (*Russian*).

Cathodic protection of underground water, gas and heat mains against corrosion is explained and technical data are given of four Soviet systems; plans for installation of systems at a number of sugar factories are mentioned.

Experience in the use of non-nickel stainless steel tubes in sugar factory evaporators

V. P. Zubchenko, I. K. Klebanova and I. Z. Mashinson. *Sakhar. Prom.*, 1986, (5), 34 - 37 (*Russian*).

Stainless steel containing 0.08% carbon, 0.7% silicon, 0.6% manganese, 17 - 19% chromium, 0.6 - 1.0% titanium and iron, but no nickel, has been used in the manufacture of evaporator tubes installed in a number of Soviet sugar factories; it has properties and a service life near to that of a steel containing 0.12% C, 0.8% Si, 2.0% Mn, 17 - 19% Cr, 0 -10% Ni and 0.8% Ti. The iron increases its hardness and reduces low-temperature brittleness. The need for a suitable corrosion inhibitor when using HCl for evaporator cleaning is emphasized.

Sugar solution residence time in tube bundles of single-pass evaporators

N. A. Pryadko, V. N. Filonenko, M. A. Maslikov and B. A. Matvienko. *Sakhar. Prom.*, 1986, (5), 37 - 39 (*Russian*).

The experimental determination of the residence time of sugar solutions in 9 mm single-tube climbing- and falling-film evaporator models is reported. Lithium chloride was used as tracer, and the results are given in graph form as well as rather complex equations for the mean integral residence time and the coefficient of Li^+ concentration as a function of time.

Certain questions concerning forced ventilation of sugar beet

V. A. Knyazev. *Sakhar. Prom.*, 1986, (5), 45 - 48 (*Russian*).

Conditions under which maximum use can be made of forced ventilation of beet piles with greatest effectiveness are discussed, including provision of means for moistening the blown air and using forced ventilation even with short-term storage.

The pollution loads of sugar factory effluents and possibilities of reducing them

T. Wolski. *Gaz. Cukr.*, 1985, **93**, 191 - 193 (*Polish*).

The significance of COD and BOD_5 and their ratio as indicators of the degree of pollution of effluent is explained and the methods used to determine them are described with worked examples. Pollution loads of sugar factory waste waters and how to reduce them are discussed, including the importance of removing solids as quickly as possible so as to minimize the time of contact between them and the water and thus reduce the amount of soluble matter extracted by the water. The cost effectiveness and pollution reduction efficiency of closed water circuits are indicated, and the need stressed of eliminating open circuits for flume water and condensate.

Sugar solution purification by electrofiltration

L. G. Vorona *et al. Elektron. Obrab. Materialov*, 1985, (5), 74- 78; through *Ref. Zhurn. AN SSSR* (*Khim.*), 1986, (10), Abs. 10 R516.

It is shown that use of electrofiltration in conjunction with subsequent liming and carbonatation of raw juice allows reduction in the amount of CaO used and gives a 2nd carbonatation juice which is suitable for further processing as normal.

Laboratory studies

High performance ion chromatography

Anon. *Sucr. Franç.*, 1986, **103**, 107 - 108 (*French*).

High performance ion chromatography is similar to HPLC in that it is based on elution by a liquid phase, of ionic species adsorbed on a resin, and involves the use of a separator column, a suppressor column and suitable means of detection. A description is given of the system used by IRIS to determine e.g. mineral and organic acids in sugar factory products using conductivity detection. Two sample chromatograms are presented, one showing the mineral acids in raw juice before and after purification, and the other showing the organic acids in molasses.

Reproducible sugar standards using modulated reflectance and a photoelectric reflectance meter for measurement of the whiteness of crystal sugar in solid state and introduction of a 31 colour series in India

J. V. Bhargava and R. Kumar. *Indian Sugar*, 1986, **35**, 539 - 549.

Because of the wide variation in grain size of the Indian sugar grades (ranging from 0.6 to 2.36 mm or even greater) and in colour standards as established at different times in India since 1936, the authors investigated the situation and found that reproducible sugar standards were possible using a photoelectric reflectance meter. Equations have been developed for modulated reflectance values of standard sugar colours in the 30 and 29 series and for sugar of superior whiteness that constitutes a new colour series, 31. It is suggested that the size variation within a grade should be limited to 0.3 ± 0.05 mm and that standard modulated reflectance values and grain sizes should be established for three grades per colour series.

The density of aqueous solutions of glucose, fructose and invert sugar and its measurement

A. Emmerich and L. Emmerich. *Zuckerind.*, 1986, **111**, 441 - 448 (*German*).

Evaluation of measurements of the density of glucose, fructose and invert sugar solutions earlier carried out by Emmerich *et al.* using a DMA 02 Paar meter developed by Kratky *et al.*[1] required correction factors for which no data were available. However, in the meantime, adjustment has been made possible by measurements on sucrose solutions of known concentration and density. The procedure used is based on measurement of the oscillation frequency of a U-shaped glass capillary which is firmly clamped at its open end. The system is comparable to a harmonic oscillator having a frequency that is dependent on the weight of the oscillating body and hence on the density of the medium in the capillary. Allowance is made for the viscosity of the test sample. New values have been obtained for glucose, fructose and invert sugar and are tabulated (as well as values for sucrose as control). The data cover the range 0 - 70% concentration at 20°C. The results are accurate to within approx. $\pm 1 \times 10^{-5}$ units, corresponding to a precision better than $\pm 0.005\%$ absolute in determination of concentration. Comparison with values given in the literature show that the glucose densities obtained by Jackson and by Schliephake and the fructose densities obtained by Jackson & Matthews were lower than the new values (possibly as a result of failure to take sufficient account of the residual water content in the samples); values obtained by Snyder & Hattenburg for invert sugar were on the average in better agreement with the new values as a consequence, it is suggested, of more care in the drying of the samples. Mention is made of a printing error that has appeared in the tabulated data of Snyder & Hattenburg for 60% invert sugar solutions and which has been copied in publications by other authors; the value should read 1.28212 instead of 1.28112 g/ml.

Automated analytical method for the determination of individual sugars in mixtures of glucose, fructose and sucrose

A. M. Tawfik and C. J. Mardon. *J. Sci. Food Agric.*, 1985, **36**, (7), 621 - 627; through *Anal. Abs.*, 1986, **48**, Abs. 5F11.

The colorimetric method of Blakenbey & Mutton[2] was adapted for use on an automatic analyser (the system of which is described), and applied to the determination of fructose (i), sucrose and glucose (ii) in beet juice, fermentation liquors, etc. Individual carbohydrates were measured by analysing the sample before and after hydrolysis by treatment with 4-hydroxybenzohydrazide (for total carbohydrates and sucrose, respectively) and analysing the sample again by treatment with thiobarbituric acid for (i) and (ii). Recoveries of (i) and (ii) were 97 - 104% and the coefficients of variation were approx. 1.4%. The calibration graphs were rectilinear for 1 - 6000 and 0.1 - 1500 mg/litre for total reducing sugars and (i), respectively.

Amperometric enzyme electrode system for the flow injection analysis of glucose

G. J. Moody, G. S. Sanghera and J. D. R. Thomas. *Analyst*, 1986, **111**, 605 - 609.

An analytical technique employing glucose oxidase, immobilized on nylon mesh and fitted over platinum to form an indicator enzyme electrode in a modified Stelte microcell, exhibited good linearity, short response times and high capacity when applied to determination of glucose in various foodstuffs including molasses and glucose syrup. Results obtained by the method were in very good agreement with those given by the Boehringer Mannheim method using a soluble enzyme test kit for molasses and by the Yellow Springs Instrument glucose analyser for unrefined glucose syrup.

1 *Z. angew. Physik*, 1969, **4**, 273.
2 *Anal. Abstr.*, 1981, **40**, Abs. 4F37.

By-products

Combined evaporation units for concentration of molasses vinasse

Yu. M. Rabiner and V. P. Troino. *Ferment. i Spirt. Prom.*, 1985, (6), 7 - 9; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (8), Abs. 8 R371.

Development of combined evaporation units for concentration of molasses vinasse is described. The plant comprises units having conventional heat transfer surfaces arranged in series at the head of the line and a direct-contact vessel at the tail which utilizes boiler flue gases and thus provides for fuel economy. The vinasse in the head section is concentrated to a dry solids content of only 35 - 40%, so that scale formation is reduced. The mixture of vapour and gas discharged from the direct-contact vessel is free of impurities that could contaminate the environment.

The comparative action of two chemical bactericides on alcohol fermentation of beet juice and molasses

M. J. Bourdarel and A. Ramirez. *Ind. Alim. Agric.*, 1986, **103**, 219 - 224 (*French*).

The performance of peracetic acid (PA) and hydrogen peroxide (HP) against bacterial contamination of the alcohol fermentation process were determined in preliminary laboratory tests in which juice and molasses samples were diluted to a sugar concentration of 100 g/litre, adjusted to pH 3.3. and 4.5, respectively, fed into Erlenmeyer flasks and inoculated with yeast at 30°C. Results showed that 30 ppm PA or 3000 ppm HP were effective against moderate contamination in beet juice fermentation without adversely affecting yeast growth and metabolism; with considerable contamination, 60,000 ppm HP was needed and 50 ppm PA before yeast inoculation or 150 ppm after inoculation. Both chemicals caused an initial deceleration of fermentation and killed 20 - 30% of the yeast (in the case of PA) and 15 - 20% (HP) after 4 hours' activity, but up to 75% mortality is tolerable provided the bactericides have a sufficiently radical effect. In the case of molasses (for which only PA was tested), 100 - 150 ppm (according to the strain of *Saccharomyces cerevisiae* used) was effective against moderate contamination, or 200 and 350 ppm before and after yeast inoculation in the case of a marked degree of contamination.

Manufacture of bakers' yeast and alcohol from molasses

S. Labendzinski, A. Salek and M. Skrzynka-Karkoszka. *Przem. Ferm. Owoc.-Warzyw.*, 1985, **29**, (3), 12 - 13; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (9), Abs. 9 R419.

The technological aspects of simultaneous production of bakers' yeast and alcohol from molasses are examined, and the merits and demerits of the method used are noted. It is shown that variation of the fermentation parameters permits regulation of yeast and alcohol manufacture.

Production of higher alcohols and short chain fatty acids by different yeasts used in rum fermentations

L. Fahrasmane, A. Parfait, C. Jouret and P. Galzy. *J. Food Sci.*, 1985, **50**, (5), 1427 - 1430; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (9), Abs. 9 R423.

The formation of higher alcohols and fatty acids by cultivation of pure yeasts was studied as a function of the composition of the medium used. *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe* were grown anaerobically at 30°C on a synthetic medium A containing 10% sucrose and 1.2% $(NH_4)_2SO_4$ and on a natural medium B consisting of cane juice, 0.25% $(NH_4)_2SO_4$ and 0.12% KH_2PO_4. *S. cerevisiae* yielded more higher alcohols and fatty acids than *S. pombe*, considerable differences occurring in acetic acid formation. The composition of the medium and its type played a secondary role in the biosynthesis of the higher alcohols, but played a key role in fatty acid formation, both quantitatively and qualitatively. Shortening the fermentation time in the presence of citric and aconitic acids affected the final pH of the medium, which was 0.3 - 0.4 units higher than initially in the case of A. Moreover, citric acid induced the synthesis of acrylic acid. Since the acids in question are present in the original raw material, their effects on fermentation will govern the flavour of the rum.

High fructose syrups: possibilities for producing them from refinery molasses and liquors at sugar mills

N. Polanco and E. Duarte. *GEPLACEA Bull.*, 1986, **3**, (04), 6pp.

The advantages of liquid over solid sugar, particularly for bottling, are discussed and the basic processes for invert syrup manufacture (acid hydrolysis, ion exchange and enzymatic hydrolysis) described, with mention of "sucro-serv" syrup produced in Cuba from refinery liquor by acid inversion and of an ion exchange method developed at ICINAZ for liquid sugar manufacture from decolorized refinery liquor. The characteristics of the two products are tabulated. The manufacture and properties of HFS are discussed, and development of a technology for HFS manufacture proposed, starting with a syrup of 42 - 45% fructose content obtained from decolorized refinery liquor. Methods for fructose separation from glucose are briefly described.

A new process for obtaining inverted sugar using carbon dioxide

A. M. L. Esteves, V. F. Ferreira and L. M. C. Paiva. *Starch/Stärke*, 1986, **38**, 173 - 175.

A 40% refined sugar solution was hydrolysed with CO_2 at a gas pressure of 3 or 4 atm and 125°C. Results for up to 180 minutes at 3 atm and up to 130 min at 4 atm showed that both reducing power and inversion efficiency were higher at the higher gas pressure, an efficiency of 98.36% being achieved after 130 min at 4 atm.

Patents

UNITED KINGDOM

Glutamic acid production

Ajinomoto Co. Inc., of Tokyo, Japan. **2,152,057.** December 21, 1983; July 31, 1985.

Cane molasses to be used for L-glutamic acid fermentation is diluted to 5.5 g/litre and inverted using an invertase at 20 - 60°C (55°C) and pH 1 - 4 for 5 - 20 (10) hours or using a mineral acid (hydrochloric or sulphuric acid) at 80 - 110°C (100°C) and pH 1 - 4 (1.5) for 20 minutes followed by neutralization with e.g. NaOH. The molasses is then passed through a column of strongly acidic cation exchange resin in Na^+ or K^+ form at between room temperature and 90°C (50 - 90°C) (50 - 80°C) (70°C) and a sugar concentration of 1.5 - 5 g/litre (3.5 - 4.5 g/l) (4 g/l), followed by elution with water at pH 5.7 to provide a fraction suitable for fermentation by *Brevibacterium flavum, B. lactofermentum, B. saccharolyticum, B. thiogentalis, Corynebacterium glutamicum* or *C. melassecola.*

Lysine manufacture

Kyowa Hakko Kogyo Co. Ltd., of Tokyo, Japan. **2,152,509.** August 6, 1982; August 7, 1985; May 21,1986.

L-lysine is produced by aerobic cultivation of a micro-organism such as *Corynebacterium glutamicum* or *Brevibacterium lactofermentum* on glucose, fructose, sucrose or molasses, etc., at 20 - 40°C (30°C) and pH 3 - 9 (7) (7.2) (6.8) for 1 - 6 days (3 days) (2 days).

Crystal sugar conditioning

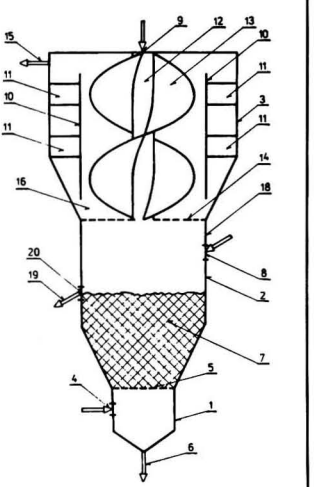
Vysoka Skola Chemicko-Technologicka, of Praha, Czechoslovakia. **2,155,604.** March 4, 1985; September 25, 1985.

Prior to storage, crystal sugar at 60 - 70°C is dried for 1 - 5 minutes by an air stream in a fluidized bed at an air flow rate of 0.4 - 2.5 m/sec and a sugar flow rate of 4 m^3/sec whereby fines having a maximum size of 0.1 - 0.4 μm (up to 0.2 μm) are partially removed. The sugar is discharged at 35 - 60°C (40 - 50°C) and is held for 1 - 5 days in a stabilizer followed by cooling to 20 - 30°C (25°C) in a fluidized bed for up to 1 min (20 sec) at a sugar flow rate of 7 m^3/sec.

Sugar dryer

Vysoka Skola Chemicko-Technologicka, of Praha, Czechoslovakia. **2,155,605.** March 4, 1985; September 25, 1985.

A fluidized bed dryer for crystal sugar comprises an upper rotating section 3 and stationary central and lower parts 2 and 1, respectively. Air enters through inlet 4 and passes up via grid 5 into the



mass of sugar which is fed through port 8 and leaves via port 20. The upper section 3 contains a separating ring 10 (which is of the same diameter as the internal diameter of section 2 or is of larger diameter) and a helix 11 which is either continuous or has a number of segments. A coaxial cylindrical body 12 having at least one external helix 13 may be a tube serving as inlet 9 for the treated sugar. At least one horizontal sieve 14 may be located at the entrance to section 3 to improve air and entrained particle separation. The coarser particles are separated and returned to the fluidized bed in the space between ring 10 and the body of section 3.

Sugar crystallization

Tate & Lyle plc, of London, England. **2,155,934.** March 14, 1985; October 2, 1985.

A supersaturated sucrose syrup of 90 - 95°Bx (93°Bx) or supersaturated glucose syrup of 95 - 99°Bx is crystallized by subjecting it to shear in an uncooled nucleation zone in a continuous screw (twin-screw) extruder for <25 seconds (2 - 11 seconds) at 115 - 145°C (125 - 150°C) in the case of sucrose and 100 - 135°C in the case of glucose and an extruder speed of 100 - 500 rpm (300 - 400 rpm). After passage through the shear zone and possibly after passage through a relatively quiescent, non-agitated zone of the extruder (during which there is no further nucleation but crystallization commences), the syrup is transferred to a moving band where crystallization continues for 0.5 - 10 minutes (2 - 3 minutes) at a band load of 6 - 15 (10) kg/cm^2; the ultimate product is a friable solid of open structure having a moisture content of approx. 4% by weight.

properties at radio frequencies.

The success of this control system is clearly shown by the exhaustion performance of the Maidstone *A*-pan over the last few seasons. In the first year of operation, exhaustion was low. As the control problems were overcome, exhaustion improved to a point where Maidstone's *A*-exhaustion is the second highest in the South African industry, in spite of low syrup purities at this factory. This is shown in Table I.

Table I. Comparison of *A*-massecuite apparent purity and exhaustion at Maidstone with average South African mill results

	Maidstone		Industry average	
	Purity	Exhaustion	Purity	Exhaustion
1981/82	85.9	61.1	85.8	63.0
1982/83	85.1	61.9	85.4	62.6
1983/84	84.0	59.6	84.6	61.8
1984/85	84.7	62.4	85.6	63.7
1985/86*	83.8	66.1	85.0	63.8

*To date figure (November 1985)

Note: Continuous *A*-pan operation at Maidstone from the 1983/84 season onwards

It is possible at any stage to shut off the steam to *B*- and *C*-pans and stop the boiling operation. Even after lengthy mill stops the pan can, within a relatively short space of time, be on-line and in production again. With *A*-massecuites, it has been found to be necessary to slacken-off the massecuite a little before shutting the pan down. If this is not done, encrustation on the internal surfaces and inside the tubes can be quite severe, as the crystallization process continues. If the pan is slackened-off, however, the pan can be left out of operation for a few days and started up again with very little trouble.

Evaporation and heat transfer rates

It is impossible to measure massecuite circulation in a pan directly, but heat transfer rates can be used to gauge the degree of circulation achieved. Heat transfer and circulation rates are closely related in a system such as this, which relies on natural convection. The faster the heat transfer rate, the more vapour is generated and the better the circulation. Thus, heat transfer rates were regarded as one of the prime variables in this pan development program.

Measurements undertaken at Mount Edgecombe in the modified batch *C*-pans yielded evaporation rates of about 9 kg/hr/m^2, or a heat transfer coefficient of 140 W/m^2/°C. This was very much in line with heat transfer measurements on batch pans and roughly equal to the average value obtained in the course of a *C*-batch boiling. This is considerably better than those reported for continuous pans with horizontal tubular calandrias[7,8].

Similarly, measurements taken at Amatikulu in the converted *A*-batch pan gave evaporation rates of about 30 - 40 kg/hr/m^2, equivalent to 450 - 600 W/m^2/°C. This also was considerably higher than that measured in a continuous *A*-pan in Réunion[9], which gave an evaporation rate of 15.5 kg/hr/m^2. These results were responsible for the decision to utilize a vertical, tubular calandria in the new design. The prototype continuous pan at Maidstone incorporated a heating surface to volume ratio of 10 m^{-1}. This was regarded as conservative, but necessary in the prototype unit. It was immediately apparent in boiling all three grades of massecuite during the trial period at Maidstone that the calandria pressure had to be reduced to about atmospheric pressure or below to reduce the overall evaporation rate. These trials led to the following evaporation rates for use for design purposes for Felixton: *A*-massecuite 22 kg/hr/m^2; *B*-massecuite 10 kg/hr/m^2; and *C*-massecuite 7.5 kg/hr/m^2.

Overall heat transfer coefficients have been measured over a wide range of conditions in the continuous *A*-pans at Maidstone and Felixton. These have been found to be dependent on the temperature difference between condensing steam and boiling massecuite and some preliminary data are shown in Figure 4. Most of the data are for massecuite temperatures in the range 60 - 68°C. Data obtained when purposely boiling at higher massecuite temperatures show higher values, owing to reduced viscosities. Lower Brix boiling improves heat transfer rates for same reason.

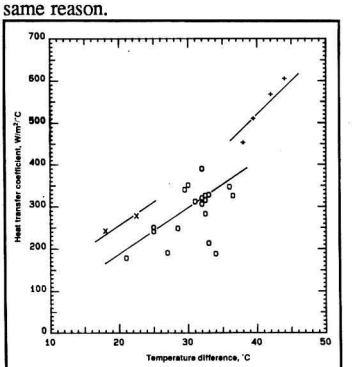


Figure 4. Some heat transfer coefficients measured in continuous vacuum pans boiling *A*-massecuite Legend: O Tongaat–Hulett pans at Maidstone and Felixton, massecuite temperature <68°C; × Tongaat-Hulett pans at Maidstone, massecuite temperature >75°C; + Modified batch pan, Amatikulu

The dependence of heat transfer coefficient on ΔT is to be expected in this system which relies on natural convection. Thus, modifying the calandria pressure provides a convenient method of regulating the overall evaporation rate to meet required throughput rates.

This trend with ΔT has not been firmly established with *B*- and *C*-boilings, perhaps because jigger steam is used to promote circulation in low-grade pans. Average values of heat transfer coefficient of about 180 and 130 W/m^2/°C have been measured on the *B*- and *C*-continuous pans, respectively.

It is apparent from the figures quoted above that those achieved in the continuous pans are lower than those

7 Julienne & Munsammy: *Proc. S. African Sugar Tech. Assoc.*, 1981, **55**, 79 - 82.

8 Munsammy: *S.M.R.I. Tech Rpt.*, 1982, (1315).

9 Rivière: Personal communication, 1982.

achieved in the early experiments in modified batch pans. This is considered to be due to the different lengths of tubes.

Experiments by the S.M.R.I. have confirmed that higher heat transfer rates can be achieved in shorter length tubes[10]. Tube length in the Mount Edgecombe and Amatikulu pans were 1.0 m and 0.8 m, respectively, while those in the Maidstone and Felixton pans are between 1.5 m and 1.3 m. Thus, the shorter tubes appear to give better heat transfer performance. In practice, however, if the tube is made too short, it leads to a pan geometry which is very squat and wide and takes up considerably more plan area. Some compromise is therefore necessary, and newer designs allow for pan tube lengths of 1.2 m to 1.3 m.

Batch pans are operated with calandria steam pressures of around 50 kPa gauge and overall ΔT of about 45°C. The continuous pans of this design, because of their construction, are able to use low-pressure vapours in the calandria and currently are operated with ΔT's of about 30°C. This provides a significant advantage if thermal economy is of importance. At Felixton, Vapour 2 is used in the calandrias to enable the mill to supply sufficient bagasse to a downstream paper mill without having to burn coal. Clearly, the heating surface:volume ratio can be adjusted at the design stage to suit the particular conditions under which the pan is required to operate.

Residence time distribution

A large number of tracer tests have been undertaken on continuous pans in South Africa by the Sugar Milling Research Institute and Tongaat-Hulett Sugar[3]. The reason for this was to assess the approach of the flow system to plug flow, bearing in mind that significant variations from plug-flow conditions could lead to variations in crystal residence time, which would significantly affect crystal size distribution.

The tanks-in-series model has been used to characterize the flow system. With this model, a true plug-flow system can be represented by an infinite number of well-mixed tanks-in-series, while a complete back-mix system is represented by only a single tank. Most flow systems fall somewhere between the two extremes. Experience with the converted batch pans showed that it is important to give careful consideration to the way in which massecuite flows within each compartment and from one compartment to the next. The modified batch pans and Felixton pans have a cut-out immediately above the calandria in the compartment walls, through which massecuite passes from one compartment to the other. Suitable placement of baffles before and after the openings ensures that no short-circuiting will occur. In the Maidstone pan, the cross-over duct from one compartment to the other was positioned in the downtake, in the form of a "postbox chute", diverting massecuite flowing down the downtake from one compartment to the next. The design of this cross-over port was such that short-circuiting across the compartment would be very unlikely.

In practice, tracer tests at Maidstone and Felixton have confirmed the results achieved in the Mount Edgecombe pan tracer tests. These pans have shown that the flow system is equivalent to somewhere between 12 and 23 tanks-in-series. The results of the tracer tests at Maidstone are shown in Figure 5.

These pans give a closer approach to plug flow than other continuous pans in service in South Africa[3,7,8].

Sugar quality

It is not possible to make firm statement about the quality of sugar obtained in batch pans compared with that obtained in the continuous pan unless the two can be operated side-by-side, since large variations in cane quality occur which have a profound effect on sugar quality. When the change was made from batch *A*-pan boiling to continuous *A*-pan boiling at Maidstone, an improvement in sugar colour, although small, was noticeable and the operators were able to reduce the water wash on the *A*-centrifugals[5].

At Felixton, no difficulty has been experienced in achieving VHP sugar quality, even in an area which was previously known for its poor cane quality. In this case, however, sugar quality is also improved by the operation of a syrup clarifier.

10 Rouillard: *Proc. S. African Sugar Tech. Assoc.*, 1985, 59, 43 - 47.

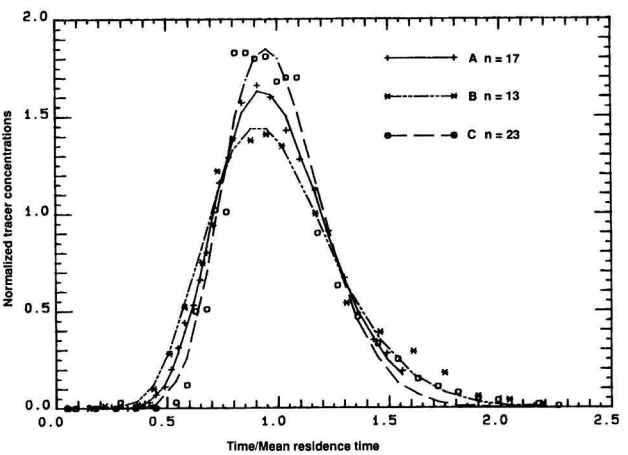


Figure 5. Residence time distribution measured in the Tongaat–Hulett pan at Maidstone boiling *A*-, *B*- and *C*-massecuites. Lines represent best fit of tanks-in-series model (n is the equivalent number of tanks)

Index to Advertisers

A few measurements were done at Maidstone by boiling some batch *A*-strikes to compare with results from the continuous *A*-pan. Six sets of comparative tests were done and the average results are shown in Table II. These show that the sugar, in terms of crystal size and CV, was very similar. However, a statistically significant reduction in the colour of the affined sugar from the continuous pan of about 16% relative to that from the batch pan was achieved.

Table II. Comparison of *A*-sugar produced by batch and continuous pans at Maidstone from the same *A*-seed

	Batch	Continuous
Massecuite		
Brix	90.8	92.3
Purity	83.6	83.9
Sugar		
MA, mm	0.73	0.72
CV	27	28
Colour after affination, (ICUMSA - 420)	820	690

Crystal size distribution

A considerable amounts of attention was given to crystal size and size distribution of *A*-sugar, since it is required to meet VHP specifications for size and percentage of fines. Most attention was given to the coefficient of variation or CV of the sugar, particularly in comparison with sugar from batch pans. It has been shown that, if equivalent CV values can be obtained while achieving the required average crystal size, limits on fines are easily met[5].

In the Maidstone pan, it was found that the improvement in CV from seed to massecuite was of the order of 6 units, which was virtually identical to that measured in batch pan boilings.

It has been clearly shown that the CV of the massecuite crystals depends very much on the CV of seed crystals[3]. Some data obtained are shown in Figure 6. They emphasize the need to prepare a seed of good quality.

In addition to the effect of the seed size distribution, the product crystal size

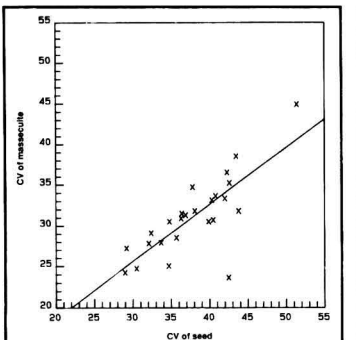


Figure 6. Measured values of crystal CV in seed and massecuite from Tongaat-Hulett continuous *A*-pan at Maidstone

distribution is affected by deviations from plug flow leading to non-uniform crystal residence times, as well as other effects which are also present in batch pan boilings (such as non-uniform conditions of temperature and concentration, inherent variations in crystals and nucleation and dissolution in poorly controlled pans).

From the measurements taken at Maidstone, the variance in crystal size distribution due to non-ideal flow conditions was evaluated relative to that due to these "other" effects[3]. It was shown by simple analysis that for *A*-massecuite, if the flow system can be represented by 4 tanks-in-series, the variance due to the flow system is just slightly more than that due to other effects. However, if the pan

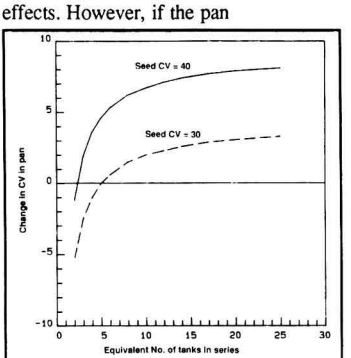


Figure 7. Calculated change in CV from seed to massecuite, based on measurements in the continuous *A*-massecuite pan at Maidstone, as a function of the equivalent number of tanks-in series

approximates a flow system of 16 tanks-in-series, the dispersion due to the flow system is only just over a quarter of the other effects.

From this analysis, the expected change in CV from seed to massecuite can be calculated and the results are shown in Figure 7. Note that this only applies to South African *A*-massecuites.

The results are only approximate, but they nevertheless show firstly that a bigger change in CV occurs from seed to massecuite when the CV of the seed is high and secondly that, provided the flow system approximates to more than about 14 tanks-in-series, the penalty due to deviations from plug flow in terms of CV will be less than 1.5 units. In practice, there is evidence to show that because of more uniform growth conditions in a continuous pan relative to a batch pan, the variance in crystal size could actually be superior to that achieved in the batch pan[3,11].

Instrumentation and control

A schematic diagram of the control systems utilized is shown in Figure 1. In essence, there are 14 control loops, a conductivity control in each of the 12 compartments and, in addition, a calandria pressure control loop regulating the steam flow to the calandria and an absolute pressure control loop regulating the water flow to the condenser. Measurement of the condensate rate from the pan is considered to be important as a means of assessing production rate, and seed pump feed speed is indicated and regulated at the pan. In general, the ratio of massecuite rate to seed rate is about 3:1, but this can be varied to suit the seed crystal size and required massecuite crystal size.

In *B*- and *C*-massecuites, conductivity is a completely adequate means of controlling the feed to each compartment.

In *A*-pans, conductivity can still be an effective means of control, providing that the probe can be kept clean. In practice, it has been found that this means cleaning the probe at least once every 8 hours. It appears that

11 Austmeyer: *Zuckerind.*, 1982, **107**, 401 - 414.

immediately a probe has been cleaned, there is a fairly quick but small build-up on the probe, which changes its level and then drifts off more slowly as encrustation progresses. Steam sparging onto the probes has not proved to be effective and it has been necessary to remove the probes and clean them by hand. In addition, in *A*-massecuites, the relationship between conductivity and massecuite Brix does change regularly and this needs to be checked by the operators.

For this reason, a different measurement technique has been devised, which makes use of the measurement of electrical properties at radio frequencies in the range of 20 MHz to 50 MHz and is less sensitive to concentration or scaling. This probe, together with a micro-processor, is able to measure the reactive and resistive properties of the massecuite and from these measurements infer both crystal content and mother liquor properties. Suitable combination of these signals provides a measurement which enables massecuite quality to be effectively controlled. The system is still under development, but has been used with sucess at Maidstone on the *A*-pan, as can be seen from the high exhaustion figures given previously.

Boiling point elevation control has also been used for controlling feed to each compartment on the Felixton *A*-pans. Boiling point elevation is more suited to control in a continuous pan because the hydrostatic head is constant, as is the absolute pressure. Its main drawback is that it is not affected at all by the crystal content.

Other control strategies involving either the maintenance of a fixed ratio between seed and molasses or syrup feed or the maintenance of a fixed evaporation rate are possible. At Felixton, the required evaporation rate, measured by condensate flow, is set and the calandria pressure is automatically varied to achieve this. This helps to share the load equally between the two *A*-pans. In practice, however, if all the other factors affecting crystallization, such as seed crystal quality and molasses or syrup feed conditions are steady, more elaborate control systems are not required.

Encrustation

In a batch pan operation the pan is steamed-out regularly and the build-up of sugar layers or encrustation on the internal surfaces of the pan is not a problem. In a continuous pan, sugar encrustation is not regularly removed and can cause problems. Generally, it has been found that this encrustation is highly dependent on the massecuite purity.

In *B*- and *C*-massecuites, encrustation is not serious and the pan can be operated for long periods without having to empty and boil-out the pan with water. In some cases, *C*-pans have been run continuously throughout a season without emptying at all and *B*-pans have operated with just a few boil-out periods during a 38-week season. Visual evidence inside *B*- and *C*-pans shows that some of the encrustation which does occur breaks off in layers.

Encrustation in *A*-massecuite pans, where the purity is around 85, is far more severe. It has been found at Felixton and Maidstone that an *A*-pan can easily run for 2 weeks without having to be emptied and boiled-out. In some cases, this period between boil-outs has been extended to longer than 4 weeks, but generally a routine of 2-week periods has been established, which coincides with weekly maintenance stops. *A*-massecuite purities have spanned the range of 80 to 87, and no dependence on purity has been evident over this range.

A system of fine water sprays was installed in the continuous *A*-pans, the objective being to spray small amounts of water onto the internal surfaces and thereby keep them clean. This technique has been found to be totally satisfactory. The period between boil-outs may be extended, but this does not eliminate the problem of scaling-up on the heating surfaces of the pan, which then dictates the pan be taken off for cleaning.

On stopping and emptying the pan, the side and bottom internal surfaces of the pan have been inspected for encrustation or build-up, but found to be quite clean. This confirms the conclusion from tracer tests that the shape of the pan is such that no static regions of massecuite exist in the pan.

Conclusions

The use of continuous pan boiling for all grades of massecuites has been proved to be a practical proposition in raw sugar factories. This brings with it some significant benefits compared with a batch process, so that in the Tongaat-Hulett Sugar mills, all future pans will be continuous in operation.

The problems which have previously retarded the change from batch to continuous operations, namely encrustation and the production of a wider range of crystal sizes, have been overcome or effectively dealt with.

The benefits of this type of continuous pan, as far as thermal economy is concerned, can be considerable. In the first instance, lower quality vapours can be used in the calandria, which makes the re-use of low quality heat possible. In addition, the steadier operation of the whole pan floor contributes to improved thermal economy.

At present, batch pans are required to produce the seed for feeding to continuous pans. The next step will be to dispense with this batch operation as well. In this respect, the developments in the beet sugar industry will be watched with interest.

Summary

The development of continuous pan technology within the Tongaat-Hulett Group is reviewed. Full-scale investigations in different types of continuous units are described, which culminated in a new design of continuous pan. Design features, performance trials and operating experience with this design of pan are covered.

Indonesian sugar imports[1]

Indonesia, which has not imported any significant sugar quantities since 1982/83, has purchased between 100,000 and 120,000 tonnes of sugar from Thailand, Angola and Brazil. The imported sugar is to boost stocks before the beginning of the next harvest in May 1987.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 637.

Liquor evaporation using mechanical vapour recompression*

By Thomas N. Pearson and Brian T. Harrison
(Imperial Sugar Company, Sugarland, Texas, USA)

Introduction

First liquor evaporation at Imperial had been accomplished with a double effect rising film evaporator built in 1948, designed for a melt rate of 1100 short tons/day. It was designed to evaporate liquor from 60° Brix to 70° Brix, and was still doing its job even though the melt rate had increased to over 1700 tons/day, but boiling off the water above 70° Brix in single-effect vacuum pans was very costly in energy and in last pan time.

In the late 1970's Imperial started looking at conventional triple-effect evaporators, but the steam savings did not justify the cost of this type of evaporator. The project was put on hold for several years.

In early 1980 we started a dialogue with the APV Equipment Corporation about upgrading the 1948 evaporator to handle a 2000 tons/day melt rate at a discharge Brix of 76°. Several schemes that were evaluated included:

(1) enlarging the existing double-effect evaporator

(2) enlarging the existing double-effect evaporator and employing mechanical vapour recompression (turbine), and

(3) enlarging the existing double-effect evaporator and employing mechanical vapour recompression (electric).

Each of these schemes had its own advantages and disadvantages, but the one common to all was the use of the existing evaporator which at that time was 32 years old.

APV then made a fourth proposal, viz. to install a completely new evaporator. This proposal called for a single-effect four-stage falling-film tubular evaporator with a 1500 h.p. electrically driven vapour recompression unit.

The duty specifications were to treat a feed flow of 293,000 lb/hr, at 65.6° Brix and 165°F (73.8°C), to give a product flow of 247,313 lb/hr at 77.5° Brix and 175°F (79.4°C). This involves an evaporation of 45,687 lb/hr.

The order for this unit was placed in September 1983 and the slab was poured

T. N. Pearson

B. T. Harrison

in December 1983. The unit was installed at an outdoor location next to the building which housed the older evaporator. This allowed for the best use of the existing tankage and piping and reduced the need for new piping runs.

Description

The evaporator sits on a three foot thick concrete slab measuring 30 × $32^1/_2$ ft. It consists of a feed balance tank of 500 gallons capacity, a plate heat exchanger, two double-pass tubular calandrias, two liquid/vapour separators and centrifugal compressor driven by a 1500 h.p. electric motor. The calandrias are 58 ft tall and 68 inches in diameter. They contain 550 two-inch O.D. 304 stainless steel tubes 40 ft long, giving a total heating surface of 27,368 ft². Attached to the base of the first calandria is a liquid/vapour separator that is 90 inches in diameter, while that attached to the second calandria is 84 inches in diameter.

The compressor is a single-stage centrifugal compressor manufactured by Atlas Copco Turbonetics. The compressor is driven by Westinghouse 1500 h.p. induction motor. It uses a three-phase, 60 Hz, 2200 volt supply and operates at 1800 rpm. The compressor is equipped with an instrumentation panel which contains all gauges, warning and shutdown alarms.

On the suction side of the compressor is a set of adjustable guide vanes that act as a throttling valve to control the vapour flow to the compressor. With the use of the guide vanes the evaporator may be run as low as 50% of capacity.

A tubular condenser which uses 100 gpm of water condenses vapours as required to maintain the absolute pressure. There are two Kinney vacuum pumps both of which are run to provide the initial vacuum but only one to maintain it.

Liquor flow

The liquor feed rate design is 146.5 tons/hr at 65.6° Brix and 165°F (73.8°C). The liquor flows by gravity from the storage tanks to the feed

* *Paper presented to the 45th Ann. Meeting Sugar Ind. Technol.*, 1986

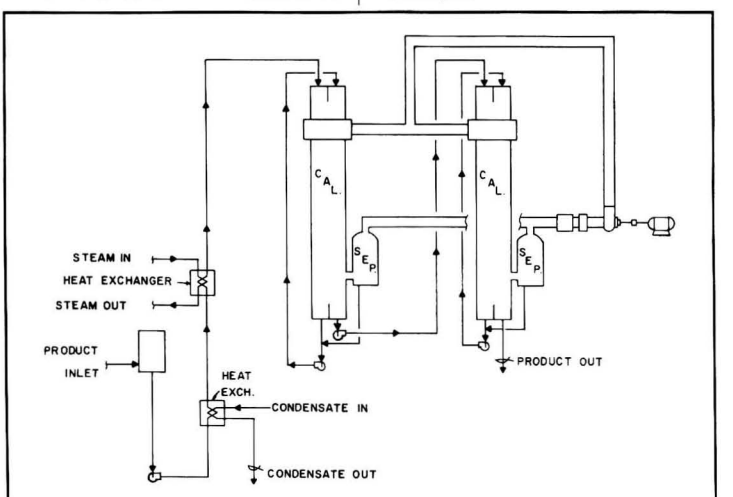


Fig. 1 Liquor flow

balance tank which has a D/P cell for level control. A centrifugal pump moves the liquor through a plate heat exchanger where it is heated with condensate from the calandrias to 170°F (76.6°C). In the event that the liquor is below 165°F (73.8°C), such as on a start-up day, a steam valve to the plate heater will open to provide the necessary heat. The liquor enters the top of the calandria which is partitioned, allowing the liquor to flow through only half of the tubes. A distribution plate provides for uniform flow through the tubes. The liquor collects in the bottom of the calandria and is pumped to the second stage of the first calandria. The second stage liquor in a like manner is pumped to the third and fourth stages of the second calandria. The liquor leaving the fourth stage is at 77.6° Brix and 175°F (79.4°C). A Texas nuclear density controller controls the flow rate to the evaporator in order to maintain the desired Brix.

Vapour flow

Separation of vapour from the liquid is achieved in four stages:

(1) pre-liquid extractions from the base of the falling film unit,

(2) change in direction of the vapour passing to the separator,

(3) cyclone action in the separator

(4) final mist elimination in the suction of the compressor.

These combined actions are so effective that the condensed vapours from the compressor are used as boiler feed water make-up.

Vapour from the evaporation at 4.629 p.s.i. absolute, after passing through the demister, is ducted to a superheater where the temperature is raised to 168°F (75.5°C) or 9°F superheat to ensure that no liquid passes to the compressor. The vapour flow to the compressor is 61,058 a.c.f.m. (45,640 lb/hr). These vapours are compressed to discharge pressure of 9.746 p.s.i. abs. at a temperature of 328°F (164°C) and contain 136°F (57.8°C) of superheat. The compressor's operating speed is 9398 rpm. The compressed vapours are desuperheated to 191.5°F (88.6°C) using condensate from the calandrias. The condensate collected from the calandrias is pumped through the feed liquor heat exchanger and then to the power plant for boiler feed make-up.

Incondensables are bled off at three points — the top, middle and bottom of the calandrias — and are removed by a Kinney vacuum pump. An absolute pressure controller on the suction side of the compressor modulates a control valve that allows vapours to be condensed through a shell and tube heat exchanger, the condensed vapours flowing back to the steam side of the calandria.

Operation

Prior to start-up of the system, it must be heated on both the fluid side and vapour side of the system. In order to heat the fluid side, water or liquid is circulated from the feed balance tank through the heat exchanger, then pumped through the two calandrias and back to the feed balance tank. The steam valve for the heat exchanger is automatically controlled to heat the fluid to a temperature of 165°F (73.8°C). The start-up vent valve is open during this circulation and the vapours off the water or liquor are pulled through the separators, up through the demister/ superheater and into the condenser. This procedure heats the entire fluid system along with the vapour inlet to the compressor.

The discharge side of the compressor is heated using live steam which is admitted into the discharge duct just above the compressor. This condensate is pumped through the heat exchanger to heat the incoming liquor, then is sent to the boiler house after ascertaining that there is no sugar present. During the time that the system is heating (which is approximately 30 min) the vacuum is raised to a minimum of 18 inches of mercury. The compressor gearbox oil is being heated and circulated during this time and the air and steam seals are activated. Whenever all start-up parameters are satisfied, the compressor is ready for start-up. The operator will notify the power plant and request permission to start.

When the compressor is started and is coming up to speed, the radial vibration is monitored by the operator until the compressor has obtained its operating speed of 9398 rpm in approximately thirty seconds.

If the system is started using water, the liquor will be introduced to the feed balance tank while the system is recirculating. The liquor will continue to recirculate until 74.0° Brix is achieved.

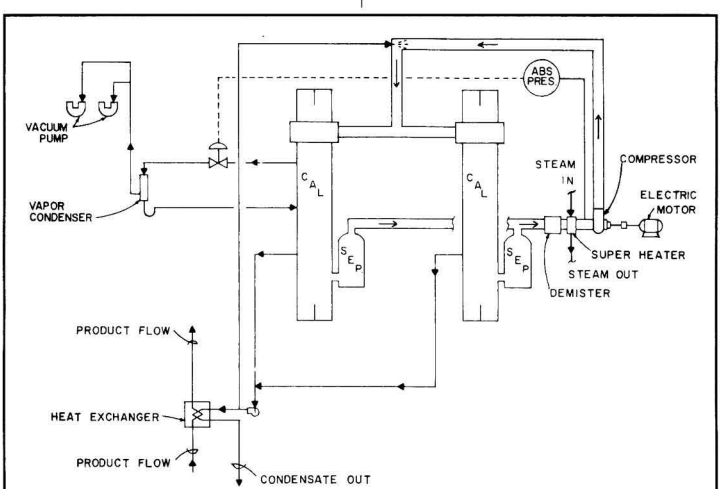


Fig. 2 Condensate and vapour flow

At this desired Brix the evaporated liquor will be pumped to a surge tank prior to pumping to the pan floor.

With the system on line and in the automatic mode the liquor outlet Brix is measured by a Texas Instruments device which controls the flow rate to produce the desired Brix at the particular vane setting. The vane setting, which acts as throttling valve on the inlet to the compressor, can be manually adjusted to increase or decrease the desired outlet Brix. By adjusting the vane setting the evaporator can be operated at 50% of design flow rate. If the need arises during normal operation for recirculation of the liquor, this can be done by reducing the vane opening to 10%, lowering the liquor temperature to 160°F (71°C) and recirculating all the liquor and condensate to the feed balance tank.

An operator's control panel is located on the third floor of the pan house adjacent to the evaporator. All equipment, other than the independent compressor monitors, is controlled and monitored continuously by a Texas Instrument PM 550 programmable controller. The systems operator utilizes a TI loop access module (LAM) to interface into the control loops for switching to manual or automatic modes, altering automatic setpoints and manual outputs to valves. The LAM is also used by the instrument department to tune the gain, rate and reset on all loops. The process variable and setpoint/output are displayed continuously on any given loop. The compressor inlet vanes and start-up steam valve are manually operated by individual potentiometer input.

Along with the individual loop displays at the LAM, there are nine BCD displays located at the control panel. The systems operator can constantly view the feed balance tank level, inlet liquor flow rate, the level of each effect, vacuum (inches of mercury), inlet liquor temperature after the heat exchanger and the concentrated liquor Brix. Throughout the evaporator system there are ten resistance bulbs to measure temperatures and they are displayed at the control panel (one at a time) using a push button switch system. One other BCD indicator located on the panel will display a constant amperage reading of the compressor motor. All receiving tanks, surge tanks and the pan floor tank levels are also constantly displayed at the control panel.

There is another instrument panel located at the compressor station where its critical operating conditions are displayed. This panel displays the radial vibration, air seal pressure, steam seal pressure, air seal differential pressure, oil pressure before and after the filter, gearbox oil pressure, oil temperature and compressor vapour discharge pressure. There is also a light display panel that indicates all alarms and equipment operating.

System protection

In order to protect the compressor from mechanical breakdowns a number of automatic shutdowns were installed into the operating system.

Once an automatic shutdown has been initiated, there is a one-hour delay for motor protection before restarting the compressor. A list of the automatic shutdown conditions are:

1. Compressor shaft radial vibration exceeding 0.002 in.
2. Compressor gearbox oil temperature exceeding 145°F.
3. Compressor gearbox oil pressure below 15 psig.
4. Compressor oil reservoir low.
5. Compressor vapour discharge temperature exceeding 350°F.
6. Compressor vapour differential pressure surge of 0.25 psid.
7. Compressor amperage load exceeding 350 amp.
8. Compressor seal air differential pressure below 7 inches w.g.
9. Compressor seal steam differential pressure below 7.8 psid.
10. Compressor inlet vacuum below 10 inches of mercury.
11. Compressor inlet vacuum exceeding 28 inches of mercury.
12. Liquor is sensed in the demister/superheater.
13. Liquor is sensed in the No. 1 or No. 2 vapour separator.
14. High compressor motor temperature.

Along with the shutdown alarms there are also several non-critical alarms displayed on the control panel with an ISS 2210 message display. These alarms will be displayed in the form of a BCD printed message, until the alarm input to the PM 550 is inactive.

Conclusions

The MVR evaporator supplied by the APV Corporation cost a total of $922,600. The payback period was less than one year.

The benefit of having higher Brix liquor going to the pan floor has resulted in a reduction of 20% in the boiling time of the first sugar. This has eliminated the bottleneck on the pan floor and has resulted in a melt increase of about 10%.

Although it may seem to be unconventional approach to 1st liquor evaporation, the use of a MVR evaporator has proved to be beneficial and cost effective at Imperial.

Zaire sugar project[1]

The government has submitted to the African Development Bank plans for financing a sugar project valued at $90 million. The project includes a cane plantation and construction of a sugar factory as well as the necessary infrastructure for the Mushie Pentane region. The Ministry of Agriculture is reported to have made contact with West European suppliers in countries which are ready to grant credits.

West German sugar factory to close[2]

The Barum sugar factory, built in 1858 and the second oldest in Lower Saxony, is to close after the 1986 campaign. In the 1985 campaign it sliced 211,725 tonnes at a rate of 2750 tonnes/day, to produce 33,406 tonnes of white sugar. The work force will be transferred to the Uelzen and Wierthe factories owned by the same company, formed in 1985 by the fusion of Zuckerfabrik Uelzen AG and Braunschweiger Zucker-AG.

Spain beet sugar industry rationalization[3]

Since 1982 seven beet sugar factories in Spain have closed and the Ebro group has now decided that the San Fernando factory at Rosales in Sevilla is to close, reducing its plants to nine and bringing the total remaining to 24 with a total slice of 950,000 tonnes/day.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 545.
2 *Zuckerind.*, 1986, **111**, 981.
3 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 557.

New books

Brazils's Pro-Alcohol program: its development and prospects

J. M. M. Borges. 16 pp; 10.0 cm × 21.0 cm. (Copersucar, Rua Boa Vista 280, 4° andar, C.P. 5691, São Paulo, SP, Brazil 01014.) 1985.

This is a reprint in English of a paper presented by the author at the Washington Conference on Alcohol held in November 1985. Professor Borges is the Economic Advisory Group Manager for Copersucar and thus speaks authoritatively on the subject, so that the historical aspects and the then current situation are described very well. The future scenario envisaged by the Brazilian alcohol program included a decline in the oil price to $24 a barrel by 1987 and a climb after 1988 until it reached $35 around the year 2000. In the intervening period, however, the oil price has collapsed to below $10 and, following agreement among OPEC members, has recovered to about $18. The economics of alcohol manufacture have been transformed since the paper was written and the Brazilian authorities have announced a switch in emphasis from alcohol to sugar production. "The best laid schemes..."

Alternative sweeteners

Eds. L. O'B. Nabors and R. C. Gelardi. 368 pp; 15.0 × 22.7 cm (Marcel Dekker Inc., 270 Madison Ave., New York, NY 10016, USA.) 1986. Price: $77.50.

This book, Volume 17 of the Food Science & Technology Series, is a compilation of the work of 21 experts in the field on non-sucrose sweeteners and provides a comprehensive overview, combining the results of interdisciplinary investigations in a single source. An introduction by the editors discusses the nature of the sweet taste and relative sweetness, the purpose of alternative sweeteners and the "ideal sweetener". They review briefly regulatory demands and US food additives regulation, pointing out the huge cost of developing an alternative sweetener and the years of scrutiny before it can be used. Individual sweeteners are then reviewed in separate chapters, each with many literature references and describing the chemical nature, history, function, stability, metabolism, etc. These include saccharin, aspartame, cyclamate, acesulfame-K, talin protein (thaumatin), dihydrochalcone sweeteners from citrus flavanones, the L-sugars, polyalcohols (sorbitol, mannitol, etc.) xylitol, palatinit and stevioside. Separate treatment is given to pure crystalline fructose and to the high fructose syrups, while two final chapters provide a review of other alternative sweeteners and mixed sweeteners functionality. For those concerned with marketing of sugar this book is essential reading so that they can know the strengths and weaknesses of their opposition.

The ethanol file

Anon. 20 pp; 21 × 29.5 cm. (Association Française pour la Biomasse, Pyc Edition, 254 rue de Vaugirard, 75740 Paris Cedex 15, France.) 1986. Price: 30 F.

Drawn up by a working group of the French Biomass Association and edited by *Biomasse Actualités*, this report is an appraisal of the situation regarding ethanol manufacture from sugar beet, molasses and wheat and its use as motor fuel. The contents cover many aspects of the subject, including the agricultural requirements, the use of ethanol by comparison with methanol as 5% additive to gasoline, the energy balance of alcohol as a fuel (allowing for the energy consumed in growing the raw material and producing the alcohol from it against the energy value of the gasoline-alcohol mixture), national and EEC revenue from fuel alcohol and the question of customs duty, plus a number of other facets.

Hawaiian sugar manual 1985/86

27 pp; 15.2 × 22.8 cm (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, Hawaii 96701, USA). 1986.

Subtitled "A Handbook of Statistical Information", this brochure is more than indicated; it includes names and addresses and Presidents of the operating sugar companies, grouped under the principal owners, gives details of the HSPA, a history of the sugar industry in Hawaii with a panel of facts and figures, and 1985 production figures as well as a survey of the industry's organization. Articles describe US sweetener industries, sources, sugar legislation, etc. and world sugar production data, a brief history of the 1978/84 International Sugar Agreement, and a glossary of sugar industry terms.

Manual azucarero Mexicano 1986

Ed. Ma. de Los Angeles López Coria. 496 pp; 19.3 × 26.7 cm. (Cía. Editorial del Manual Azucarera S.A., Carlos J. Finlay No. 6, 06500 México, D.F.) 1986. Price: US $20.00.

This, the 29th edition of the Mexican sugar manual, includes a map showing the location of the country's 69 sugar factories and lists them in an index with their operating companies (most are managed by the government organization Azúcar S.A. de C.V.) and addresses. Each is then the subject of a description occupying around 4 - 5 pages which includes information on cane and sugar capacities, executive and technical personnel, offices and details of equipment for cane reception and milling, steam and power generation, clarification, evaporators, pans, condensers, crystallizers and centrifugals, sugar, molasses and oil storage, refining equipment and distillery plant where they exist. Cane and sugar statistics for 1980/84 are listed while more detailed information is provided on the 1985 season, including factory analyses and agricultural information on cane varieties, irrigation, fertilization, etc. Details are provided of Mexican organizations and a directory of sugar factory personnel included, together with a Buyers' Guide to suppliers of equipment and services in Mexico. The book is in Spanish, naturally, and is a comprehensive guide to an important industry.

Facts and figures

Continued drought in Cuba[1]

The intense drought affecting Holguín province has already caused a state of emergency in the livestock sector and the cane crop has also been affected by the long dry period. There are reports of drought from other provinces but Holguín is the worst affected because rain has been lacking during several months. Cuban sugar production in 1986/87 will again be affected, as was the case in 1985/86 when a long spell of drought resulted in a substantial production shortfall.

New Italian sugar group[2]

Industria Saccarifera Italiana S.p.A. (ISI), the new Italian sugar group, started business in July and has put into operation in the 1986 season the sugar factories at Argelato, Bottrighe, Casei Gerola, Fano, Finale Emilia, Mirandola, Pontelongo and Porto Tolle. The remaining factory of the former Montesi group, located at Crevalcore, is to be closed for sugar manufacture and will serve as a beet reception station. The Sermide sugar factory in Italy, which has been closed for several years, is being dismantled.

Honduras sugar situation[3]

The Honduras government estimates sugar production in 1986 at 220,000 tonnes, and a further 20,000 tonnes of white sugar was illegally imported from Guatemala. Sugar exports are put at 105,000 tonnes but local white sugar sales have been displaced and this has led to unsold stocks in the factory warehouses. Exports in 1987 are expected to be almost equal to those of 1986, and domestic consumption to remain the same. With low world market prices and a reduction in the US quota, sugar production in 1987 is forecast at only 212,000 tonnes.

Hawaiian Sugar Technologists 1986 Meeting

The Hawaiian Sugar Technologists' 45th Annual Conference was held during November 10 - 12, 1986 at the Ala Moana Americana Hotel in Honolulu. Its theme, "Innovation - Pathway to Success" symbolized new directions the Hawaii sugar industry must take in order to survive, according to HST President Les Wishard, Jr. of Hamakua Sugar Co. Inc. Rep. Kika de la Garza, chairman of the House Agriculture Committee, spoke to the group on the prospects for continued sugar support under the Farm Bill. John B. Bunker, president of C and H Sugar, discussed the present administration of the sugar program and its economic and political implications. Sarah Setton, vice president for public affairs of The Sugar Association, described the Association's new, aggressive advertising program on behalf of sugar. Hawaiian industry leaders addressing the general sessions were Francis S. Morgan and Don J. Heinz, chairman and president, respectively, of the Hawaiian Sugar Planters' Association (HSPA). Technical presentations were made by 73 people from Hawaii plantations, the HSPA Experiment Station and sugar-related industries. About 300 people attended the three-day conference. HST is a professional organization of 653 members representing management, agriculture, field engineering and factory operations in the Hawaiian sugar industry. Dr. Kobe Shoji and Shigeo Uyeda received Distingushed Service Awards at the Conference. The awards are presented annually by HST to individuals who have made outstanding contributions to Hawaii's sugar industry. Shoji is vice president-chief agriculturist for Alexander & Baldwin Inc. and is considered one of the foremost sugar cane technologists in the world today, as a researcher, university professor and consultant. He joined C. Brewer & Co., Ltd. in 1960 and took a major role in establishing Brewer's sugar operations in Iran and Puerto Rico. In 1966 he became the principal agricultural advisor to all of Brewer's agricultural operations, and in 1975 joined Alexander & Baldwin in similar capacity. Uyeda is known as a creative thinker who analysed technical problems in sugar cane culture and, at home after work, invented new methods or equipment to solve those problems. When Roundup was issued in 1979, it was too potent for high-volume herbicide applicators then in use. Uyeda is credited with developing two devices which applied herbicide sparingly without damaging the cane plant. One of these devices was later manufactured commercially and became widely known as the magic wand. He led or assisted in many other developments which improved efficiency in weed control, irrigation, seed cutting, replanting and rat control. Uyeda was employed by McBryde Sugar Company Ltd. throughout his career, rising from a field hand in 1936, to agriculturist and weed control superintendent, and field development superintendent from 1982 to retirement in 1983.

Ivory Coast sugar industry restructure[4]

The French aid agency, Caisse Centrale de Coopération Economique (CCCE) has stepped in to replace the World Bank in a major program to restructure the loss-making sugar industry of the Ivory Coast. The CCCE is lending $27.7 million to help finance a $129 million program, substantially changed from the original World Bank scheme. The project has been scaled down and now involves far less foreign technical assistance. Instead of being privately managed, the four sugar complexes will continue to be managed by the state-owned Sodesucre, with assistance from the French group Adra. The program aims to raise output to 185,000 tonnes/year by 1990/91 from 133,000 tonnes in 1985/86, with a view to entirely satisfying local demand. This compares with the record output of 187,000 tonnes in 1982/83, of which just over half was exported.

Swaziland sugar production

Production of sugar by the three sugar factories in Swaziland is of prime importance to the country's economy in terms of export revenues and employment. While it is efficient overall, and yields are high by world standards, output has been uneven in recent years. After increasing by an annual average of 6.7% between 1981 and 1984, to 420,000 tonnes, unfavourable conditions contributed to a fall in raw sugar output to 396,000 tonnes in 1985 while a recovery to a record 460 - 490,000 tonnes is expected from the 1986 season. Around 95% of output is exported, of which some 150,000 tonnes a year are sold through favourable arrangements with the EEC at prices well above currently depressed world market levels. Because of problems encountered in securing transport through Mozambique, the Swaziland Sugar Association is considering plans for the expansion of storage capacity within the country.

International seminar on alcohol fuel

This seminar took place in Mexico City during November 3 - 5, 1986, under the auspices of GEPLACEA and Azúcar S.A., the Mexican state sugar organization. It was attended by more than 125 participants from the 13 member countries of GEPLACEA as well as others from Australia, the US and USSR and representatives of the UN and IADB. The sixteen speakers and participants in the round-table discussions surveyed the world situation for sugar and for energy resource prices and their effects on alcohol fuel programs. Other aspects of fuel alcohol covered were technology, cost and profit analysis, ecology effects, and prospects for exports from producers in GEPLACEA countries.

German sugar companies merger

The former Hannoversche Zucker AG, with sugar factories in Rethen and Weetzen, and the former Lehrter Zucker AG, with a factory in Lehrte, have merged to form a new company, Hannover Zucker AG Lehrte.

Chile sugar expansion[5]

Outlook for the 1987 beet sugar crop is highly favourable, according to the General Manager of Industria Azucarera Nacional S.A., because the area cultivated is expected to rise to 53,000 hectares from 51,000 and current record yields (52 tonnes/ha in 1986 *vs.* 44 tonnes/ha in 1985) will have made it possible to produce a record 430,000 tonnes of white sugar in 1986 against 320,000 tonnes in 1985[6]. Chile is among the nations with the best yields in the world.

Dominican Republic sugar factory closures[7]

The Dominican Republic has announced plans to close two of the country's 14 sugar factories following the halving of its 1987 US sugar quota allocation to 160,160 short tons, compared with 302,016 tons in 1986.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 584.
2 *Zuckerind.*, 1986, **111**, 983.
3 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 603 - 604.
4 *Financial Times*, October 24, 1986.
5 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 620.
6 *Zuckerindustrie*, 1986, **111**, 1171.
7 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 12.

Possible cane milling extraction record

The South African record mill extraction of 98.24%, set by Darnall sugar factory in the 1981/82 season, has just been broken by Illovo Mill which logged an average of 98.25 for the 1986 season. It is believed that this achievement may be a world record and readers are invited to advise us if any other factory has attained a higher average milling extraction during a complete season.

West German sugar industry rationalization[8]

In order to be competitive, sugar facilities in Germany must process at least 6000 tonnes of beet per day. Concentration is therefore proceeding and two of the 19 factories in Lower Saxony will close after the 1986/87 campaign.

Distillery in new area of Brazil[9]

The first alcohol distillery in the far western state of Acre, on the Peruvian and Bolivian borders, will go on stream in April 1988 with an installed capacity of 120,000 litres/day or 21 million litres/year, and will supply the total demand for alcohol fuel in the state and half the needs of the neighbouring state of Rondonia. Cane plantations to supply the distillery will eventually extend over 5000 hectares. The project will be located 33 miles from the state capital, Rio Branco, and will cost an estimated $20 million.

Alcohol from sugar in West Germany[10]

Plans to construct a bio-ethanol plant at Gross-Munzel[11] are being maintained in spite of currently low gasoline prices. Planning is to be completed by mid-1987 for a pilot plant to produce some 25,000 hl annually of alcohol from some 40,000 tonnes of surplus C-sugar. The costs of the plant are estimated at some DM 35 million.

Mali sugar production increases[12]

Mali's sugar production increased substantially during 1984 - 1986 from a cane crop which rose from 97,000 tonnes in 1983/84 to 133,000 tonnes in 1984/85 and to 173,000 tonnes in 1985/86. Sugar production increased from 10,327 tonnes in 1983/84 to 13,067 tonnes in 1984/85 and to 18,392 tonnes in 1985/86. In the current season Mali plans to produce 19,000 tonnes of sugar from around 200,000 tonnes of cane and production is to be raised to 30,000 tonnes by 1990. The increase is reported to be due to the fact that Mali's sugar sector has been partly privatized and is now co-managed by China.

Guatemala sugar output forecast raised[13]

Guatemala is expected to produce 7.0 million tonnes of cane in 1986/87, up from 5.4 million tonnes the previous year, according to the US Agricultural Attaché. Planted area has been increased by 16,000 hectares to 97,000 ha, and raw sugar production is estimated at 664,000 tonnes against 581,000 tonnes produced in 1985/86. The favourable exchange rate between the quetzal and dollar has led to large illegal exports of plantation white sugar to Honduras and Mexico, but better border controls are expected to cut these.

Morocco sugar production, 1986[14]

Beet sugar production in Morocco during the 1986 season amounted to 338,627 tonnes, tel quel (including 132,948 tonnes of white sugar and 205,679 tonnes of raw sugar), produced from 2,568,000 tonnes of beet. In 1985 the beet crop of 2,176,000 tonnes had yielded 37,000 tonnes less of sugar. The 1986 sugar cane harvest reached 793,000 tonnes, up some 80,000 tonnes from the year before, and cane sugar production totalled 74,005 tonnes (54,885 tonnes of white sugar and 19,120 tonnes of raw sugar), up nearly 13,000 tonnes from 1985. Thus total Moroccan sugar production was 428,965 tonnes, raw value, substantially up from the 377,723 tonnes produced in 1985.

Zambia Sugar Co. Ltd. results, 1985/86[15]

The Zambia Sugar Co. Ltd., jointly owned by the Zambian government and Tate & Lyle Ltd., has posted its highest-ever profit of 22.65 million kwacha (£1.3 million). The company crushed 1.2 million tonnes of cane and recorded an 18% increase in sugar sales to 129,286 tonnes which included a 100% rise in export sales to 15,540 tonnes. Production at its two plants remained at high levels of efficiency despite expansion and modernization works in progress.

West Germany sugar production, 1986/87[16]

The West German beet sugar campaign was virtually complete by the end of December, by which date sugar factories had processed 20,409,000 tonnes of beets and had produced 3,160,000 tonnes of sugar, white value. Although the beet slice was down some 600,000 tonnes from the year before, sugar production was up from the 1985/86 level owing to the higher sugar content of the beets, 17.92% against 17.30%. With sugar extracted from molasses (19,000 tonnes, white value), total sugar production at 3,180,000 tonnes, white value (3,460,000 tonnes, raw value), is up 24,000 tonnes from 1985/86.

Philippines sugar exchange proposal[17]

The Manila International Futures Exchange has announced that it will soon begin to trade in sugar as well as other agricultural commodities. The exchange has appropriate offices in the Makati trade district but needs the final authorization of the government Securities and Exchange Commission. This will be granted when a minimum of 20 members is reached (there were at least 13 at the time of the announcement). The sugar contract specifies 50 long ton lots of raw cane sugar, of 96 pol, f.o.b., deliverable in ports of nine Asian countries, with prices quoted in Philippine pesos.

Alcohol manufacture in Jamaica[18]

Biocom International Ltd., a subsidiary of Queensland Science & Technology Ltd., has announced that it has put the finishing touches to an arrangement with the government Petroleum Corporation in Jamaica for the use of the Australian bacterial process at a new alcohol distillery. The contract was negotiated by Sucres et Denrées, acting as agents for Biocom. It is estimated that the distillery, with a capacity of 13 million gallons annually, will begin operation in mid-1987.

Tanzania sugar expansion[19]

Tanzania has begun implementing an ambitious program intended to achieve self-sufficiency for Zanzibar. The program involves rehabilitation of cane estates and expanding sugar production capacity of the Mahonda factory. Initial efforts will be to rebuild the irrigation structure with new drains and irrigation channels and planting of trees to prevent soil erosion. The 735-hectare estate is to be expanded to 2000 hectares in the second stage of the program.

Colombia–Venezuela sugar project abandoned[20]

For almost a decade, Colombia and Venezuela have been trying to establish a large sugar factory (Azurca) near the border of the two countries, originally to crush sugar cane grown in Colombia to produce sugar for sale in Venezuela. A recent analysis of the situation advises its closure and rebuilding anew, according to a USDA report from Bogotá. The two countries have already spent $21 million on the project, including the purchase of used equipment.

Spain sugar imports possibility[21]

Spain may have to import sugar for the first time in ten years if the 1986 estimated output of 980,000 tonnes fails to cover demand, according to a spokesman for the Sugar Producers' Association. The EEC set a one million tonne quota for the 1986/87 marketing year ending June 30, but current production levels are below that target owing to drought and a reduced planted area. If demand rises above 980,000 tonnes, sugar imports will become necessary, according to the spokesman.

8 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 650.
9 *Sugar y Azúcar*, 1986, **81**, (10), 12.
10 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 650.
11 See *I.S.J.*, 1986, **88**, 158.
12 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 655 - 656.
13 *Reuter Sugar Newsletter*, October 8, 1986.
14 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 656.
15 *Standard Chartered Review*, November 1986, 9.
16 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 7.
17 *Reuter Sugar Newsletter*, October 1, 1986.
18 F. O. Licht, *Int. Molasses Rpt.*, 1986, **23**, (15).
19 *World Commodity J.*, 1986, **9**, (3), 16.
20 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 14.
21 *Reuter Sugar Newsletter*, November 28, 1986.

reader inquiry service

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

photocopy service

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

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of £50.00 for supply by surface mail. The additional cost for air mail is £24.00.

FIRST FOLD

reader inquiry service

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

Advertiser	Product	Page

Signature .....

Block Letters

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

Position .....

Firm .....

Address .....

SECOND FOLD

photocopy service

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

Page	Author(s)	Title

Signature .....

Block Letters

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

Position .....

Firm .....

Address .....

Payment of £ is enclosed

FIRST FOLD

THIRD FOLD AND TUCK IN

additional subscription order

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

.....19.....

Block Letters

.....

.....

.....

.....

.....

Signature .....

Date .....

I enclose cheque/draft/M.O./P.O. for £50.00/74.00.

The International Sugar Journal
P.O. Box 26,
Port Talbot,
West Glamorgan SA13 1NX,
United Kingdom.

SUGAR BOOKS

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

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

AUSTRALIAN SUGAR YEARBOOK 1986	(1986)	**£15.90**
HANDBOOK OF CANE SUGAR ENGINEERING (3rd ed.): *Hugot, transl. Jenkins*	(1986)	**£231.30**
CANE SUGAR HANDBOOK (11th ed.): *Meade-Chen*	(1985)	**£108.90**
GEOGRAPHY OF SUGAR CANE: *Blume*	(1985)	**£65.90**
F. O. LICHT'S INTERNATIONAL SUGAR YEARBOOK AND DIRECTORY	(1985)	**£53.90**
WSJ DIRECTORY OF THE WORLD SUGAR INDUSTRY	(1984)	**£230.00**
ELSEVIER'S SUGAR DIRECTORY : *Chaballe*	(1984)	**£70.00**
NOEL DEERR: CLASSIC PAPERS OF A SUGAR CANE TECHNOLOGIST: *Ed. Payne*	(1983)	**£105.55**
BEET SUGAR TECHNOLOGY (3rd ed.): *McGinnis*	(1982)	**£51.30**
UNIT OPERATIONS IN CANE SUGAR PRODUCTION: *Payne*	(1982)	**£46.40**
MANUFACTURE AND REFINING OF RAW CANE SUGAR (2nd ed.): *Baikow*	(1982)	**£121.10**
BY-PRODUCTS OF THE CANE SUGAR INDUSTRY (3rd ed.): *Paturau*	(1981)	**£68.50**
STANDARD FABRICATION PRACTICES FOR CANE SUGAR MILLS: *Delden*	(1981)	**£49.50**
THE EFFICIENT USE OF STEAM :*Ed. Goodall*	(1980)	**£53.90**
SUGAR ANALYSIS: ICUMSA METHODS: *Schneider*	(1979)	**£14.30**
PHYSICS AND CHEMISTRY OF SUGAR BEET IN SUGAR MANUFACTURE: *Vukov*	(1977)	**£86.90**
SUGAR BEET NUTRITION: *Draycott*	(1972)	**£27.30**
PROCEEDINGS 16th (1974) SESSION ICUMSA	(1975	**£8.65**
" **17th (1978)** " "	(1979)	**£23.90**
" **18th (1982)** " "	(1983)	**£18.65**
ANALYTICAL METHODS USED IN SUGAR REFINING: *Plews*	(1970)	**£30.30**
SUCROSE CHEMICALS: *Kollonitsch*	(1970)	**£9.35**
INTRODUCTION TO CANE SUGAR TECHNOLOGY: *Jenkins*	(1966)	**£82.20**
TECHNOLOGY FOR SUGAR REFINERY WORKERS (3rd ed.): *Lyle*	(1957)	**£20.00**

SUGAR BOOKS DEPARTMENT

INTERNATIONAL SUGAR JOURNAL
P.O. Box 26, Port Talbot, West Glamorgan SA13 1NX, U.K.

Putsch

Membrane Press Filter model PKF

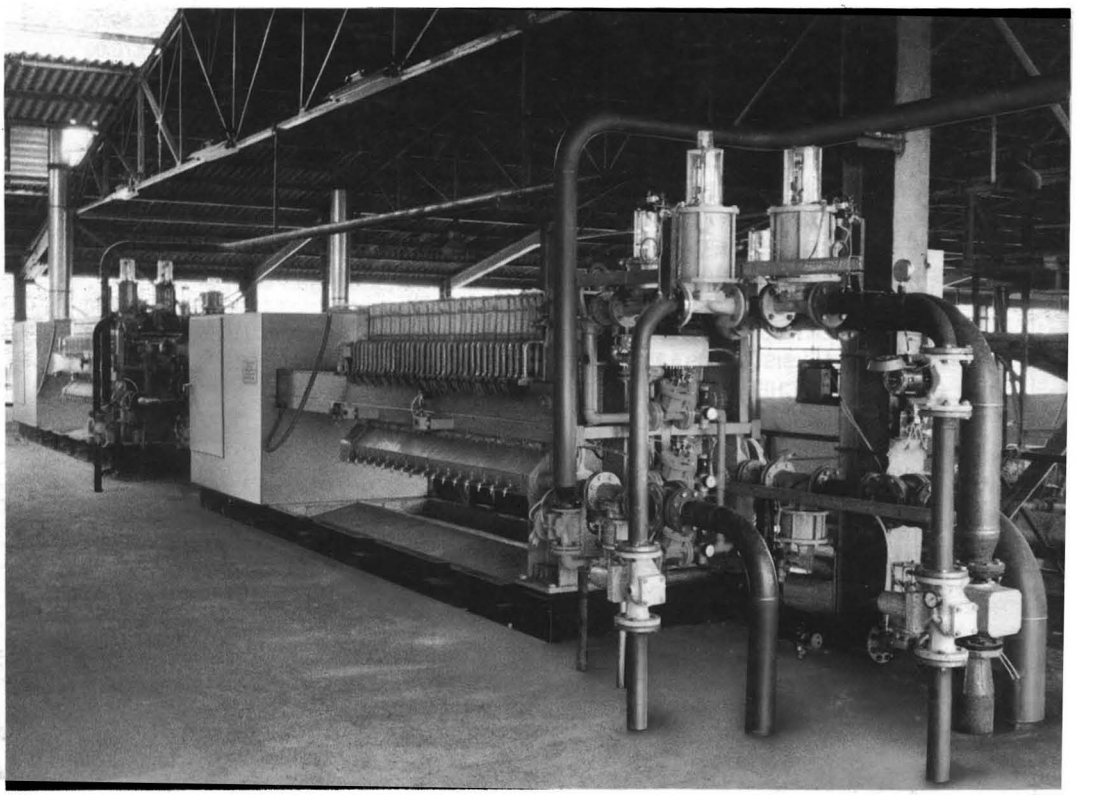
You can obtain more than 70% dry substance in your filter cake when processing beet and less than 45% moisture when processing cane.

High operating capacity.

Excellent sweetening-off results.

Fully automatic operating cycles.

For more details ask Putsch about their PKF Filters.



Putsch

H. Putsch GmbH & Comp. · P.O. Box 4221 · 5800 Hagen 1/W.-Germany · Tel. (23 31) 399-0 · Telex: 8 23 795
In the USA: H. Putsch & Company, Inc. · P.O. Box 5128 · Asheville, N.C. 28803 · Tel. (704) 6 84-06 71 · Telex: 577 443
In Italy: Putsch-Meniconi: Loc. Bellavista, 48 · 53036 Poggibonsi (Siena) · 0577/979146 (3 Linee) · Telex: 571 169
In Spain: Putsch-Nerva. SA. · Apartado 406 · Valladolid 8 · Tel. (83) 272208-12-16 · Telex 26383