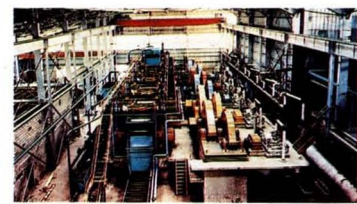


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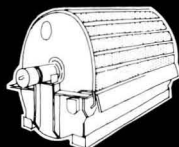
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# News and views

## World sugar prices

Sales of sugar to China buoyed sugar prices during the first half of July and the LDP, which had started the month at \$171, stayed at the same level or slightly higher, as did the LDP(W) which began at a \$181.60. Good weather in Europe carried the implication of better crop prospects, while the USDA considered that the Brazilian 1987/88 sugar crop is likely to exceed the target by 10%; the chief economist of the European sugar traders association, ERSUC, spoke at the World Sugar Farmers Conference on the poor prospects for the world sugar market and the combined effect of these factors was a marked decline in sugar values which took the LDP down to \$148.60 by July 24 and the LDP(W) to \$168.60. Initial beet tests then started to be reported which showed that the cold, wet weather was having an effect whereby beet yields are higher than last year but the sugar content lower. Although a period of hot dry weather would change this picture, the possibility of a poor European crop helped to steady the market and the LDP finished the month at \$150.60 while the LDP(W) reached \$171.80.

## China sugar situation<sup>1</sup>

Manufacture of cane sugar is mainly carried out in the south-eastern coastal areas of China and has enjoyed a long history. The production of beet sugar, initiated early this century, was first restricted to North Manchuria and remained an insignificant industry for four decades. In recent years, however, the cultivation of both beet and cane has been stepped up very rapidly. The area planted to cane rose at an average annual rate of 6.6% between 1976 and 1985 to reach 965,000 hectares, while the area sown to beet rose at an average annual rate of 5.2% to reach 561,000 ha. The sugar cane crop in 1985 was of the order of 51.5 million tonnes while sugar beet rose to 8.9 million tonnes.

Production capacities have been expanded accordingly; in 1984 the Chinese cane sugar industry comprised 535 factories with a total cane crushing

capacity of 322,000 t.c.d. against 381 factories with a daily capacity of 173,000 tonnes in 1978. The beet sugar industry in 1984 comprised 122 factories with an overall daily slicing capacity of 64,000 tonnes which compares with 256 factories and a slice of not more than 32,000 tonnes/day in 1978. Thus, many of the smaller factories have been closed down and production concentrated in fewer but larger units. Nevertheless, the average daily cane and beet processing capacities remains far below western standards.

After the rapid rise in production over the past few years, production growth seems to have come to a halt in 1986/87. Cane sugar output rose only slightly to 4,760,000 tonnes, raw value, from 4,663,000 tonnes in 1985/86. Adverse weather played a role in this but the main reasons were economic; food and vegetable crops are more profitable than cane and beet so that their areas declined.

Per caput consumption rose between 1980 and 1985 from 3.83 to 5.63 kg, white value, although this level is below that recorded for India or Indonesia and leaves significant scope for expansion. Retail sales rose from 3,635,000 to 5,725,000 tonnes, white value, with imports doubling from 911,800 tonnes to 1,908,700 tonnes (although imports fell to 1,182,500 tonnes in 1986). Chinese white sugar consumption by 1980 is forecast to rise to 7.5 million tonnes, while the authorities' plan provides for an overall production level of 6.0 million tonnes the same year, leaving a gap of 1.5 million tonnes to be covered by imports.

The gap could be significantly greater if land is diverted to other crops and sugar production were to fail to reach the target. This, however, will not necessarily lead to higher imports as the Chinese government will not be willing to allocate more scarce foreign exchange for the imports of a commodity which can be produced at home. If production should fail to meet its target it must be assumed that steps will be taken to restrict consumption growth; this should not be too difficult as a centrally planned

economy is in a much better position to regulate demand than a free economy.

## World sugar production, 1986/87

C. Czarnikow Ltd. recently issued<sup>2</sup> a new estimate of world sugar production for 1986/87 showing a total of 102,077,000 tonnes, raw value, compared with 99,147,000 tonnes in the previous crop year. Little change applied to the figures for beet sugar production, compared with the previous estimate, apart from the USA, but increases have been noted for a number of cane sugar producers including the US, India — where problems earlier in the season have been surmounted, Thailand — where farmers have reacted to higher world market prices, the Philippines — where the downturn in production is now thought to have been over-estimated, Japan — where typhoon damage has been less than feared, and South Africa — where the crop reduction is now believed to be smaller than originally expected. On the other hand, lower crops are forecast for Vietnam — where the cane area has been reduced, and Latin American countries — where production has not come up to earlier expectations.

World consumption is put at 103,832,000 tonnes in 1986/87 against 101,549,000 tonnes in 1985/86 and, as a consequence, Czarnikow expects the drop in stocks over this season and the last to reach just over five million tonnes.

## Jamaica sugar situation<sup>3</sup>

Jamaica is expected to comply with its preferential exports quota in 1987 for the EEC (127,000 tonnes) and the US (9000 tonnes), according to a USDA report. On the other hand, however, it will continue to import refined sugar from the US in 1987 (23,000 tonnes) and 1988 (20,000 tonnes) and raw sugar from the Caribbean Basin producers, to meet domestic demand. Government proposals to re-open the Monymusk sugar factory could reduce imports from the US, beginning in 1988. Stock levels

1 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 279 - 284.  
2 Czarnikow Sugar Review, 1987 (1761), 66 - 69.  
3 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 259.

should return in 1988 to normal (15 - 20% of consumption).

Failure of the fourth major winter vegetable project in 1986 raised concern in the sugar industry that land diversified out of sugar should be replanted with cane. A total of 22,200 acres (9000 hectares) of land will be taken out of cane between 1986 and 1988. Government efforts to diversify land and administrative moves to restructure the sugar industry are meeting stiff resistance from cane farmers and associations who believe that sugar is a viable industry in Jamaica — one that should be encouraged rather than diversified.

---

### International Sugar Organization

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A number of meetings of the appropriate committee have been held but without success in solving the budget problem of the I.S.O. The importer and exporter groups have shared costs equally but, since there are many more of the latter (44 vs. 12), individual importing countries have been required to pay more and have complained, especially since the Agreement in force has been only an administrative one. The dispute over funding throws into doubt a proposed conference in September 1987, intended to settle a new International Sugar Agreement. Most of the terms for this — also an administrative agreement — are reported to have been settled, but the funding issue, and relative voting strengths, are two parallel issues which require agreement. It has been suggested that the present ISA could be extended on a continuing basis but this is not likely to be acceptable to the importing members.

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### Aid for US sugar refiners

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The US Senate has approved a trade bill which includes a provision of benefit to US sugar refiners, in spite of the opposition of the US Administration. The bill includes provision for a drawback of duty on sugar imported between 1977 and 1982, extending the drawback entitlement beyond the current limit of 1983. This would enable

refiners to export white sugar competitively with beet sugar produced in Europe. Supporters of the measure point to the closure of a number of refineries in recent years and claim that the bill will enable the continued existence of companies in face of the reduced throughput resulting from US import cuts. Opponents point out that the cost to the taxpayer is estimated at \$365 million, that most of this would benefit only three firms, that documentation to verify claims back to 1977 is no longer available, and that there is a danger of fraud in such circumstances.

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### EEC farm price agreement

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At the end of June leaders of the European Community agreed to a last-minute Franco-German deal on farm prices removing a major blockage to the farm budget but affectively wiping out any remaining savings in the annual farm price package<sup>4</sup>. It was decided to leave sugar and beet prices unchanged in terms of ECU for 1987/88, against the Commission's proposal of a 2% reduction; however, the storage refund was cut by 7.55% and the storage cost levy was unchanged. Because of variation in the "green currency" rates, prices in the various national currencies of the Community are raised by between 2.51 and 13.12% except for Holland (-0.51%) and West Germany (unchanged). Whether these rises are adequate to compensate farmers depends on the inflation rate in the country concerned.

A special elimination levy has been introduced, retro-active from 1986/87, which is designed to cover losses of 185 million ECU on 1986/87 marketing of EEC sugar; this levy is additional to existing production and elimination levies and it is thought that the mounting complex of levies may eventually become a disincentive to surplus sugar production. The EEC Commission has admitted that its estimate of the shortfall between export restitutions and the sums raised by levies for the 5-year period to June 1986 was more than its earlier estimates of 400 million ECU.

The price paid to African, Caribbean and Pacific raw sugar quota holders is to be frozen at the level of the EEC intervention price which, of course, is much higher than such sugar fetches on the world market. The ACP countries have criticized the fact that amount they receive is "dictated" by the Community, but it is not practical politics for the price for quota holders to be above that paid to producers in the EEC countries themselves. Nevertheless, ACP countries are lobbying for an increase in their 1.3 million tonnes total quota so that they can meet the additional requirements following the admission of Portugal — an importer — to the Community.

British Sugar, the monopoly beet sugar company of the UK, is similarly seeking an increase of 150,000 tonnes in its quota in order to supply the growing demand of biotechnological and chemical industries.

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### Soviet sugar and alcohol consumption<sup>5</sup>

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In early July the Soviet newspaper *Pravda* published a front-page editorial about what is an indicator of the way that the USSR's anti-alcohol laws are being circumvented — the huge rise in the consumption of sugar. With beet and grain, sugar is the chief ingredient of home-made vodka, known as "samogon". According to one recipe, three kilograms are needed to make ten litres. In the past 18 months, according to *Pravda*, sales of sugar in state shops have gone up by a million tonnes, an increase of 11%. As for the illicit spirit, last year police confiscated two million litres and 77,000 illegal stills. This year they have already arrested more than 100,000 offenders.

The increase in sugar sales came to public attention last March when the newspaper *Sovietskaya Rossiya* asked correspondents across the country to say how the anti-alcohol campaign was faring. As well as empty shop shelves, they reported a spiralling of thefts from sugar factories and apartment.

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4 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 310 - 312.  
5 *The Observer*, July 12, 1987.

# Product news

## Hawaiian raw sugar quality study

Tate & Lyle Enterprises Inc. of Coral Gables, Florida is undertaking a consultancy study for the Hawaiian sugar industry to assess the feasibility of upgrading the quality of raw sugar produced by all 12 factories. A team of technologists and engineers from various parts of the Tate & Lyle Group including Tate & Lyle Process Technology and Tate & Lyle Technical Services, has been in Hawaii since mid-May and was expected to present its recommendations by the end of July. Tate & Lyle was selected after bids were received from three international consulting firms, responding to an invitation issued by California & Hawaiian Sugar Company (C&H) on behalf of all the Hawaiian sugar companies, who jointly own C&H. Hawaii produces over one million short tons of raw sugar each year, most of which is delivered to the C&H refinery at Crockett, California. It is estimated that substantial savings in operating costs could be achieved at Crockett if raw sugar of a consistently low colour and high pol could be supplied from the Hawaiian factories. These savings would in turn improve the profitability of the Hawaiian industry as a whole, at a time when refined sugar margins are under increasing pressure in the US market.

## Active carbon

Two brochures have been published by the Norit company, specialists in active carbon for use in sugar refining as well as many other industries. "Introduction to activated carbon" describes the types used industrially with especial reference to production and physical forms, adsorption from the liquid phase, operation with powdered and granular carbons, etc. The second brochure, "Darco", is a catalogue of powdered and granular carbons under this trade name, with details of their physical properties and use. Copies of both brochures can be obtained from Norit N.V., P.O. Box 105, 3800 AC Amersfoort, Holland.

## Management buy-out at Silver

Silver Engineering Works, Inc. of Aurora, Colorado U.S.A. is once again under local ownership. The new owners are President Richard J. Wright and Vice President John Moyer. They have acquired all shares from the previous owner, BMA. Silver will continue to design, manufacture and market crystallizers, diffusers, evaporators, heaters, pans, condensers, mechanical circulators, washers, pilers, continuous centrifugals, etc., for the sugar industry.

## Krupp alcohol plant will help Indonesia save foreign currency

Krupp Industrietechnik GmbH is building a combined plant worth around DM25 million to produce alcohol from sugar cane for P. T. Indo Acidatama Chemical Industry in Surakarta, Indonesia. The alcohol produced will be processed in a downstream facility into acetic acid and ethyl acetate, two chemical feedstocks which Indonesia currently has to import. The combined plant, scheduled for completion in early 1988, will thus make an important contribution to the country's efforts to save foreign currency and create new jobs.

## New flowmeter

The new model CMS 21000 liquid flowmeter, which is available from Auriema Ltd., measures rates of 1 - 100 litres/min to a high degree of accuracy over its complete range. This is made possible by the 100:1 turndown ratio obtained by using a variable-aperture principle of operation.

As the fluid rate is increased, displacement of a piston within the aperture is sensed, giving an output signal directly proportional to the displacement. The signal is linearized by the in-built electronics to give a 4-20mA output. A temperature probe is built-in and an optional pressure sensor is available, both giving 4-20mA outputs within the flowmeter. The body material is stainless steel with BSP connexions, a pressure range of 400 bar, and process

temperature up to 120°C.

The meter can be used in conjunction with a portable hand-held display unit which gives an indication of flow, temperature, pressure, peak flow and peak pressure. A wall mounted display unit is also available while, alternatively, the 4-20mA output can be fed into the customer's own existing electronics/monitoring system. A 400 litres/min model is also available.

Further details:

Auriema Limited,  
442 Bath Road,  
Slough,  
Berks. SL1 6BB, UK.

## Dust collectors' item

DCE Group, Europe's largest manufacturer of industrial dust control equipment, has just published a full colour brochure giving details of the company, its Unimaster and Dalamatic ranges of dust collectors and efficient methods of dust control. Copiously illustrated, the brochure contains photomicrographs of various types of danger dusts, diagrams of dust control in process areas and a résumé of DCE's unit concept of dust control. Copies are available free on request from:

DCE Group Ltd.,  
Humberstone Lane,  
Thurmaston, Leicester,  
UK.

## Flue gas analysis

The Thermox Instruments Division of Ametek Inc. has introduced the Model WDG-HP Oxygen and Combustibles Analyser specifically designed for continuous measurement of the flue gases in high particulate applications. Ideal for maximizing combustion efficiency, the new Model WDG-HP is able to analyse dirty combustion gases containing high particulates by diffusing a sample through a ceramic filter into a convection loop. The sample passes over the catalytic combustibles detector and zirconium oxide oxygen sensor cell, and is returned to the process.

Because all critical analyser components are located outside the flue,

the system is easy to service. This feature, combined with the simple sampling configuration, provides a unit which is designed for long, trouble-free service.

Further details:

Ametek Inc.,  
Thermox Instruments Division,  
150 Freeport Road,  
Pittsburgh, PA 15238, USA.

### Advances in impeller design

Ekato have introduced a new design of propeller known as Interprop. It has an unusual feature of a small leading "wing" which drastically reduces unwanted turbulence as the liquid passes the main blade of the impeller (see illustrations below). It offers considerable cost savings and improvements in efficiency and is suitable for a very wide range of liquids and sizes of vessels.

Further details:

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### The way ahead?

With world over-capacity in sugar manufacture a major problem, increased emphasis is being placed on by-product utilization and plant balance, as well as traditional milling efficiency in the cane sugar sector. Fabcon have been in the forefront of promoting a total product concept — i.e. sugar, alcohol, bagasse and compost — to maximize financial

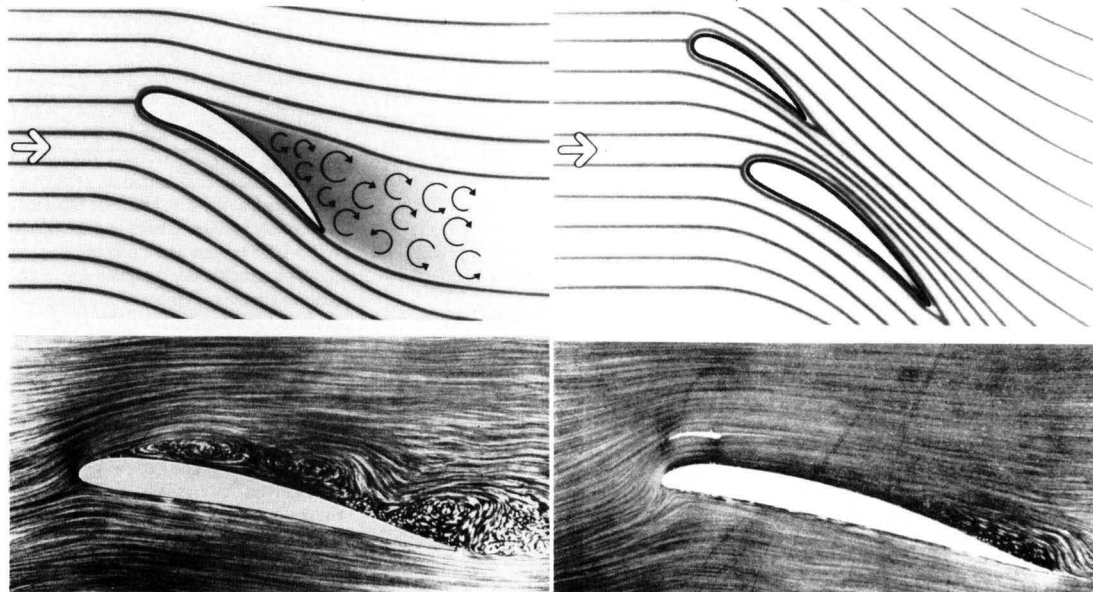
returns. Design of milling plant and separation of mill waste are vital steps in this approach, which is claimed to be far more profitable than that used in many existing factories. Details of the 4F program and schematic charts are available free of charge from:

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### New constant rate feeder and controller

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- (1) Redler conveyor - 45 TPH

## LIQUID SUGAR

- (2) Enzinger 320 sq. ft. SS filter
- (1) Industrial 400 sq. ft. press filter
- (1) Precoat, 800 gallons
- (2) Inverters 4,600 gallons
- (9) Sucrose and Invert storage, 10,000 gal.
- (1) DeLaval plate exchanger
- (1) American heat reclaim 774 sq. ft. exch.

## BLEND STATION

- (1) APV pasteurizer, 60 GPM, Mdl. R55H
- (1) APV pasteurizer, 150 GPM, Mdl. R57
- (1) BAC cooling tower
- Various tanks for corn syrup, Invert, Sucrose and blending

## UTILITIES

- (2) Joy air compressors, 526 CFM @ 100 psi
- (1) Comb. Eng. 130,000 #/hr. boiler, 500 psi gas.
- (4) Generators: (1) 2,500 kW, (1) 1,500 kW; (2) 625 kW

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- (2) 20,000 gal. FRP tanks
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- (1) Marcel Mouyard beet piler, conveyor; with stoner, tare house, weigh system. 1982.
- (1) BMA-Harland beet pump, 450 HP
- (1) BMA vertical diffuser, 5,000 tons per day
- (4) Stord-Bartz dewatering presses
- (1) Stearns 10'6" dia. x 48' long dryer
- (2) CPM pellet mills, 150 HP
- (1) Eberhardt vertical lime kiln, rated 200 tons per day
- Stainless steel vacuum pumps for CO<sub>2</sub>
- (1) BMA 3600 TPD clarifier
- (5) BMA pressure leaf filters
- (1) BMA evaporation system, stainless steel tubes, 90,000 sq.ft. total
- (5) BMA horizontal crystallizers, 9 dia. x 30' L
- (6) BMA 44", Type T1000 automatic batch centrifuges
- (8) BMA vacuum pans, 1200 cu. ft. automatic controls
- (6) Continuous centrifuges — (3) BMA Mdl. K1000; (1) BMA Mdl. K1100; (2) Silver 36", stainless steel
- (1) Keystone-Volcano 160,000 #/hr. boiler, 230 psi. #6 oil/gas, 1982

## Miscellaneous:

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- (1) Tate & Lyle scum desweetener system. st. st.
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- (2) Silver continuous centrifugals, (Model 104), 30 hp
- (4) Werkspoor crystallizers, 10' x 33'
- (1) **Cane mill 42" x 84" — 5 roll**
- (10) Nash vacuum pumps: sizes — CL203, CL402, CL2002, CL1002, C13001, C16001, CL9001
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- (2) Raymond 5027 limestone pulverizers
- (2) Tyler "Robal" 4' x 12' screens
- (1) Trough belt conveyor, 24" x 200' long
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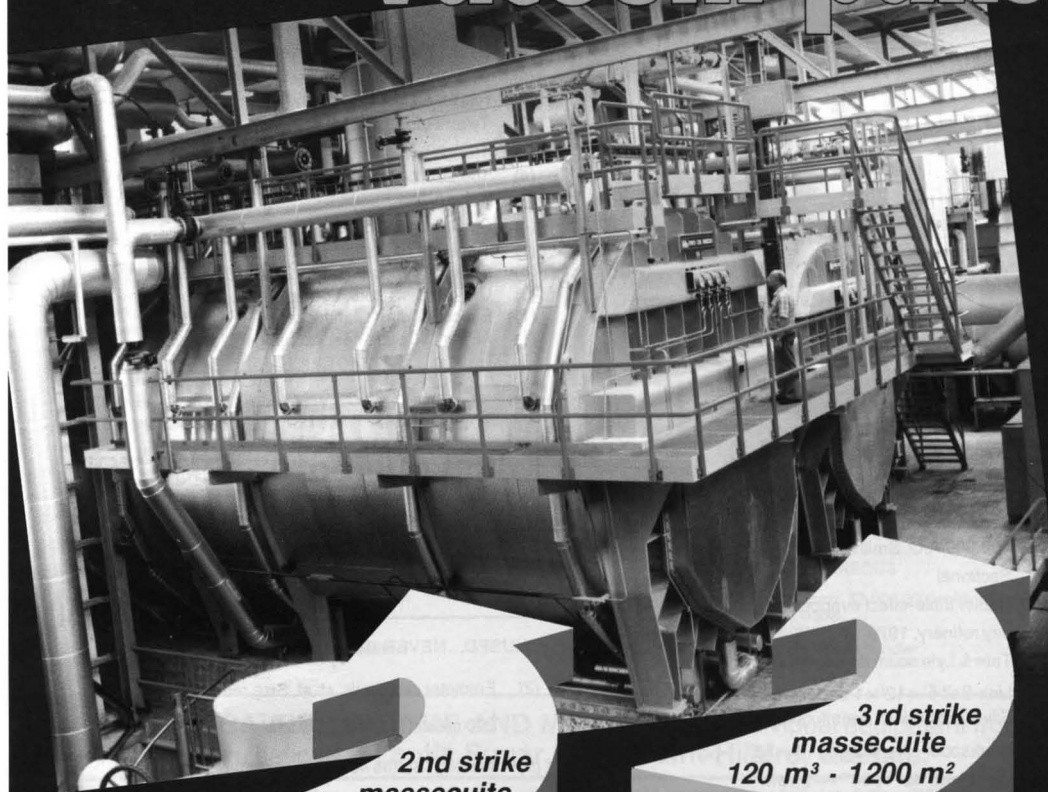
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**3rd strike  
massecuite**  
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weigher using the company's cell-within-a-cell principle and is sealed air-tight. This provides ruggedness, protection against hostile environments and full overload protection, which means that the conveyor can be totally open, rather than enclosed as with other systems, providing easy access for cleaning and maintenance. The load cell is also highly tolerant to vibration so that the belt can be run faster without affecting accuracy. Higher throughputs can therefore be achieved with a smaller machine, thus

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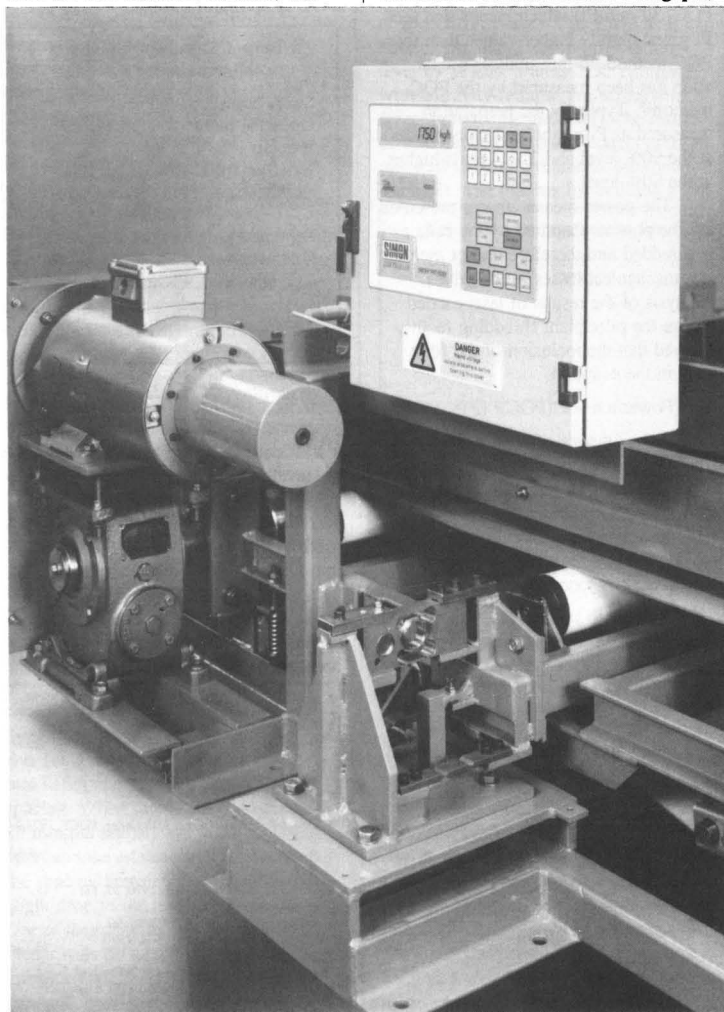
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Further details:

The Permutit Co. Ltd.,  
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United Kingdom.

## The influence of shredder design on cane preparation\*

By R. N. Cullen

(Sugar Research Institute, Mackay, Queensland, Australia)

### Introduction

The influence of cane preparation on extraction performance of milling train or diffuser is a topic which has attracted the attention of many sugar cane technologists. Murry & Shann<sup>1</sup> described the effect of preparation on the performance of experimental mills and quantified the significant benefits that could be achieved by increasing the levels of preparation beyond the generally accepted levels of that time.

In Australia in the late 1960's and early 1970's there was considerable interest in the development of heavy duty shredder units in an attempt to achieve the higher levels of milling extraction desired. This work concentrated on the mechanics of hammer design<sup>2-6</sup>, the influence of grid design<sup>7</sup> and the performance evaluation of existing and new designs<sup>8-10</sup>.

Moor<sup>11</sup> traced the development of heavy duty shredders and attributed the upsurge in interest in these units in the late 1960's to the fact that problems of feeding of fine material had been overcome, hammers could be effectively maintained with modern hard facing techniques and greater power could be made available. Renton<sup>12</sup> has described tests in South African factories and quantified the relationship between the power absorbed and the preparation level achieved for a range of preparation equipment from knives to heavy duty shredders.

Effective preparation requires the matching of the shredder design to the prime mover power. It is as inefficient to put an underpowered prime mover onto a heavy duty shredder as it is to overpower a weak shredder. In both cases the total potential of the installation cannot be achieved.

This paper addresses the relationships that exist between the various parameters of shredder design, the preparation that can be achieved and the power that can be effectively absorbed. Reference is made to the results of tests carried out on an experimental facility in which the parameters of shredder design, e.g. operating speed, hammer configurations and grid configuration could be varied over a

wide range. In all cases the cane fed to the preparation equipment was in billet form as harvested by chopper harvesters.

### Measurement of preparation and power

There are several generally accepted methods of measuring the levels of cane preparation — Pol in Open Cells (POC), Preparation Index (PI), and Displaceability Index (DI). The principal difference between the POC and PI systems of measurement is the duration of time in the rolling machine (10 min POC, 30 min PI) which means that the PI gives slightly higher values than the POC method. In this analysis preparation has been measured by the POC method<sup>13</sup>. Typically the preparation measured as PI might be 2 units higher at the 90% level and 3 to 4 units higher at the 80% level.

The power measurements presented are the powers absorbed by the cane as it is shredded and therefore do not include any mechanical losses in the drives. Analysis of the results of tests carried out on the pilot plant shredding facility showed that the inclusion of the fibre term in the equation

$$\text{Power/tch} = k (\text{POC})^a (F)^b$$

where tch = tonnes cane per hour, F = fibre % cane, and k, a and b are constants, gave no better fit to the data than by leaving it out. All power relationships have been expressed as kW/tch. This is the same as expressing the energy per tonne of cane in kWh/tonne.

### Factors affecting shredder performance

The performance of a shredder is affected by many factors. Some of these are directly associated with the internal configuration of the machine and others with the conditions of operation. The factors that will be considered here are summarized below:

#### (a) Configuration of shredder

- Operating speed
- Hammer type and mass
- Hammer arrangement
- Grid configuration
- Use of feeder rolls
- Sweep diameter of hammers

#### (b) Operating conditions

- Variety of cane
- Use of knives prior to shredding
- Use of two shredders in series
- Shredding rate

In assessing the influence of these factors, changes will be considered relative to a "standard" design of machine. This will be taken to be as specified in Table I — a typical "heavy duty" shredder unit. This shredder would give a preparation level of typically 86 to 88 POC at optimum settings.

Table I. Details of "standard" configuration for shredder

Sweep diameter	1450 mm
Operating speed	1200 rpm (91 m/s)
Hammer mass	15 kg
Hammer configuration	Arranged to give full coverage across the width
Feed	Gravity
Grid wrap	90°
Grid type	Pocketed with 150 mm deep pockets at approximately 200mm spacing.

### Configuration of shredder effects

**Operating speed:** The operating speed of a shredder has a very significant effect on the level of preparation that can be achieved and the power that can be absorbed. By reducing the operating speed from 1200 rpm (91 m/s) to 960 rpm (73 m/s) the level of preparation fell by approximately 6 units POC.

**Hammer mass:** After tests on hammers of 5.8, 10 and 15 kg mass it was concluded that there was an insignificant

\* Paper presented to the 19th Congr. ISSCT, 1986.

- 1 Proc. 10th Congr. ISSCT, 1959, 122.
- 2 Shann & Cullen: Proc. Queensland Soc. Sugar Cane Tech., 1968, 35, 95.
- 3 Crawford: *ibid.*, 1969, 36, 329.
- 4 Shaw & Shann: *ibid.*, 1970, 37, 171.
- 5 Crawford: *ibid.*, 1971, 38, 231.
- 6 Cullen & McGinn: Proc. 15th Congr. ISSCT, 1974, 1583.
- 7 Greenwood: Proc. Queensland Soc. Sugar Cane Tech., 1971, 38, 239.
- 8 Clarke & McCulloch: *ibid.*, 1970, 37, 181.
- 9 Cameron: *ibid.*, 197.
- 10 Hartley & Clarke: *ibid.*, 1972, 39, 99.
- 11 Proc. 15th Congr. ISSCT, 1974, 1590.
- 12 *ibid.*, 1575.
- 13 Anon: "Laboratory Manual for Queensland Sugar Mills", 5th Edn. (Bureau of Sugar Experiment Stations, Queensland), 1970, p. 106

**Table II. Average preparation levels and powers for feeder rolls compared with conventional feeding**

Grid length, degrees	Setting, mm	Preparation level, POC	Power, kWh/tonne
90	0	88.5	7.82
(gravity feed)	22	80.4	4.58
160	0	91.6	10.09
(feeder rolls)	22	87.6	6.04
	28	81.7	5.25

effect of mass of hammer on the level of preparation achieved provided that the same coverage (% of the length of the shredder covered by the width of hammer heads) was achieved.

**Hammer arrangement:** The number of rows found to have only a marginal effect on preparation level achieved. No difference in performance was found between shredders operating with 6 or with 8 rows. A slight improvement in preparation level (approximately 1.3 POC) was obtained when operating with 12 rows, but choking was more prevalent. A change from full hammer coverage per row to a hammer-space-hammer-space configuration has a very significant effect. Running at half complement reduces the preparation level by approximately 4 units POC.

**Grid configuration:** For 15 kg hammers, settings of hammer-tip-to-grid clearance in the range 0 to 10 mm have been found to have no significant effect on preparation. With a setting change from 0 to 22 mm however, preparation falls off by approximately 3.3 units POC. Limited tests carried out with grids of 70° and 90° of "wrap" showed no significant effect of the change in grid length on the level of preparation obtained. Tests with 160° grid wrap will be discussed later. Of a range of grid designs evaluated, the best performance was achieved with a pocketed grid of 150 mm depth and approximately 200 mm spacing. When the depth was reduced to 25 mm the preparation level decreased by approximately 1.5 units POC. Reducing the spacing between grids also caused a slight drop in the level of preparation.

**Use of feeder rolls:** By using a set of feeder rolls on a shredder, feeding can be enhanced and higher levels of preparation can be achieved because of the large

angle of wrap that can be incorporated into the design. A comparison of the results which can be achieved by the use of feeder roll is shown in Table II. It can be seen that increases in preparation level by at least 3 units POC compared with a gravity fed unit are achievable.

**Effect of machine diameter:** The results of tests carried out on shredders of 1450 mm and 1830 mm diameter are shown in Table III. The reasons for building a

**Table III. Average results for 1830 mm diameter machine (8 rows of hammers)**

Diameter, mm	Speed, rpm	Setting, mm	Average preparation level, POC	Power, kWh/tonne
1830	1200	0	92.3	13.77
		10	90.6	11.29
*1830	960	0	91.0	9.11
		10	90.2	7.40
*1450	1200	0	88.7	7.08

\* Note that these conditions have the same tip speed (73 m/sec)

machine of larger diameter are to achieve a higher potential preparation level or to allow the machine to run at a lower rotational speed (e.g. 960 rpm electric motor speed) and still achieve an acceptable preparation level. From Table III it is seen that a larger diameter machine running at the same tip speed as a smaller diameter machine achieves a higher level of preparation, presumably owing to the longer grid bar length.

*Effect of operating conditions*

**Varietal effects:** The variety of cane can have a significant effect on the preparation achieved with a particular shredder configuration. For example, for single shredding, the average preparation for variety Q 63 was 3.8 units POC lower than for NCo 310. Power requirements per tonne cane per hour were the same for both varieties, indicating that Q 63 is a harder cane to shred.

**Effect of knifing prior to shredding:** The effect of pre-knifing on preparation after one shredder pass was found to be significant where the preparation potential of the shredder configuration was low (less than 75 POC). Improvements of up to two units POC could be achieved by using knives. Where the shredder configuration had potential to achieve greater than 80 POC, the improvement in final preparation due to the use of knifing prior to the shredder was insignificant.

**Effect of double shredding:** When shredded cane is passed through a shredder a second time its preparation level is increased to an extent which depends on both the shredder configuration and the initial level of preparation. Table IV summarizes the results obtained in double shredding tests. The increases in POC following double

shredding are seen to be from eight units POC for medium potential shredders to three units POC for high potential shredders.

**Table IV. Preparations achievable with two shredders in series (configuration: 15 kg hammers, 1450 mm diameter)**

Nominal speed, rpm	Pass 1 Av. POC	Pass 2 Av. POC
960	78	86
1200	86	90

**Effect of cane rate:** The effect of rate on preparation level and power per tonne of cane per hour has been shown to be not significant for single pass shredding at rates equivalent to 250 and 350 tonnes per hour through shredders 2130 mm wide.

*Power requirements for shredding*

Analysis of the results of tests carried out for the 1450 mm diameter

machine at 960 rpm and 1200 rpm showed that relationships between preparation level and POC differed at the two speeds. The relationships are shown in Figure 1.

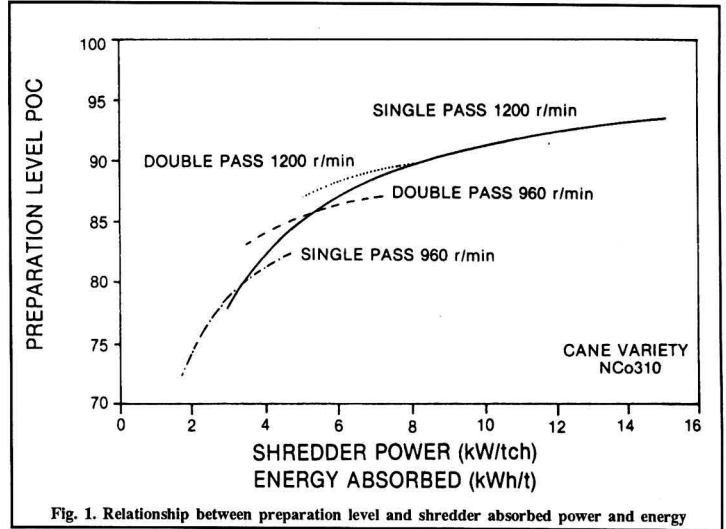
There is a significant difference between the relationship for single and double pass conditions. When a given level of preparation is achieved in one, alternatively two, passes, the total power requirements are less when the preparation is done in two passes. For tests with the 1830 mm diameter machine at both 960 and 1200 rpm, the relationships between preparation and POC were not significantly different from those obtained for the single-pass 1200 rpm 1450 mm machine. The values of absorbed power shown in Table III illustrate that power requirements for shredding become very high for preparation levels in excess of 90 POC.

*Relationship between machine configuration and shredding potential*

The discussions so far have outlined the effect of various parameters on shredder performance and power requirements. A shredder is designed primarily to achieve a certain level of preparation; the higher the design level the more sophisticated and powerful the machine required.

The principal decisions involved in selection of a new shredding installation centre on selecting the diameter, speed, and method of feeding. Other parameters such as grid bar configuration, setting, and hammer configuration can be more readily modified if necessary after installation.

The shredding potentials of different shredder configurations are summarized in Table V. These shredders are arranged in descending order of shredding potential. The assumptions that have been made in preparing this table are: (i) the cane is NCo 310 variety, (ii) for gravity feed a 90° grid wrap is used, (iii) the preparation levels and power specified are for the "effective" operating range of the unit; below the lower limit the preparation can be non-uniform, and (iv) powers specified are *absorbed* powers at the shaft – they are not the required



installed powers. A suitable allowance must therefore be made when selecting the prime mover.

*Conclusions*

The results that have been discussed here have quantified the effect of the different operating parameters on the performance that can be achieved with a range of shredder configurations. The results in general have been confined to one variety – NCo 310 – and there is therefore a need to "calibrate" the performance of a configuration for cane varieties with shredding characteristics different from those of NCo 310. The influence of cane variety on shredder performance remains a fertile area for investigation.

Some factors in shredder design are difficult to quantify, such as the condition of the contact edges of the hammers

and grid bars. The results reported here are for well maintained hammers and grids. Nevertheless it is hoped that the information presented will assist in the matching of shredder design to the preparation level that is expected to be achieved.

*Summary*

The paper discusses the various factors that influence the design of a shredder to achieve a particular level of cane preparation. The effects of hammer mass and arrangement, operating speed, grid configurations and swept diameter are reviewed. The influence of different operating conditions such as cane variety and the use of knifing or shredders in series are also discussed. Relationships between the level of preparation achieved and the power requirements are presented and the shredding potential of different configurations compared.

Rating	Shredder configuration			Effective preparation range POC	Power requirements kWh/tonne
	Diameter	Speed	Feeding		
1	1830	1200	Gravity	89.0-95.0	8.0-14.0
2	1450	1200	Feeder	81.7-91.6	5.2-10.0
3	1830	960	Gravity	86.0-91.0	6.3-9.1
4	1450	1200	Gravity	80.0-88.9	4.6-7.2
5	1450	960	Gravity	78.0-85.0	3.5-6.5



# KKK Steam Turbines for the Cane Sugar Industry



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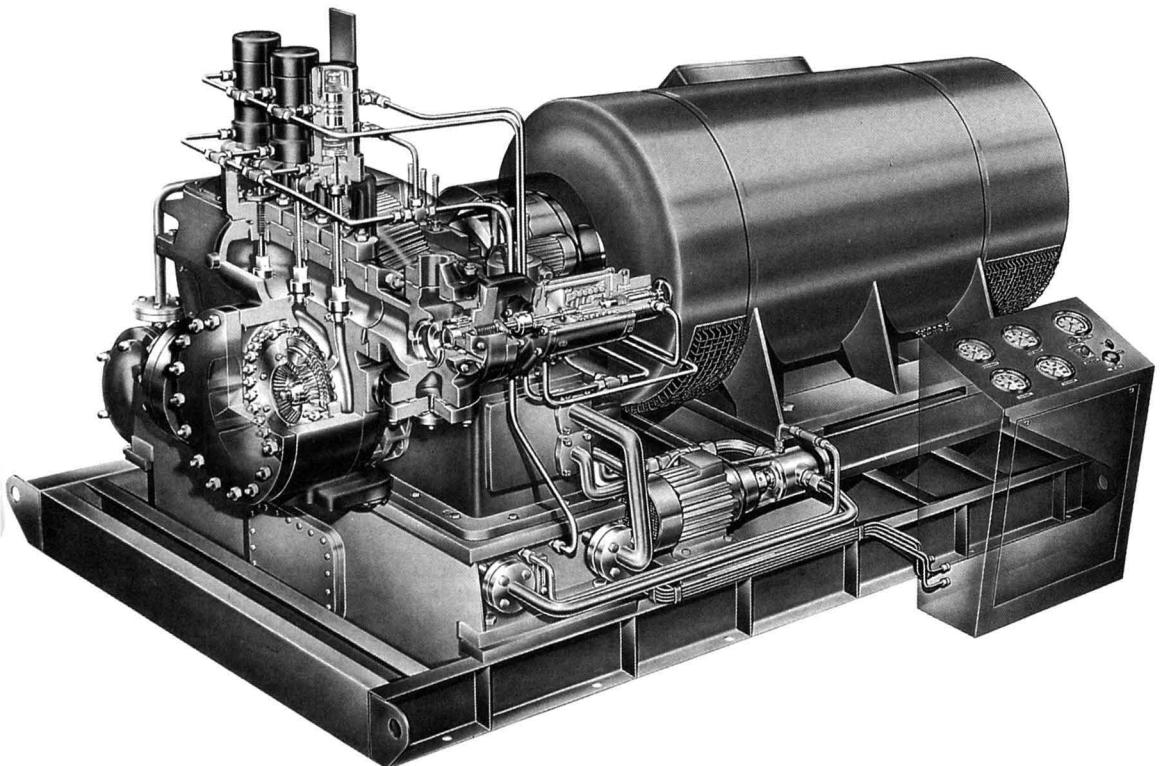
- Operating safety and reliability
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- Rapid starting without preheating
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The standardised series of single-stage KKK steam turbines cover a

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- Milling tandems
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- Fans and Compressors

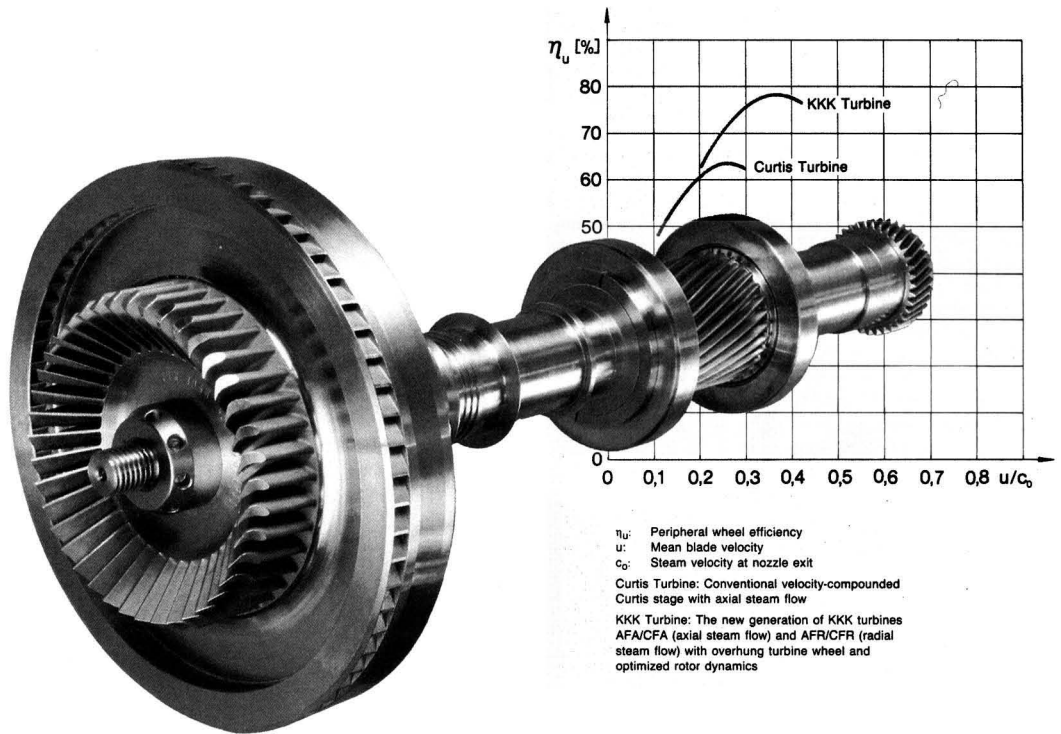
KKK steam turbines are available either for direct-drive over the whole power range or, for outputs exceeding 200 kW, as compact geared turbines. When they are equipped with automatic nozzle group control valves, they ensure economical operation at partial load, and the steam throughput is considerably lower than that of turbines with simple throttle control.



Sectional drawing of a single-stage integrally geared steam turbine with radial steam flow of the new CFR series, equipped with three automatic nozzle-group control valves for a three-phase alternator drive

Turbine series	Power range (kW)	Maximum speed (rpm)	Maximum steam inlet/outlet pressure (bar abs.)	Maximum steam temperature (°C)
BF	10 - 225	4500	126/11	525
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CF	250-5000	16000	126/26	530
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CFA	150-4000	15000	126/26	530
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## Comparison of the efficiency of single-stage steam turbines



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## A self-setting mill — a simple but effective innovation\*

By Mydur Anand†, B. S. Gurumurthy‡ and —. Gunasekaran‡

### Introduction

Milling is the most important operation in a cane sugar factory. Milling efficiency and capacity depend upon several factors such as size of rollers, length of tandem, the horse power of the mill drives, extent of cane preparation, hydraulic loading on top rollers, grooving of rollers, extent and efficiency of imbibition, etc. For a given mill, the operation efficiency depends largely on the uniformity of cane feeding (fibre loading) and particularly on the effectiveness of mill setting.

### Mill setting

In any mill, setting is the most important factor in the hands of the mill engineer to improve the mill performance be it higher capacity or higher performance. Many formulae are in use, all depending mainly on fibre loading and calculation of the escribed volume to be generated at the discharge opening under a given set of milling parameters. After calculating the discharge opening, the feed opening is set at a certain work ratio. This may vary from 2.5 to 1.75 depending upon the formula adopted and the experience of the mill engineer. It is common experience that the correct calculated mill settings remain in the notes of the engineer and the actual settings differ widely. Then again, the settings are often disturbed by unexpected loads or unequal wear and tear of mechanical parts.

### Self-setting mills

In spite of utmost care in calculating and adjusting mill openings, the mill performance depends largely on the uniformity of the fibre loading. Many control systems have been devised but even minor variations disturb the mill settings, particularly because, in the conventional mill, the lift of the top roller alters the ratio of the feed and discharge openings, "varying almost every minute"; to quote Hugot<sup>1</sup>.

To offset such disadvantages, it has been the constant effort of designers to evolve a design in which the escribed volume at the discharge roller is proportional to the fibre loading. This is a

stiff demand on mill designers and so far, no mill design has proved satisfactory. The nearest to succeed, though far from the ideal, is perhaps the model F63 mill marketed by Fives-Cail Babcock of France.

The F63 mill has become quite popular. Though the manufacturers claim it to be a "self-setting mill", Hugot<sup>2</sup> describes it correctly as a constant ratio mill". By an ingenious design of holding the top roller in a cap, it pivots about an axis situated on the delivery side of the mill and so located as to enable the discharge opening to open or close to the extent of 50% of the feed opening at any movement. This is an important development, though, in the opinion of the authors the maintenance of a constant ratio is not equivalent to generation of the required escribed volume at the discharge opening according to the fibre loading at any given moment. Thus, the F63 mill does not entirely satisfy the requirement of a self-setting mill. Model F63 has indeed other ingenious innovations such as hydraulic plungers on each of the housings at the end of pivoted top caps which greatly improve the uniform application of hydraulic pressures and hence the performance of this mill. Its success should not blind one to the understanding of and the claims of the self-setting characteristics. Again, the F63 mill suffers from the many weaknesses inherent in a conventional 3-roller mill, such as limitations on the diameter of the discharge roll, mill angle, drive through the floating top roller, a large trash plate etc. These can be avoided and improved upon in the future mill design to be described hereafter.

### Free rotating discharge roller

In his search for a mill in which the escribed volume varied proportionally with even momentary variation in the fibre loading, the senior author was visualizing a discharge roller of which the speed could be varied independently regardless of the speed of the top or feed rollers. The simple idea of doing away with the pinion on the discharge roller and allowing it to be rotated by frictional

forces was the natural development of this thought process<sup>3</sup> (Figure 1).

This idea was first tested at the beginning of 1983 and has since been adopted in several factories. Table I gives the lists of factories which adopted it during 1984/85, either on a few mills or all mills of the tandem.

Table I. Factories at which the new technique has been adopted

Arignar Anna Sugar Mills	All mills
Jawaharlal Nehru Sugar Mills	do.
Ulundurpet Co-op. Sugar Mills	do.
Dharmapuri Co-op. Sugar Mills	do.
New Horizon Sugar Mills	do.
Ponni Sugars & Chemicals Ltd	do.
Ambur Co-op. Sugar Mills	First & last mills only
Vellore Co-op. Sugar Mills	do.

The new technique involves the simple step of removing the pinion from the discharge roller of a 3-roller mill. The only precaution to be taken is to arrange for the drive of the mechanical lubricator to come from the feed or top roller. In this arrangement, the discharge roller rotates only if the cane mat is passing through, as in its absence there is no friction and the discharge roller comes to a stop.

In most mills, no adjustments have been needed to make the change but in a few installations, the cane mat would not flow freely, causing some vibrations. Suspension of the hydraulic load for a short time and slight increase in the discharge opening solved the problem.

As the movement depends on friction, the speed of rotation of the discharge roller varies according to the feed. As the friction load varies the speed also varies and it is common experience that the rate of rotation of the discharge roller ranges between 60% and 90% of the top roller, the figure being higher when the feed is heavier. At any time, the speed of the delivery roller is less than the speed of the top roller. The

\* Paper presented to 19th Congr. ISSCT, 1986.  
† Consultant, Bangalore, India.  
‡ Ponni Sugars, Evode, India.

1 "Handbook of cane engineering" (Elsevier, Amsterdam), 1972, p. 263.

2 *ibid.*, p. 266.

3 Anand et al.: Paper presented to the South India Sugar & Sugarcane Technologists Association, 1983.

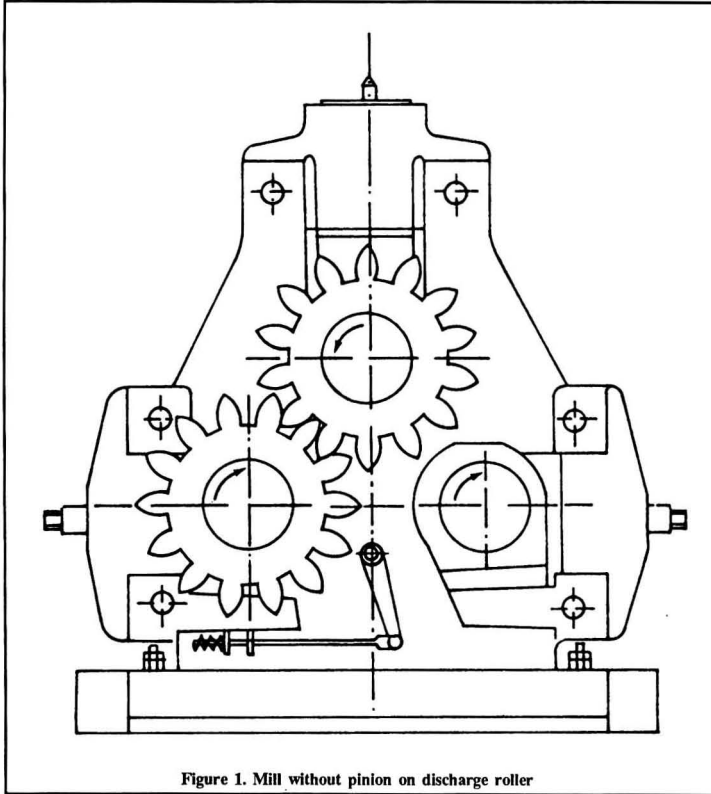


Figure 1. Mill without pinion on discharge roller

speed adjusts itself and the expectation is that it adjusts itself to provide the correct escribed volume for the occasion.

This in essence, is the "real" and "simple" self-setting mill; real because it provides the critical escribed volume that adjusts itself to even momentary variations in fibre loading. It does not bother about ratios which are less important; simple because every conventional mill, irrespective of make or model, can be easily converted to self-setting operation by the removal of the delivery roll pinion; self setting because the opening can adjust itself to variations in fibre loading. Even the initial setting is not critical and can be made after practical observation. It ensures optimum milling performance under even very poor and irregular feeding conditions. No thin blanket of wet bagasse can escape the mill.

**Observations**

Amongst the mills which have adopted this technique, the general observations have been that normal rates of crushing were easily maintained and

exceeded where tried; that all that was required to increase the crushing rate was to increase the mill speed; and that mills operated with no chokes whatsoever. Heavier imbibition may be applied; some mills have adopted 300% or more of water on fibre and the absence of choking and roller slippage has helped the use of hot water, up to 80°C, with obvious advantages.

The emerging bagasse blanket was uniform; well compressed and uniformly dry even with varying rates of cane feeding. The bagasse was found to burn more easily in the boilers. The pol in bagasse, under identical rates of milling, was found to be lower by about 0.5 and the moisture lower by 1-2%. The variations, from sample to sample, narrowed considerably. No forward slip (re-absorption) or spurling of juice through the discharge opening was observed, even in the final mills of a tandem.

**Trials and results**

Ponni Sugars factory started its first regular season late in 1984. During the early part of the season the cane supply was irregular and it was considered desirable to stabilize the operations of the factory by adopting conventional techniques. This continued until March 1985. Adoption of the new technique of running mills without pinions on the discharge rollers was initiated during April 1985. This caused no problems and there were visible indications of improved performance, which have been

Date, March 1985	Cane, t.c.h.	Pol % cane	Fibre % cane	Imbibition % fibre	Pol % bagasse		
					Max.	Min.	Ave.
20	57	13.49	13.98	349	2.3	2.3	2.30
21	55	13.31	13.84	352	2.4	2.2	2.28
22	54	13.27	13.95	389	2.4	2.2	2.28
23	55	12.92	13.69	341	2.3	2.2	2.26
24	57	13.14	13.60	346	2.4	2.2	2.32
25	58	13.27	13.94	344	2.4	2.2	2.30
26	54	13.09	13.60	358	2.3	2.3	2.30
27	59	12.61	13.76	313	2.3	2.2	2.28
28	62	12.65	14.00	316	2.3	2.2	2.27
29	61	12.58	13.83	313	2.4	2.2	2.30
30	57	12.57	13.86	326	2.3	2.2	2.28
31	59	12.56	14.04	295	2.4	2.2	2.30
Average							2.29





# ISJ Abstracts

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# Cane sugar manufacture

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## Post harvest deterioration of whole-stalk sugar cane

G. R. E. Lionnet. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 52 - 57.

See Anon.: *I.S.J.*, 1987, 89, 67A.

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## Tuning of pan feed controls

D. J. Love and R. A. H. Chilvers. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 103 - 111.

At Felixton, three different types of measurement are used to control the feed to the continuous vacuum pans, namely boiling point elevation, radio frequency conductivity and conventional conductivity. Difficulties in setting up the control loops were caused by the large number of loops, interaction of the loops in the pans and the need for the loops to be tuned to a compromise between the optimum settings for water and molasses. Conventional tuning procedures using closed-loop cycling tests and open-loop step response tests were found to have limitations. Application of a simple model of a pan feed control loop led to development of a simple two-step test procedure which allows determination of capacitance and dead-time in a batch pan or in the compartment of a continuous pan and hence permits quantitative comparisons between pans or compartments. By comparing the model with the closed-loop cycling test it was possible to express optimum controller settings in terms of capacity and dead-time; the two-step test plus capacitance and dead-time determination, followed by calculation of the optimum settings of gain, integral time and derivative time of a PID controller (according to a detailed procedure which is described), allows simple and rapid tuning of pan feed control loops. The model also permits more sophisticated tuning techniques to be used.

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## Developments in sugar manufacture in South Africa from 1959 to 1984: the Sezela factory

S. North-Coombes. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 120 - 125.

Developments at Sezela sugar factory since 1959 are discussed. Expansion took place in three phases: an increase in throughput from 150 - 165 tch in 1959 to 247 tch in 1965/66, to 340 tch in 1975/76 and to a rated 450 tch in 1981/84. Extraction rose from 93% in 1959 to 97.2% in 1984 (at 422 tch). The general trends in cane quality and performance of the factory and of the South African sugar industry are compared, and the major changes in process and equipment discussed as well as the influence of a bagasse-based furfural plant at Sezela on the steam balance and energy requirements. The treatment of effluent, water recycling and soot disposal are briefly described.

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## Energy management project at Malelane sugar mill: results and comments after one season of its introduction

M. Damms. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 126 - 130.

Since all but a small proportion of the raw sugar produced at Malelane is processed in a back-end refinery, bagasse is exported to a neighbouring particle board plant and electricity is exported for irrigation purposes, the factory normally has to import electricity and coal that is burnt together with residual bagasse. During the 1985/86 crushing season an effort was made to measure and, where possible, reduce energy consumption. The parameters used to monitor and appraise energy usage, problems encountered and the results achieved by adopting specific measures in the various processes are discussed. Diagrams clearly demonstrate a dramatic fall in fuel consumption in 1985/86 compared with the levels since 1978.

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## The computerization of preventive maintenance at Malelane mill

E. M. Laubscher. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*,

1986, 131 - 134.

The advantages of a computerized preventive maintenance system are compared with the disadvantages of a manual system as previously used at Malelane. With the new scheme, information is provided on all preventive maintenance activities; the required activity and its frequency are identified and a hard copy work schedule or inspection list automatically generated for the maintenance crews. The preventive maintenance module is linked to the history module to allow the maintenance information to be updated relative to each piece of equipment. Elimination of unnecessary scheduled work has led to noticeable savings in labour costs. The integrated subsystems involved include, besides preventive maintenance, equipment history and other data and information on stocks, costs and downtime.

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## Flap valve cam and follower for rotary pumps

C. C. Mack and B. Mackenzie. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 135 - 137.

Details are given of the design of a flap valve cam and follower developed to replace a spring-loaded system on massecuite pumps at Umzimkulu; use of a spring or rubber bands to keep the flap valve in contact with the pump rotor had led to excessive wear on the valve contact surface and on the rotor lobes. The cam-loaded flap valves produced an average 9.4% increase in volumetric efficiency by comparison with the use of rubber bands when A-massecuite of about 92°Bx was being pumped, while a 7.7% increase resulted with C-massecuite (of up to 96.6°Bx). The volumetric efficiency of a spring-loaded valve was usually slightly higher than that of the rubber band system.

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## Measuring vacuum pump performance

R. A. H. Chilvers and D. J. Love. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 138 - 142.

A simple reliable method of measuring vacuum pump performance by using a test manifold with a series of critical flow orifice plates is described and the factors affecting pump performance are discussed. The equations needed for calculation of the dimensions of orifice plates for a given flow are given together with details of the test manifold.

#### Quantitative studies on phenolics — development in Egyptian raw sugar manufacture

A. Abou El-ela and A. Abou Doh. *Zuckerind.*, 1986, **111**, 1047 - 1048.

Free and chemically bound phenolic acids were determined in mill and diffusion juice, clear juice and syrup before and after sulphitation. The results are discussed as are the comparative efficiencies of three juice purification methods (tested in the laboratory) relative to elimination of phenolic compounds. Phospho-sulphitation gave the best results (39% removal), followed by phosphatation (22%) and sulphitation (19%).

#### Continuous pans

F. Cordovez Z. *Sugar J.*, 1986, **48**, (12), 10 - 11.

A brief outline account is presented of continuous pan designs and of their boiling controls.

#### On some aspects relating to bagasse drying

N. A. Ramaiah and V. G. Chikhalikar. *Bharatiya Sugar*, 1986, **11**, (8), 9 - 11, 13, 15 - 19.

Bagasse moisture reduction, the amount of energy required to achieve a given level of dewatering and the resultant saving of bagasse are discussed with the aid of two case studies in which steam consumption is 54% and 48% on cane. The use of flue gas or of high-pressure steam for bagasse drying is examined.

#### Conservation of energy and modern mill techniques.

#### Welding of mill roller surface

P. K. Shewale and A. R. Patil. *Bharatiya Sugar*, 1986, **11**, (8), 25 - 27.

The advantages of cane mill roller resurfacing by arc welding are examined, an account is given of the procedure used and results that can be obtained are discussed.

#### The cost of production in a sugar factory

P. P. Chaturvedi. *Bharatiya Sugar*, 1986, **11**, (8), 81 - 83.

Fixed and variable costs of sugar production in India in each season in the period 1979/85 are tabulated and discussed.

#### The developments of the sugar industry in the People's Republic of China

S. K. Liu. *Sugar J.*, 1986, **49**, (1), 14 - 19.

A survey is presented of the Chinese sugar industry as represented by about 500 centrifugal factories in 1983, of which 75% processed cane. Total sugar production in 1985 is estimated at 4,100,000 tonnes. Future prospects are discussed.

#### Factors affecting mill extraction

H. S. Birkett, S. J. Clarke, Y. K. Cho, W. Keenlside and J. A. Polack. *Sugar J.*, 1986, **49**, (2), 8 - 12.

See *I.S.J.*, 1987, **89**, 34A.

#### Pipeline desuperheating — a practical approach

K. Goldspink. *Bharatiya Sugar*, 1986, **11**, (11), 9 - 10.

Advice is offered on the use, sizing, selection and installation of pipeline desuperheaters.

#### Different massecuite boiling schemes and exhaustibility of molasses

D. S. Lande. *Bharatiya Sugar*, 1986, **11**, (11), 11, 13, 15 - 16, 19.

The poor molasses exhaustibility achieved in Maharashtra sugar factories is discussed and the adoption of 4-massecuite boiling recommended. Comparison is made between 2-, 3- and 4-massecuite schemes.

#### Dextran and the Louisiana sugar industry

D. B. Fontenot and D. F. Day. *Sugar Bull.*, 1986, **65**, (3), 8 - 9.

The subject is briefly discussed in the form of questions considered most likely to be put by cane farmers and their answers, covering causes, measurement, problems created by dextran, etc.

#### Pol deviation as a quality indicator in sugar cane

C. S. Yeh. *Rpt. Taiwan Sugar Research Inst.*, 1986, (113), 21 - 26.

While delay in cane milling causes sucrose inversion for which purity drop is used as index, there is no starting value available for estimation of this loss, so that measurements of pol and apparent purity in routine control are not utilized to assess inversion that has already occurred. A study was made of the relationship (found to be linear and highly significant) between juice Brix and pol in 480 samples of normal healthy cane, from which pol deviation was calculated as: juice pol - (1.25Brix - 7.32). The correlation between purity drop and pol deviation was found to be highly significant ( $r = 0.9742$ ), so that pol deviation is regarded as a valid quality indicator for general assessment of cane quality. For deteriorated cane, a value below -1 is suggested compared with  $\pm 0.5$  for normal cane. The effects of storage and drought on cane deterioration are indicated.

#### The model of TSC's productivity measurement

C. T. Chen. *Taiwan Sugar*, 1986, **33**, (5), 22 - 23.

Mathematical models of the total system productivity of Taiwan Sugar Corporation and of sugar, pig, alcohol and bagasse pulp productivity are discussed.

# Beet sugar manufacture

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## Reduced material usage in ventilation ducts of steel tubing for sugar beet storage

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P. V. Schmidt, E. Manzke and B. Senge. *Lebensmittelind.*, 1986, 33, 222 (German).

Hitherto, steel ducts used for forced ventilation of beet piles have been of constant diameter even though the volume of air at the outlet is smaller than at the inlet. In trials on a duct made up of sections of reducing diameter which used 15 - 20% less steel than normal ducting, almost the same volume of air passed through as in a duct of constant diameter, despite the increase in pressure head caused by the reduced diameter.

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## A beet fluming and washing system — VVZ CP Praha

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I. Havranek, V. Horejsi and L. Duffek. *Listy Cukr.*, 1986, 102, 223 - 236 (Czech).

Details are given of a beet fluming and washing system developed by the Sugar Research & Development Institute in Czechoslovakia; diagrams accompany the descriptions of the individual pieces of equipment, and the water consumption is given for each component in a scheme designed for 2000 and 3500 tonnes of beet/day; the total water usage is rated at 50% on beet. An indication is given of the quantities of extraneous matter the system is designed to handle, and information is given on instrumentation and controls.

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## Control of technological processes by microcomputer in Prague sugar factories

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P. Svarc and J. Horice. *Listy Cukr.*, 1986, 102, 237 - 239 (Czech).

Centralized analogue-to-digital control of the beet end of Cakovice sugar factory is described and the technical and economic effects of the system indicated. Control of lime dosing has raised the juice purification efficiency by about 8% compared with the previous conventional pneumatic control system.

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## From our marketing activities. The beet sugar industry

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Anon. *Stord Bartz Rev.*, 1986, 10, 12 - 13.

The importance of pulp pressing to a higher degree as a means of reducing energy costs is mentioned, and reference made to the positive effect of additives combined with reduction in the speed of press screws. Improved results obtained in French and West German sugar factories as a result of these two measures are discussed. The risk of corrosion and consequent high maintenance costs have favoured the use of calcium sulphate as additive rather than aluminium sulphate. Mention is made of the Stord Bartz patented perforated press spindles which have increased pulp dry solids by 3 - 3.5 units, representing a 15% reduction in moisture content and a 5 - 8% increase in throughput; about 50 such units were in operation in e.g. Denmark and the UK during the 1985 campaign. The Stord 980 press having a rated daily throughput corresponding to 3000 tonnes of beet and designed to provide pulp of 25% dry solids has given promising results, and a number have been ordered, including five for installation in factories of British Sugar plc.

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## The world's largest press for sugar beet pulp — Stord 980

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Anon. *Stord Bartz Rev.*, 1986, 10, 17 - 18.

The Stord 980 press was designed to provide a greater volume of press-cake by increasing the diameter of the cage, necessitating only a modest increase in the length of the press and thus retaining adequate screw rigidity; relying on lengthening of a press to achieve a greater cake volume could cause deformation of the screw. The straining area was increased by 60 - 90% using fully perforated screws which made it possible to increase cake thickness without reduction in press output. Trials on three different experimental versions of the press at three factories operating different types of diffuser and employing different sets of conditions in diffusion showed that

one of the presses had an output closely approaching the target value.

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## Rationalization of mechanical treatment of sugar factory effluent

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B. Polec. *Gaz. Cukr.*, 1986, 94, 93 - 95 (Polish).

The types of suspended matter found in flume-wash water and difficulty in removing poorly precipitable matter by mechanical treatment are discussed. The use of settling tanks with special inserts and of flocculants is described, followed by an account of trials in which the performance of Magnafloc M-156 was compared with that of six different unnamed organic flocculants of Polish origin. Results are of only a tentative nature in view of the shortness of the tests and the fact that only one type of effluent was involved; however, the superiority of organic over inorganic flocculants was demonstrated and of both over conventional treatment without flocculants in terms of greatly increased settling rates and degree of COD and suspended matter removal. Magnafloc M-156 was better than the other flocculants in all cases.

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## Stabilization of water in the flume circuit

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B. Zalicka. *Gaz. Cukr.*, 1986, 94, 95 - 97 (Polish).

Bacterial development in flume water is discussed and the benefits of liming in regard to removal of suspended matter, reduction of BOD<sub>5</sub> and bacteriological control are indicated. Preliminary tests on the use of a number of disinfectants are reported in which the amount of chemical needed for stabilization was greatly reduced and the settling of muds improved; the disinfectants had no adverse effect on auto-purification. The permissible concentration limits of the disinfectants in regard to aquatic life were far higher than those of Sterinol (used hitherto as disinfectant in Polish sugar factories) and of Kamin quaternary ammonium salts; tests with Kamin showed that at 50 g/m<sup>3</sup> it inhibited auto-purification.

### The structure of the Spanish sugar industry

H. H. Jahn. *Die Zuckerrübe*, 1986, 35, 292 - 293 (German).

An outline is given of the Spanish sugar industry, with a list of the beet sugar factories (only 1% of the total raw sugar production is obtained from cane, which is grown on a declining area). Average daily slice was 3856 tonnes in 1985/86, ranging from 2400 to 6800 tonnes. The expansion in production of glucose from maize from the start of the 1970's is discussed. The consequences of Spain's entry into the EEC are examined.

### Improvement of pulp pressing by controlled infection

F. Hollaus and G. Pollach. *Zuckerind.*, 1986, 111, 1025 - 1030 (German).

While fermentation during diffusion clearly improves the pressing properties of pulp, acid formed as a result of microbial activity entails sugar losses. Continuous formalin dosing in tower diffusers at two factories using a special metering system was intended to minimize bacterial activity and rely on the controlled acidification to improve pulp pressing. The quantities of lactic and acetic acids, glucose and fructose occurring in diffusion were compared between four sets of conditions: no disinfection, total disinfection with 0.02% formalin on beet, addition of 0.005% formalin at the bottom of the tower, and addition of 0.011% at the bottom and in the middle of the tower. Calculation of the balance between sugar loss and reduction in the energy consumed in pulp drying showed that a saving of 86 MJ/tonne of beet in pulp drying was accompanied by a loss of 1 kg of sucrose/tonne of beet. A more detailed cost calculation involved white sugar losses by degradation in diffusion and through melassigenesis, and the costs of formalin, of a Quentin plant for molasses and of pulp drying. Results differed between the two factories: at one, a formalin dosage of 0.005% on beet balanced the sugar losses with drying costs, whereas the costs of sugar losses exceeded the energy savings in drying with all the variants tested at the

other factory. Possible reasons for this are suggested. Further investigations were planned.

### Colour formation and colour elimination from crystals

P. W. van der Poel, J. L. M. Struijs, J. P. M. Vriens and A. A. W. Marijnissen. *Zuckerind.*, 1986, 111, 1032 - 1039 (German).

See *I.S.J.*, 1987, 89, 72 - 78.

### Factors affecting white sugar colour. II. The sources of white sugar colour

N. W. Broughton, B. J. Houghton and A. Sissons. *Zuckerind.*, 1986, 111, 1039 - 1046.

See *I.S.J.*, 1987, 89, 37A.

### Further development of batch sugar boiling. II. A mathematical model of the sucrose crystallization process. III. Optimum sugar boiling

M. A. Karagodin and R. Lásztity. *Cukoripar*, 1986, 39, 100 - 103, 133 - 135 (Hungarian).

II. A mathematical model of the crystallization process in a batch vacuum pan is presented that is based on experimental laboratory-scale boiling as well as on a theoretical approach. The model includes all the important boiling parameters and is suitable for computerized control of the process.

III. Conditions are examined under which the optimum is achieved at a supersaturation of 1.11 - 1.16 whereby the cycle is shortened and steam consumption reduced. (See also Karagodin & Lásztity: *I.S.J.*, 1987, 89, 42A.)

### New biocides for diffusion disinfection

M. Tömördi and L. Németh. *Cukoripar*, 1986, 39, 135 - 141 (Hungarian).

Tests are described in which Coburon 900, a Bussetti product based on sodium dimethyl thiocarbamate, at 5 - 10 ppm proved more effective as a disinfectant than formalin at 140 ppm in a Buckau-Wolf tower diffuser and gave as good as

or better results than a number of other disinfectants tested. The costs of treatment with it are discussed.

### The amount of fine pulp in raw juice and pulp separator efficiency

L. Dömötör. *Cukoripar*, 1986, 39, 141 - 147 (Hungarian).

The adverse effect of pulp particles on raw juice carbonation and increase in sugar losses resulting from degradation products formed from the pulp is discussed. The quantities of fine pulp in juice from trough-type and tower diffusers at four Hungarian sugar factories are indicated and the efficiencies of pulp catchers examined; there was considerable variation in the initial juice pulp content and in the performance of rotary vertical catchers at three factories, while at Sarkad the raw juice contained the smallest amount of pulp and the arcuate screen used had the highest efficiency (40% removal). However, the performances of both types of catcher were considered satisfactory.

### Energy management

P. Wertán. *Cukoripar*, 1986, 39, 147 - 148 (Hungarian).

The specific heat consumption in Hungarian sugar factories in the 1985/86 campaign is indicated, showing that in 75% of the factories the results were better than in previous years. Various means by which energy consumption can be reduced in processing are discussed. The basic recommendations include ensuring that there is the least possible water to evaporate in processing, evaporating to as high a Brix as is practical and maintaining an even rate of beet processing.

### Reconstruction of a pulp dryer furnace

N. G. Alekseev. *Sakhar. Prom.*, 1986, (11), 36 - 37 (Russian).

Details are given of the pulp dryer furnace at Gul'kevichi sugar factory which has operated 14 years since its reconstruction without need to replace the refractory lining.



# Sugar refining

## **The effect of certain non-sugars on the viscosity of refinery products**

L. A. Sapronova. *Sakhar. Prom.*, 1986, (12), 21 - 25 (Russian).

The effects of various non-sugars and additives on model refinery syrups were investigated using a Hoppler viscometer. Ash, sodium sulphite, sodium triphosphate and magnesium sulphate had little effect, while increase in the concentration of colloids from 0.1 to 1.9% on Brix caused a considerable rise in viscosity. Acetyl monostearate used as surfactant caused a slight rise in viscosity with increase in its concentration at 60° and 70°C as a result of coarse dispersion of its particles in the syrup; however, at 80°C and at low concentration it caused a 15% fall in viscosity, but at all three temperatures the viscosity rose at 0.10% concentration. The normal viscosity-reducing action of a surfactant is explained in terms of the effect on foam formation. Increase in the proportion of glucose to sucrose in a mixture of the two sugars caused a gradual fall in viscosity.

## **The BIBO carrier - a transportation and marketing tool**

J. Boyle. *Zuckerind.*, 1987, 112, 59 - 60.

The BIBO (Bulk In Bags Out) system is described, in which refined sugar is loaded into the ship in bulk and, at its port of destination, is reclaimed from beneath the hold and bagged before being landed. The benefits of the scheme for all parties and the economics are discussed. The development is a result of increase in EEC white sugar exports and involved conversion of white sugar bulk silos at Antwerp and Dunkirk to allow bulk loading of a ship, as well as conversion of a cargo ship to a special sugar carrier of 20,000 tonnes total sugar-carrying capacity. Loading and discharging are computerized and take two and six days, respectively. The project is ultimately aimed at a Bulk In Bulk Out system with white sugar bulk silos being built at the ports of destination.

## **Calculation of the viscosity of products in sugar refining**

L. A. Sapronova and Yu. I. Sidorenko. *Sakhar. Prom.*, 1987, (2), 32 - 33 (Russian).

The viscosities of refinery run-offs of varying concentration were found to be only 4 - 6% higher than those of pure sucrose solutions of comparable concentrations, so that empirical equations for (i) solutions containing 0 - 48% sucrose, (ii) for solutions of 48% up to the saturation limit and (iii) for supersaturated solutions are considered valid for purities of 86 and above.

## **The Australian sugar industry**

B. M. Munro. *Sugar J.*, 1986, 49, (7), 7 - 10.

See *I.S.J.*, 1987, 89, 52A.

## **Current knowledge on ignition and explosion of dusts from food powders**

J. P. Pineau. *Sucr. Franç.*, 1987, 111, 5 - 19 (French).

Aspects of dust ignition and explosion examined, with particular reference to the situation in France, include the conditions under which a cloud of combustible dust is formed, the mechanism of ignition of a dust cloud and the nature of the material in question, the mechanism by which fire and shock waves spread and the effect of confined space, the ignition and explosive properties of different dusts (including icing sugar), conditions conducive to fire and explosion, the temperature at which spontaneous combustion can occur in the case of various products, the minimum energy required for ignition, the violence of an explosion in a confined space, the type of equipment in which a dust explosion is most likely to occur, characteristics of flammability and explosiveness and classification of products on their basis, and methods of preventing an explosion. Diagrams are presented relating to the explosive properties of icing sugar and sugar particles from a dust separation system.

## **Explosion prevention: the situation in France in the face of international experience**

J. F. David. *Sucr. Franç.*, 1987, 111, 21 - 24 (French).

A discussion of dust explosions in general includes the legal aspects in France, how to prevent explosions or limit their effects and the problems created by electrical apparatus and static electricity.

## **Summary of arrangements applied to systems of white sugar handling and storage**

M. Desal. *Sucr. Franç.*, 1987, 111, 25 - 27 (French).

French regulations concerning silos and white sugar storage are set out; they cover silo design and installation, walkways, conveyors and elevators, dust separation, electricity and compressed air.

## **Explosion prevention in handling equipment**

J. M. Prodhomme. *Sucr. Franç.*, 1987, 111, 29 - 34 (French).

Prevention of dust explosions and fires in silos and in the vicinity of conveyors and elevators is discussed, including minimization of dust emission, proper attention to electrical components and means of alleviating the effects of an explosion such as in elevator shafts.

## **Analysis of total polysaccharide contents in the raw sugar refining process**

Z. Saenz C., J. L. Díaz R., B. Laza S. and M. Salinas. *Centro Azúcar*, 1984, 11, (3), 83 - 89 (Spanish).

Samples were taken of liquors at different stages of the refining process and analysed for pH, colour, reducing sugars and polysaccharides contents. The average values are tabulated and the polysaccharides levels shown in graph form. There was a tendency for polysaccharides to increase during the process but not regularly, there being decreases as well as increases between stages.

# Starch based sweeteners

## Determination of conditions for separation of fructose and glucose

T. Ya. Chernyakova, N. A. Arkhipovich and S. I. Usatyuk. *Sakhar. Prom.*, 1986, (9), 48 - 50 (*Russian*).

In experiments on fructose separation from glucose by liming, the largest amount of fructose in the Ca fructosate (90 - 93% of that in the initial solution) was obtained by adding  $\text{Ca}(\text{OH})_2$  at 170% of the theoretical amount of 30% on weight of fructose. Investigations of the time factor showed that, while 40 min was adequate to give 91.5% fructose precipitation and increased time did not give significantly higher yields, at 60 min the precipitate had a crystal structure that allowed easy removal of glucose by washing three times with lime-saturated water at 100% on weight of precipitate. The crystal fructose was of 99.3 purity.

## Weakly basic polystyrene anion exchangers for treatment of products during the manufacture of glucose-fructose syrup

T. A. Ladur *et al.* *Sakhar. Prom.*, 1986, (9), 50 - 52 (*Russian*).

The stability of ion exchange resins for decolorization and demineralization of starch hydrolysate after filtration and active carbon treatment is discussed. While a Soviet-made cation exchanger is available that is as effective as imported resins, anion exchangers of Soviet manufacture are unsuitable. However, tests on a number of resins showed that one, ANT-511, containing 80% *n*-decane by volume and 85% tertiary amine groups, had an average syrup decolorization efficiency of 79% at a specific load of 63 volumes syrup per volume of resin and adsorbed 70% of the protein. It had an SVC of 6.22 meq/g in 0.1N HCl. A glucose syrup treated by the resin in a 2-stage scheme satisfied requirements of a substrate for enzymatic isomerization to fructose.

## Enzymatic hydrolysis of different types of starch

G. Tegge and G. Richter. *Starch/Stärke*, 1986, 38, 329 - 335 (*German*).

The effects of saccharification by amylolytic enzymes on different commercial starches and treatment of their hydrolysates were investigated, whereby no significant differences were found in the final degree of saccharification between the starches. Compensation was made in the final saccharification stage for the lower DE values of waxy corn hydrolysates after liquefaction. Viscosity after liquefaction and saccharification was highest in raw hydrolysates from wheat starch, but the differences in viscosity disappeared after filtration. Addition of pentosanase during saccharification did not affect viscosity or filtration of the hydrolysates, but glucoamylase with increased pentosanase activity had a positive effect on filtration of wheat starch hydrolysates, while viscosity remained unaltered. Use of a Brabender viscograph to study enzymatic liquefaction revealed differences in the order of viscosity maxima of the starches as a result of alpha-amylase addition; potato starch fell from top to bottom of the scale when the enzyme was added, while the reverse occurred in the case of wheat starch.

## Development and field confirmation of a mathematical model for amyloglucosidase/pullulanase saccharification

T. R. Swanson, J. O. Carroll, R. A. Britto and D. J. Duhart. *Starch/Stärke*, 1986, 38, 382 - 387 (*German*).

Response Surface Methodology (RSM), a computer-based experimental-design technique for evaluation of the effects of independent variables on a response or dependent variable, was used to formulate a mathematical model of enzymatic saccharification of corn starch hydrolysate whereby the effects on glucose yield (determined by HPLC) of time, initial dry solids and dosage of amyloglucosidase and pullulanase were established. Coefficients for a 2nd-order equation were calculated from regression analysis of the experimental data and the validity of the model was tested at

laboratory, pilot-plant and factory levels, showing that it predicted glucose yields on a routine basis to within  $\pm 0.2\%$ . The plant trials were conducted in three factories, two producing 600 tonnes and one producing 150 tonnes of HFS daily; at all three, comparison was made between the use of amyloglucosidase alone and in a 3:1 blend with pullulanase; at one factory the blend increased glucose yield by about 0.5%. The effects of reduction in enzyme dosage and in process time while maintaining the same yield as in this factory were determined at the other two factories; in both cases, discrepancies occurred between the predicted and true yield values in the control run with amyloglucosidase alone, but there was very good fit of the data from the blend portion of the trial. In one of the factories, the model was used to find the causes of the reduced yield and suitable remedies, demonstrating its value as a troubleshooter.

## Comparative properties of variants of schemes for purification of glucose solutions in the manufacture of glucose and fructose from sucrose

L. I. Tanashchuk, N. A. Arkhipovich, T. V. Lopato, O. P. Nazarova and N. I. Odorod'ko. *Sakhar. Prom.*, 1986, (11), 46 - 48 (*Russian*).

A scheme involving treatment of carbonated glucose syrup with cation exchange resin followed by 2-stage granular active carbon treatment removed 93% hydroxymethyl furfural and its polymerization products, which was a better result than that given by cation-anion-exchange resins with or without carbon treatment after the first cation exchange resin stage. The 2-stage carbon procedure involved addition of 1.75% carbon on Brix (which removed 75 - 80% colouring matter) followed by addition of 1% on Brix (which removed 50 - 55% of the residual colour). Almost complete removal of  $\text{Ca}^{++}$  ions was obtained by precipitation with sodium triphosphate, followed by addition of  $\text{SO}_2$  to pH 4.0 - 4.5 and active carbon treatment.

# Laboratory studies

## Thermodynamic activation functions of viscous flow and the structure of a sugar solution

R. Ts. Mishchuk, S. A. Sagan' and A. A. Lipets. *Sakhar. Prom.*, 1986, (10), 13 - 15 (Russian).

On the basis of the relationship between viscosity and temperature, values were determined of the standard free energy and enthalpy, and from these the entropy was calculated. Graphs demonstrate the complex relationship between these three parameters on the one hand and concentration and temperature on the other, whereby enthalpy and entropy increase with concentration and decrease with temperature rise, while the free energy falls with increase in concentration but increases with fall in temperature at constant concentration. The behaviour of all three parameters is described in detail, and the possibility of using their values to quantify the effect of increased sucrose concentration and temperature on stiffening of the solution structure is indicated.

## An automatic digestion-filtration system

V. N. Mardal' *et al. Sakhar. Prom.*, 1986, (10), 44 - 45 (Russian).

An automatic tarehouse line for press juice extraction from beet brei, preparation and polarimetry at the rate of 60 samples/hr is described. Comparative tests with cold digestion polarimetry showed an absolute error for the line of  $\pm 0.08\%$  pol on beet weight compared with a permissible error of  $\pm 0.2\%$ .

## Investigation of colouring matter in sugar manufacture by gel chromatography on Acrylex gels

I. F. Bugaenko, M. Garcia F. and J. Hoque. *Izv. Vuzov, Pishch. Tekh.*, 1986, (4), 102 - 104 (Russian).

Colouring matter in cane raw sugar and molasses was investigated by chromatography on Acrylex R2, R10 and R60 gels after paper filtration of 20% sugar solutions and 5% molasses solutions.

The optical density of 3.5 ml fractions was measured at 560 nm. Two colorant groups were obtained on Acrylex R2, having molecular weights of approx. 100 and  $\geq 2000$ ; three groups were separated by Acrylex R10 and had molecular weights of 14,700, 12,600 and 2700, the last group being smaller in quantity than the other two; and fractionation on Acrylex R60 yielded four groups of 50,000, 27,000, 12,600 and 4500 M.W. The predominant colouring matter in both sugar and molasses was represented by a M.W. range of 3000 - 30,000.

## Analysis of thermally unstable natural organic compounds by secondary-ion mass spectrometry with use of MI 1201 mass spectrometer

K. V. Malakhov, M. Ya. Turkina and S. L. Dobychin. *Zh. Anal. Khim.*, 1986, 41, (3), 511 - 518; through *Anal. Abs.*, 1986, 48, Abs. 11D11.

Mass spectra of 18 natural amino-acids, thyroxine,  $\text{Na}_2\text{ATP}$ ,  $\text{Na}_3\text{UTP}$ , testosterone, hydrocortisone, corticosterone, 4,4'-dithiobis(benzene sulphonic acid) and sucrose obtained by SIMS (in either positive or negative-ion mode) are presented. The samples are applied to a silver target, as 1  $\mu\text{litre}$  of 1 - 100 mM solution or suspension in glycerol and the target is bombarded by  $\text{Cs}^+$  (energy 4 - 5 keV, ion current density approx. 10 nA/mm<sup>2</sup>). The limits of detection range between 1 and 100 ng and the mass resolution is approx. 600. Direct SIMS analysis of the cited compounds after TLC separation on Silufol UV254 plates (by bombarding the zones cut out of the plates and moistened with glycerol) is also possible.

## Liquid chromatography of carbohydrates

T. Hanai. *Adv. Chromatogr.*, 1986, 25, 279 - 307; through *Anal. Abs.*, 1986, 48, Abs. 11D170.

A review is presented, with 258 references, of stationary phases and detection techniques for the determination of carbohydrates.

## Spectrophotometric determination of traces of sulphite in sugar samples

S. P. Chattopadhyay and A. K. Das. *J. Indian Chem. Soc.*, 1985, 62, (8), 632 - 633; through *Anal. Abs.*, 1986, 48, Abs. 11F19.

A white sugar sample (4 - 5 g) was dissolved in water and the solution made alkaline with NaOH and diluted to 50 ml. A solution of 8 mM crystal violet in aqueous 25% ethanol (0.5 ml), 0.1M KCl (4 ml) and 0.8M HCl (2 ml) were mixed and, after 30 min, 0.25M formaldehyde (0.5 ml) and a portion of the prepared sugar solution were added. After a further 9 min, the reaction mixture was diluted to 10 ml and the absorbance of the solution measured at 605 nm against a reagent blank. Beer's law was obeyed for 0.032 - 3.895  $\mu\text{g/ml}$  of  $\text{SO}_3^{--}$  and the optimum working range was 0.3 - 2.55  $\mu\text{g/ml}$ ; the  $\epsilon$  value was 24,600 and the Sandell sensitivity 3 ng/cm<sup>2</sup>; in the determination of 1.990  $\pm$  0.04  $\mu\text{g/ml}$  of  $\text{SO}_3^{--}$  the coefficient of variation was 0.77% ( $n = 4$ ). Large amounts (relative to  $\text{SO}_3^{--}$ ) of  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{--}$ ,  $\text{SCN}^-$ , Na, K,  $\text{NH}_4^+$ , EDTA, Zn, Ni (II), Cu (II), Co (II),  $\text{Br}^-$ , acetate, Fe (III) and Ca could be tolerated; only  $\text{S}_2\text{O}_3^{--}$ ,  $\text{NO}_2^-$  and Hg (II) interfered.

## Enzyme-based electrochemical sensors

R. K. Kobos. *Chim. Oggi*, 1986, (1/2), 21 - 24, 28; through *Anal. Abs.*, 1986, 48, Abs. 11J138.

A review is presented (with 31 references) on the operation of enzyme electrodes, some specific potentiometric and amperometric enzyme electrodes, and development of sugar selective electrodes.

## Clarification with Al salts in sugar beet evaluation

C. A. Accorsi. *Ind. Alimentari*, 1986, 25, 763 - 768 (Italian).

Beet extracts clarified with basic lead acetate, aluminium sulphate and alumin-

ium chloride plus calcium hydroxide were analysed for pol, (Na + K) by flame photometry and alpha-amino-N by spectrophotometry after complexing with copper nitrate. No statistical difference was found between the pol values measured after treatment with Al chloride and Ca(OH)<sub>2</sub> and those obtained after treatment with the other agents. The variance (as determined by the F-test) was not critical for (Na + K), while the nitrate fraction had a much higher concentration when Al chloride was used for clarification, because of the differences in the physico-chemical properties of the solutions, particularly a marked residual colour. The results suggest that Al chloride could be used instead of lead acetate as extractant and clarifying agent; the advantages of the Al salt include lack of toxicity, the smaller amount required and lower cost.

### Molasses dry solids analyser

V. Ya. Babkin *et al.* *Tez. Dokl. Vses. Konf. Biotekhn.*, 1986, 152 - 153; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (21), Abs. 21 R396.

A refractometric analyser has been developed with total internal reflection for dry solids determination; it includes a molasses dilution unit, a refractometric unit and a measuring device. A special feature of the analyser is the automatic rinsing of all components that come into contact with the sample; a signal proportional to the dry solids concentration and obtained prior to the start of the rinsing cycle is maintained at the analyser outlet during this operation.

### Analytical comparison of two methods for sucrose extraction from sugar beet relative to the sugars content. II

M. Kovac, Z. Jancekova and M. Spanar. *Bull. Potravin. Vyzk.*, 1986, 25, (1), 31 - 40; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (21), Abs. 21 R463.

Results are given of the determination of the sugars content in juice and syrup obtained in laboratory experiments on sucrose extraction from beet cossettes by

the conventional method and a new method using a non-polar solvent. The sugars were determined by HPLC. It was found that the syrup obtained by the new method contained 6.37% more sucrose and much less glucose and fructose than the juice obtained by the classical method.

### A boiling house recovery formula independent of juice quality

G. R. E. Lionnet and K. C. Koster. *Proc. 60th Ann. Congr. S. African Sugar Tech. Assoc.*, 1986, 30 - 32.

A corrected reduced boiling house recovery (CRB) is derived by using s-j-m recoveries and a molasses target purity based on mixed juice analysis. The equation takes the form:

$$\text{CRB} = \text{BHR}_a - 100 \left[ \frac{S_a (J_a - M_a)}{J_a (S_a - M_a)} \right] + (49.8 - \text{TPD}_t) / (0.5493 - 0.008543 \text{TPD}_t),$$

where  $\text{BHR}_a$  = actual boiling house recovery as reported by a factory on a sucrose basis,  $S_a$  = actual sugar purity,  $J_a$  = actual mixed juice purity (sucrose/Brix),  $M_a$  = actual molasses purity and  $\text{TPD}_t$  = target purity difference, i.e. the difference between  $M_a$  and a target purity ( $M_t$ ) as calculated from mixed juice analyses by the equation  $M_t = 33.9 - 13.4 \log_{10} [(\text{fructose} + \text{glucose in mixed juice}) / (\text{ash in mixed juice})]$ . The method gives results generally independent of juice quality, and determination of sulphate ash in mixed juice is the only analysis additional to those already carried out on a routine basis. The need to use sucrose content (as determined by GLC) instead of pol is stressed.

### Non-starch, soluble polysaccharides of sugar cane

M. A. Clarke, E. J. Roberts, M. A. Godshall and F. W. Parrish. *Proc. 60th Ann. Congr. S. African Sugar Tech Assoc.*, 1986, 58 - 61.

A survey is presented of polysaccharides found in sugar cane, including indigenous sugar cane polysaccharide (ISP), sarkaran, a glucan recently isolated from ISP<sup>1</sup>, a galactomannan<sup>2</sup> and a polysacch-

aride isolated from Cuban molasses<sup>3</sup>. The apparatus and procedures used for analysis of the polysaccharides are described.

### Detection and occurrence of nucleotide cleavage products in technical sugar solutions — contribution to completion of nitrogenous compound determination

E. Reinefeld, K. M. Bliesener and H. J. Szczecinsky. *Zuckerind.*, 1986, 111, 1017 - 1025 (German).

Nucleo-bases and nucleosides were separated from nucleotides in beet press juice, raw juice and molasses by treatment with anion exchange resin in acetate form; elution with water desorbed all of the nucleo-bases except xanthosine. The nucleosides were then separated from the nucleo-bases by adsorption on a strongly acidic cation exchange resin in H<sup>+</sup> form, after which the pyrimidine and purine bases were quantitatively determined by HPLC using a U.V. detector. Uridine was present to a far greater extent than the other nucleotide cleavage products found in press and raw juice as well as Quentin molasses, and was the second most dominant in normal molasses, in which adenosine was quantitatively the most important; the third place in normal molasses and the second in Quentin molasses was occupied by guanosine, while adenine was the second most important in press juice. More nucleosides were found in molasses than nucleo-bases. Molasses analysis yielded cytidine, guanosine, inosine, cytosine and thymine in addition to the nucleo-bases and nucleosides found previously. Nucleotides were also found in raw juice. The bases and their nucleosides made up about 5% of total nitrogen in molasses. With inclusion of nucleo-bases and nucleosides and the use of more accurate analytical methods for betaine and pyrrolidone carboxylic acid, a practically complete balance of nitrogenous non-sugars in molasses is now possible.

1 Roberts *et al.*: *I.S.J.*, 1987, 89, 53A.

2 Miki *et al.*: *ibid.*, 1975, 77, 67 - 69.

3 Cremata & Orozco: *ibid.*, 1981, 83, 283.

# By-products

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## The fundamentals of a fermentation technique for molasses media of higher concentration

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E. B. L'vova, L. V. Aglish, T. V. Vybornova and V. D. Smirnova. *Povysh. Effektiv. Pr-va Pishch. Kislot*, 1985, 45 - 54; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (22), Abs. 22 R379.

A new submerged fermentation technique has been developed and tested for citric acid production by *Aspergillus niger* cultivation on molasses medium of higher concentration.

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## Ways of raising the efficiency of processes for chemical treatment of fermented solutions

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L. A. Gaidei, N. Ya. Novotel'nova, R. A. Yurchenko, T. T. Shevtsova and L. F. Petrova. *Povysh. Effektiv. Pr-va Pishch. Kislot*, 1985, 91 - 96; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (22), Abs. 22. R383.

The physico-chemical composition of fermented citric acid solutions is given in an article that shows the effect of infection of molasses media, the effect of heat treatment conditions for a culture solution at the completion of the fermentation cycle on the quality of the fermented solution and its processing properties, and the effect of the quality of precipitants on the impurities composition of ash components in the basic citric acid solutions.

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## Vinasse application in cane agronomy

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Anon. *Rpt. Zimbabwe Sugar Assoc. Expt. Sta.*, 1984/85, 38 - 39, 83 - 86. In studies on germination of cane smut spores, a thick suspension was prepared from fresh whips and three drops of this suspension added to 5 ml of water diluted vinasse of up to 100,000 ppm concentration; microscope slides were then incubated at 29°C for 16 hours. Results showed that germination was vigorous at vinasse concentrations of 10,000 ppm or above, with longer promycelia and more abundant sporidia than in control treat-

ments without vinasse. It is concluded that under field conditions, by increasing spore germination, the vinasse would reduce the numbers of viable spores left in the soil to infect subsequent cane. In 2nd and 3rd ratoons, there was a highly significant negative correlation between smut incidence and vinasse concentration at dilution rates of 1:50, 1:100, 1:200 and 1:400. Although application of vinasse at these dilution rates had no significant effect on cane yield or sugar content, the nitrogen in the vinasse boosted yield when coupled with separate application of N at 60 kg/ha. At high concentrations vinasse also caused an increase in exchangeable K in the 0 - 30 and 30 - 60 cm soil horizons and was responsible for increased conductivity in the lower soil layers but without any major changes in pH.

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## A mathematical model of the molasses vinasse evaporation process

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A. N. Alabovskii, A. I. Ivanov and Yu. M. Rabiner. *Pishch. i Pererab. Prom.*, 1986, (7), 43; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (23), Abs. 23 R505.

A mathematical model was developed to describe evaporation of molasses vinasse using waste flue gases from a boiler operating on natural gas. It was found that the mean deviation of the experimental data from the calculated values was  $\leq 3.72\%$  indicating that the model adequately represents the true process.

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## Bagasse pulp manufacture

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Anon. *Biomasse Actualités*, 1986, (52), 5 (French).

A new technique developed by Raphael Katzen Associates International Inc., of Cincinnati, OH, USA, is to be used for pulp manufacture from bagasse and other lignocellulose-containing raw materials. The lignin and some of the hemicellulose are removed with aqueous alcohol (to give a pulp generally suitable for paper production) and added to soft wood for cardboard manufacture. Separation of the water from the alcohol does not result in pollution unlike conventional paper manufacturing processes, and erection of

plants as small as 100 - 150 tonnes pulp/day is economically viable.

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## Effect of adaptation of yeasts to reduced pH of the medium on their metabolism during molasses wort fermentation

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S. T. Oliinichuk *et al. Ferment. i Spirt. Prom.*, 1986, (4), 29 - 31; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (24), Abs. 24 R501.

Results are given of investigations on fermentation of molasses wort of 24% dry solids concentration using yeasts adapted to a reduced pH of 4. The advantages are indicated of the seed material obtained for alcohol manufacture by comparison with yeasts prepared by the current method.

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## Cane molasses decolorization using Basidiomycetes. II. Sugar decolorizing efficiency and assimilation by Basidiomycetes in molasses treated with polyvinyl polypropyrolidone

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H. Tamaki *et al. J. Japan. Soc. Food Sci. Technol.*, 1986, 33, (4), 270 - 373; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (24), Abs. 24 R502.

It is noted that very often an increase in colour occurs in the growing culture at the start of molasses decolorization using Basidiomycetes; this is a consequence of oxidation of various phenolic compounds in the molasses by polyphenol oxidase in the Basidiomycetes. A method of removing phenolic compounds from molasses is suggested which involves the use of polyvinyl polypropyrolidone (PVPP) as adsorbent. *Coriolus versicolor* IFO 4937 having a decolorizing efficiency of 84.4%, *C. hirsutus* IFO 4917 (82.8%) and *Zenites betulina* IFO 6266 (80.6%) are the best for decolorization but consume sucrose. One parameter characterizing a decolorizing efficiency at reduced sucrose consumption is the sucrose:assimilation ratio S/A, according to which the most suitable for decolorization of PVPP-treated molasses are *Pleurotus ostreatus* IFO 6519 (S/A 18.56) and *Oxyporus populinus* TMI 50016 (S/A 17.08) belonging to Type 2.



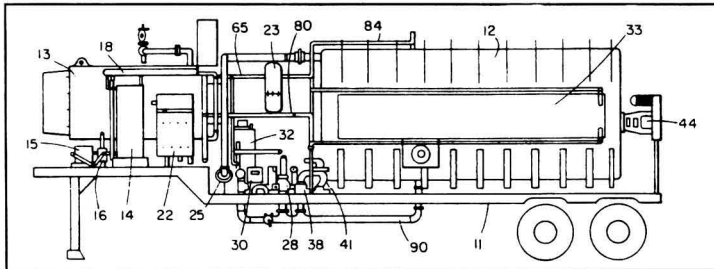
# Patents

## UNITED STATES

### Mobile sugar dissolver and invert sugar producer

M. C. Fields and P. F. Fields, *assrs.*  
Process Supply Co. Inc. **4,526,621**.  
September 6, 1983; July 2, 1985.

A mobile unit comprising a process tank 12 carrying heat panels 33 on either side is mounted on a flatbed trailer 11 which also carries a 70 hp boiler 13, feed tank 14 and various pumps. Heat exchanger 18 is used to heat cold water from an external supply using steam from the boiler. Hot water from tank 12 is pumped into a melter (not shown) fixed to a bulk railcar or bag hopper and containing granulated sugar; the resultant slurry is recirculated to tank 12. An agitator 16 aids blending. The process is continued until the requisite sugar concentration is obtained. For invert sugar production, HCl is added and the temperature raised to the level needed for hydrolysis. The unit is intended for use by bottlers where there is only a small population and a normal melting system as used for carbonated beverages is uneconomical.



### Bioconversion of agricultural waste to proteinaceous animal feed

M. M. Young, of Waterloo, Canada, *assr.* University of Waterloo.  
**4,526,791**. December 23, 1982; July 2, 1985.

A mixture of animal manure and bagasse is converted to a proteinaceous animal fodder by anaerobic fermentation with *Chaetomium cellulolyticum* at 50 - 60°C (30 - 40°C) and pH 5 - 7 for 8 - 10 (10 - 14) days.

### Glucose isomerization to fructose

G. Weidenbach, D. Bonse and B. Meyer, *assrs.* Kali-Chemie AG. **4,533,633**.  
September 23, 1982; August 6, 1985.

The isomerizing productivity of glucose isomerase immobilized on a silica carrier is increased by bringing the glucose solution into contact with particles of silica or aluminium silicate before the start of the continuous isomerization process. A pre-column is used for the contact. The weight ratio between the catalyst in the main isomerization stage and the silica or aluminium silicate particles in the pre-contact stage is between 3:1 and 1:3 (1:1); the particle size of the silica or aluminium silicate is 0.5 - 5.0 mm and that of the enzyme and carrier 0.08 - 0.5 mm. The glucose concentration is 40 - 50% and the pH 7.0 - 8.5. The glucose solution is preheated to 55 - 65°C before pre-contact. Co (II) and Mg (II) ions are added, possibly as water-soluble chlorides or sulphates, to the glucose solution as cofactors in amounts of 0.1 - 2.0 and 10 - 20 ppm, respectively, plus

100 - 600 ppm SO<sub>2</sub> as antioxidant. The isomerized solution has a fructose content of at least 42% on weight of dry solids.

### Beet juice purification

B. Winstrøm-Olsen, of Nakskov, Denmark, *assr.* A/S De Danske Sukkerfabrikker. **4,534,800**.  
November 23, 1983; August 13, 1985.

In a juice purification scheme, part of the gaseous medium (containing ammonia) formed in thin juice

preheating prior to evaporation is recycled to 1st or preferably 2nd carbonation where its addition to the juice reduces the amount of soda used for juice deliming and hence decreases the sugar losses. The recycled gas is preferably introduced in the first of two carbonation vessels at a level about 3 - 5 m below the juice surface. Vapour bled from the evaporator is used to preheat thin juice to approx. 130°C.

### Thermostable glucoamylase

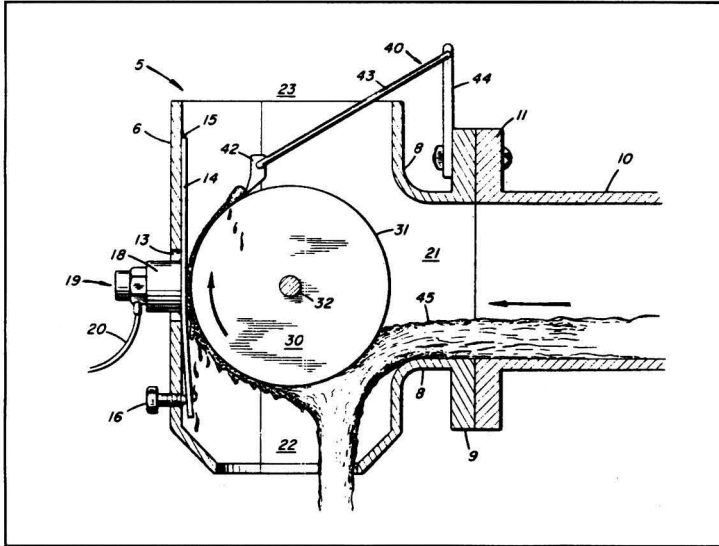
D. M. Katkocin, N. S. Word and S. S. Yang, *assrs.* CPC International Inc.  
**4,536,477**. August 17, 1983; August 20 1985.

A glucoamylase having a maximum activity at pH 5 and 70 - 75°C and a half-life greater than 3 hr at pH 6 and 70°C is derived from two new strains of *Clostridium thermoamlyolyticum*, namely ATCC 39,251 and ATCC 39,252, under anaerobic conditions. The enzyme is capable of liquefying and saccharifying starch simultaneously at pH 6 - 7 at which alpha-amylase is active and at a temperature at which the reaction rate is sufficiently fast for practical purposes to give a glucose syrup.

### Detection of sugar crystals in molasses

S. R. Reichard, of Mackay, Australia, *assr.* Sugar Research Ltd. **4,538,451**.  
March 9, 1984; September 3, 1985.

The surface of a motor-driven, slowly rotating wheel 31 is partly immersed in a stream of test molasses. A small quantity of the molasses clings to the surface of the wheel and is carried to anvil bar 14 which forces out most of the molasses over the wheel. A small amount passes through a 0.1 mm gap between the surface of the wheel and the anvil bar and is removed from roller 30 rotating within housing 5 by a blade 42 attached to arm 43 of a scraper 40 which is biased against the wheel by gravity or by a spring. If no crystals are present in the molasses, the latter passes smoothly through the gap, but any crystals larger



than the clearance are crushed between the anvil bar and the wheel. As each crystal breaks, faint but clearly detectable shock-waves are created in the anvil, and an accelerometer (vibration sensor) attached to the anvil bar produces weak electric signals which are amplified to give an audible signal or the pulse output is connected to a computer or programmable controller to log the average rate and set alarms when preset levels are exceeded. Alternatively, an indicator lamp can be made to flash or a chart recorder used by means of an analogue time averaging integrator to plot the pattern of crystal occurrence.

#### Bagasse dewatering

W. Kaether, of Brunswick, Germany. 4,543,129. January 24, 1984; September 24, 1985.

See UK Patent 2,078,125<sup>1</sup>.

#### Enzymatic treatment of sugar juices

A. P. Pellegrini, of Belo Horizonte, Minas Gerais, Brazil. 4,544,558. May 23, 1983; October 1, 1985.

Filtered cane, beet or sorghum juice or any syrup yielding crystalline

carbohydrates is treated at pH 3.5 - 8.0 with enzymes in four stages: (1) with  $\beta$ -1,4-glucan glucanhydrolase at a dosage of 1.5 U and with poly- $\alpha$ -1,4-galacturonic glucanhydrolase at 0.9 U, (2) with  $\alpha$ -D-glucoside glucohydrolase at 0.3 U, (3) with  $\beta$ -D-glucoside glucohydrolase at 0.3 U, L-arabinose-ketol-isomerase at 0.15 U and D-xylose-ketol-isomerase at 0.15 U, and (4), with  $\alpha$ -1,4-glucan-4-glucanhydrolase at 0.12 U and  $\alpha$ -1,4-glucan glucanhydrolase at 0.22 U. The temperatures and retention times in each stage are in the range 18 - 67°C and 20 - 90 minutes, although the stage conditions may be: (1) 62°C, 20 min, (2) 65°C, 30 min, (3) 65°C, 30 min, (4) 68°C, 20 min. The juice is then heated to 90 - 100°C to coagulate any remaining impurities and to inactivate the enzymes, filtered or centrifuged and then concentrated under vacuum from 13 - 17°Bx to approx. 70°Bx at a temperature not higher than 70°C. Once adequate saturation is reached so that crystals form, the syrup is mixed in crystallizers at low speed, yielding a product of less than 0.5% relative humidity (preferably 0.25%). Alternatively, the concentrated syrup may be spray-dried or turbo-dried to yield a powder or amorphous product

suitable for a range of applications including alcoholic fermentation.

#### Thermostable glucose isomerase

E. W. Hafner, of Arlington Heights, IL, USA, *assr.* UOP Inc. 4,551,430. October 27, 1983; November 5, 1985.

Aerobic cultivation of a mutant of *Streptomyces thermoviolaceus* NRRL 15615 at 20 - 55°C yields a glucose isomerase which is stable at up to 90°C in glucose isomerization to fructose. About 1500 units of the enzyme are produced per g of dry weight cells in the absence of xylose. Suitable conditions for glucose isomerization to fructose using the enzyme in immobilized form are: 40 - 90°C (50 - 80°C) and pH 6.5 - 9.5 (7.0 - 8.5). Less than 10% loss of enzyme activity relative to its activity at 80°C occurs when the enzyme is heated for 5 min at 90°C in a 42% fructose solution at pH 7.

#### Enzyme electrode and dextran analysis

R. Riffer, of Crockett, CA, USA, *assr.* California and Hawaiian Sugar Co. 4,552,840. December 2, 1982; November 12, 1985.

A system for potentiometric determination of dextran in refinery liquor samples consists of a platinum redox electrode surrounded by a cellulose absorbent sheath with immobilized glucose oxidase which is in turn surrounded by another absorbent sheath with immobilized enzymes from the group containing  $\alpha$ -glucosidase and isomaltase (means being provided for excluding compounds of 14,000 molecular weight or greater when  $\alpha$ -glucosidase is used and the sample contains starch); a final outer sheath contains immobilized dextranase. Each sheath is made from a sheet of cellulose filter paper. The system, which may be a dialysis membrane, is operated in a buffer of pH 5, at which optimum reaction of dextranase and glucose oxidase occurs.

1 I.S.J., 1984, 86, 159.

corroborated largely by the factory control figures. The factory has a 12-roller tandem with rollers 30 in × 60 in. For trial periods, pinions were restored on one or two of the mills and the results have been tabulated for the different periods. Table II shows figures for normal milling in the last days of March; Table III for the first 10 days of April with no discharge roller pinions and Tables IV and V give later results for a train partly without pinions.

**Crushing capacity:** The mill is rated to crush at 55 t.c.h. During March and April the cane supply was less than the rated capacity but in May the cane supply improved and, in spite of higher fibre % cane, the mill easily handled 72 t.c.h. The mill train could handle higher rates but the boiling house capacity was limited to around 60 t.c.h. On several days, the mill crushed over 1800 tonnes against a rated capacity of 1250 tonnes.

**Mill efficiency:** Tables IV and V indicate that at full rate the mill performance improved considerably, recording the lowest values for pol % bagasse. During other periods also, pol loss was less than that in conventional milling, although the difference was very slight.

**Uniformity:** Irrespective of rates of crushing, the performance was more uniform when the pinions were removed. This can be observed from Tables II and III which indicate that pol in bagasse showed smaller variation between maximum and minimum values on any day.

**Imbibition:** The most impressive performance is related to imbibition. During May and June, as cane supply improved, it was considered wise to reduce the load on the evaporators by reducing imbibition. During March and April, imbibition averaged over 325% on fibre with the pol in bagasse at around 2.29 (Table II). The crushing rate then was about 1250 t.c.d.. During May and June the crushing rate rose to 1450 t.c.d. and imbibition was reduced to 250% - 275% on fibre. Even so, the pol loss in bagasse fell to around 2.06 (Table V). Thus, even with reduced water, mill extraction was maintained.

**Load on mill drives:** No quantitative results can be presented, but the

**Table III. Milling results without delivery roller pinions**

Date, April 1985	Cane, t.c.h.	Pol % cane	Fibre % cane	Imbibition % fibre	Pol % bagasse		Ave.
					Max.	Min.	
1	54	12.57	13.92	327	2.4	2.2	2.28
2	59	12.48	13.88	306	2.3	2.2	2.30
3	57	12.67	13.67	339	2.3	2.2	2.28
4	58	12.58	13.87	321	2.3	2.3	2.30
5	58	12.58	14.24	324	2.4	2.2	2.33
6	57	12.83	14.05	304	2.4	2.3	2.28
7	58	13.00	14.01	292	2.3	2.3	2.30
8	51	12.93	13.87	327	2.3	2.2	2.26
9	55	12.59	13.86	319	2.3	2.2	2.26
10	49	12.56	14.12	309	2.3	2.2	2.26
Average							2.28

**Table IV. Milling results with mills 3 and 4 without discharge pinions**

Date, April 1985	Cane, t.c.h.	Pol % cane	Fibre % cane	Imbibition % fibre	Pol % bagasse		Ave.
					Max.	Min.	
13	56	12.03	14.08	280	2.3	2.2	2.28
14	54	12.19	14.00	319	2.3	2.2	2.28
15	52	12.32	13.73	314	2.3	2.2	2.26
16	53	12.27	14.08	312	2.3	2.2	2.27
17	56	12.16	14.04	283	2.5	2.2	2.28
18	60	11.90	14.21	242	2.4	2.4	2.40
19	62	11.76	14.23	205	2.5	2.4	2.43
20	65	11.67	14.25	189	2.6	2.4	2.44
Average							2.33
May 1985							
12	68	11.21	15.32	232	2.3	2.1	2.25
13	64	11.23	14.66	253	2.3	2.1	2.23
14	67	11.00	14.45	223	2.3	2.2	2.23
15	69	11.08	14.97	226	2.3	2.2	2.27
16	72	10.99	14.63	214	2.3	2.2	2.26
17	67	10.87	14.73	223	2.4	2.3	2.34
18	60	10.87	15.16	238	2.3	2.2	2.27
19	62	10.78	14.92	229	2.4	2.3	2.30
20	64	10.69	14.78	222	2.4	2.3	2.33
Average							2.28

**Table V. Milling results with mills 1, 3 and 4 without pinions**

Date, June 1985	Cane, t.c.h.	Pol % cane	Fibre % cane	Imbibition % fibre	Pol % bagasse		Ave.
					Max.	Min.	
11	64	10.22	14.46	296	2.2	2.0	2.08
12	65	10.13	14.65	280	2.1	2.0	2.02
13	62	10.33	14.30	314	2.1	2.0	2.05
14	62	10.55	15.02	307	2.2	2.1	2.12
15	60	10.64	14.58	311	2.2	2.0	2.08
16	61	10.63	13.55	326	2.0	1.9	1.98
17	61	10.63	13.55	302	2.1	1.9	2.00
18	61	10.60	14.99	301	2.1	1.9	2.00
19	65	10.74	14.74	283	2.2	2.1	2.13
20	67	10.79	14.03	290	2.2	2.1	2.13
Average							2.06

chest pressure of the turbines was steadily lower than during conventional milling, even when higher rates of crushing were reached. In another mill, steam flow meters have indicated a reduction in steam demand by about 15%.

*Another trial* - At another sugar mill (Thanjavur), Ramalingam<sup>4</sup> has reported even more impressive results with pinionless drive on three of the four mills in the tandem. The data are presented in Table VI. Ramalingam claims better shredding of cane pieces owing to the unequal peripheral speeds of top and discharge rollers and describes this technique as "a great break-through in milling technology, especially for small tandems without intensive cane preparatory devices". He has claimed reduced power consumption and higher boiler efficiency due to dryer bagasse. Ramalingam experienced a reduction in pol % bagasse from 2.29 to around 1.76 and a drop of over 1% in moisture % bagasse.

Even though the records do not indicate a substantial improvement, smooth working and marginally improved results have already been experienced. The new technique will be adopted from the beginning of the next season on all four mills at Thanjavur.

#### *The future*

The success achieved in operating discharge rollers without pinions holds the promise of vast developments in the design and construction of future mills. The areas where revolutionary changes could be foreseen are as follows:

The mill housing can be so designed as to take a discharge roller with a diameter of about 1.5 times the nominal diameter of the top and feed rollers. In the present mills, the mounting of the pinion limits the diameter. Also, a delivery roller can be used after it wears much more than at present. In effect, the mill angle, now limited to about 70°C, can be further reduced. Even in most conventional mills room will be found to increase the shell diameter by 50 mm to 100 mm because the limitation due to the pinion is eliminated.

With a large discharge roller diameter, the width of the trash plate can

**Table VI. Performance of Thanjavur tandem without pinions on discharge rollers of mills 2, 3 and 4**

Date, March 1985	16	18	20	22	24	26
Cane crushed, tonnes	1533	1317	1464	1472	1453	1445
Pol % bagasse	1.70	1.73	1.70	1.64	1.67	1.67
Moisture % bagasse	49.00	48.78	48.80	48.22	48.70	48.77
Imbibition % fibre	281.77	278.81	292.67	268.29	259.37	260.85
Fibre % cane	15.21	15.91	15.33	13.03	15.18	15.73
Reduced mill extraction	96.42	96.40	96.54	96.38	93.38	96.49
Undiluted juice loss in bagasse % fibre	29.45	30.28	29.39	28.60	28.86	28.91
Pol % cane	11.85	11.83	12.20	11.40	11.46	11.74
Recovery % cane	10.33	10.31	10.65	10.03	10.01	10.24
Pol loss in bagasse % cane	0.53	0.56	0.53	0.43	0.52	0.54
Total losses	1.54	1.54	1.57	1.39	1.47	1.52

be reduced to a fraction of its present dimensions; it should be possible to introduce a small diameter rotating roller (idler) to serve in place of a trash plate. The considerable horsepower presently being wasted in moving the cane blanket over the stationary trash plate at the high pressures involved — about 20% of the power — can be almost totally avoided. Also, the wear and tear on trash plates and complications due to wrong setting can be minimized.

As the transmission of power to the discharge roller is no longer required, it will not be necessary to drive the mill through the top roller; the drive can be given to the feed roller. This makes for great convenience by eliminating the need for the cumbersome system of muff couplings and long tail bars.

The drive to a fixed feed roller could be of a precision type. The gear system on the prime mover side could be brought down to a lower level and moved closer to the mills. This would save a lot of foundations and provide better stability to the whole system.

The application of hydraulic load loses its impact, though it should be retained with advantage. The initial mill setting is not critical for efficient milling; hence, with one setting, milling rates and efficiencies can be varied over a wider range. The slower speed of the discharge roller relative to the speed of the top and feed rollers could result in a better combination of advantages of both high speed milling (capacity) and low

speed milling (better drainage at the discharge roller).

#### *Conclusion*

Milling with free-rotating discharge rollers has already proved its practicability and utility. It has great potential for improved designs in mill construction as well as in mill operation.

#### *Summary*

M. Anand conceived the idea in 1982 of operating the conventional 3-roller mill without the pinion on the discharge roller, which would rotate only in response to frictional forces. This has now been adopted as a regular milling technique in at least ten factories in South India. Without the pinion on the discharge roller, the mill develops self-setting characteristics, with immediate results in better and more uniform mill performance. The new technique opens up immense possibilities of improved mill design such as larger discharge rollers and narrower trash plates. Results of trials on the four mills of the tandem at Ponni Sugars, India, are tabulated and discussed. Results from Thanjavur factory are also included.

#### *Acknowledgement*

Thanks are due to the managements and technical personnel of the various factories which have tested and adopted the new technique; in particular, the management of Ponni Sugars.

<sup>4</sup> *ibid.*, 1985.



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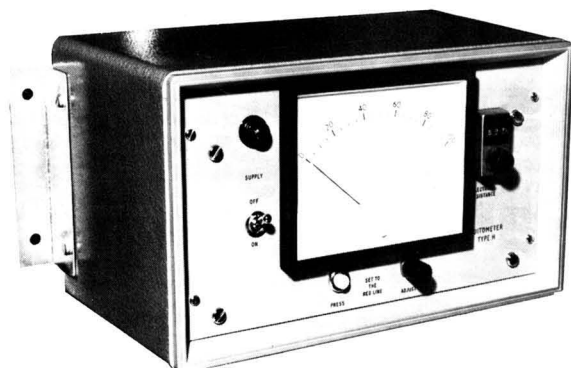
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## Clarification of beet juice by a modified double sulphitation process

By V. K. Jain  
(National Sugar Institute, Kanpur, India)

### Introduction

In India sugar beet is a new crop which matures in the months of April and May. Owing to its short season, a factory processing only sugar beet is not likely to be economically viable and the beets are therefore processed in cane sugar factories after the cane season has finished in March. In India, at present, there is only one sugar factory (Ganganagar Sugar Mills, Sri Ganganagar, Rajasthan) which processes sugar beet on a commercial scale and has done since 1971.

The processes used for cane white sugar – the double sulphitation process and the double carbonation/double sulphitation process – are fundamentally different from that used in beet sugar manufacture where double carbonation is general practice all over the world. When the conventional double sulphitation process is applied to beet juice the mud does not settle.

In India only about 9% of cane sugar factories use double carbonation; the rest employ double sulphitation for making white sugar. There is consequently a problem for most cane sugar factories if they are to process sugar beets after the cane season in that it is necessary to install additional equipment for the carbonation process and this is quite expensive. To avoid this difficulty experiments have been conducted on a laboratory scale on adapting the double sulphitation process to clarifying beet juice.

Vukov<sup>1</sup> conducted experiments on the introduction of sulphitation in beet juice purification and gave practical advice in this respect. According to German patent<sup>2</sup>, beet juice was clarified by sulphiting the raw juice from a diffusion battery, at a temperature of 60°–80°C, until a voluminous flocculent precipitate was formed, after which it was limed to an alkalinity of 0.04–0.08% and sent to the juice heaters.

Experiments on clarifying beet juice by sulphitation were carried out during the 1960/61 sugar season at the Experimental Sugar Factory attached to the National Sugar Institute, Kanpur<sup>3</sup>. Clarification was poor and foaming was



V. K. Jain

excessive and sometime uncontrollable. It was concluded that sulphitation in the usual manner was not suitable for beet juice.

Some laboratory trials were conducted in Denmark on clarifying beet juice by a sulphitation process similar to that used in cane sugar factories<sup>4</sup>. The juice was heated to 60°C and prelimed progressively over 20 minutes to an alkalinity of 0.20% CaO (pH 11.0). The prelimed juice was heated to 85°C, sulphited to pH 7.0 and the resulting juice heated to 100°C and the sludge separated by sedimentation. Brüniche-Olsen observed that during experiments on sulphitation of beet juice by a continuous process there was no foaming.

Our investigation have been to develop a method for obtaining satisfactory clarification of beet juice using sulphitation and to determine the effects on purity and contents of calcium, phosphate, interfering nitrogen, pectin and reducing sugars, as well as colour.

### Experimental

Initially during the present investigation, beet juice was clarified by a sulphitation process without phosphate addition, following the procedure suggested by Brüniche-Olsen. The juice was heated to 60°C and progressively prelimed to pH 11.0 over 20 minutes. It was then heated to 85°C and sulphited to pH 7.0. The resulting juice was then heated to 100°C and settled. During these experiments milk of lime at 15°Bé was used at 3.0% by volume of juice. The sulphited juice obtained was not clear at all and no settling of mud occurred even after 15 minutes. Similar experiments were then made with addition to the raw juice of 50 mg/litre of P<sub>2</sub>O<sub>5</sub> in the form

of a slurry in water of triple superphosphate (10.147%). Settling was not as fast as desired and the juice clarity was negligible.

Beet juice samples were treated with mercuric chloride as preservative and to separate aliquots of 12 litres each was added superphosphate slurry to raise the natural P<sub>2</sub>O<sub>5</sub> content by 100, 150, and 200 mg/litre, respectively (Samples I, II and III). As before, the juice was prelimed to pH 11.0 over 20 minutes but then sulphited to pH 8.0 followed by simultaneous liming and sulphitation to pH 7.0. The juice was then heated to 100°C and settled in volumetric cylinders. The mud volume for the three samples was noted after 15 minutes. The clear supernatant juice was separated and analysed for Brix, pol, purity, etc.

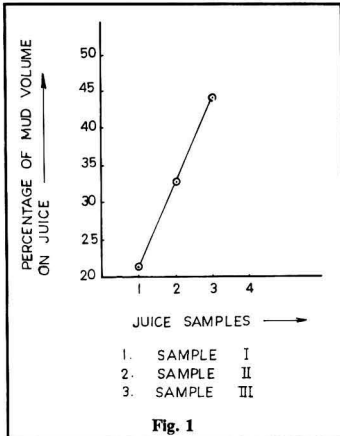
In order to provide a comparison, the juice was also clarified using the conventional carbonation process and employing 10% on juice volume of 18°Bé milk of lime. The juice was first progressively prelimed to pH 11.0, heated to 85°C and gassed with CO<sub>2</sub> from the lime kiln to pH 9.5. The remaining milk of lime was added in four doses, with subsequent gassing to pH 9.5 after the first three doses. After the fourth dose, the juice, of pH 11.0, was filtered and again heated to 85°C, gassed to pH 8.5, again filtered and the juice sulphited to pH 7.0. The clear juice so obtained was also analysed, the average of two repetitions being used for comparative purposes.

### Results and discussion

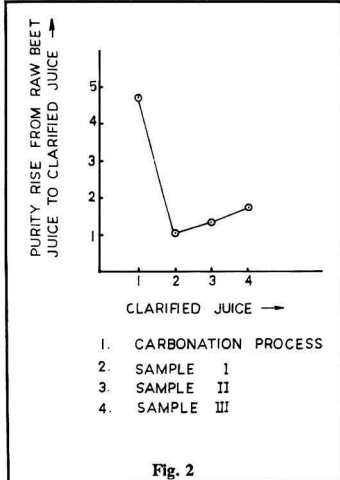
The mud volumes of the sulphited juices are recorded in Figure 1; they were 21.17, 32.67 and 44.17%, respectively. The corresponding volumes obtained in the experiments of Brüniche-Olsen were 30–40%, appreciably higher than the lowest of the three volumes obtained here.

The rise in apparent purity from raw juice to clarified juice is illustrated in Figure 2. The rises for samples I, II

- 1 S.J.A., 1973, Abs. 73-705.
- 2 Reinzucker Ges. für Patentverwertung: German Patent 358,687; I.S.J., 1923, 25, 221.
- 3 Verma: *Min.* (38), 12/N File No. 23 (1-14)/67 - beet (N.S.I., Kanpur).
- 4 Brüniche-Olsen: *Private communication to N.S.I.*, 1968.

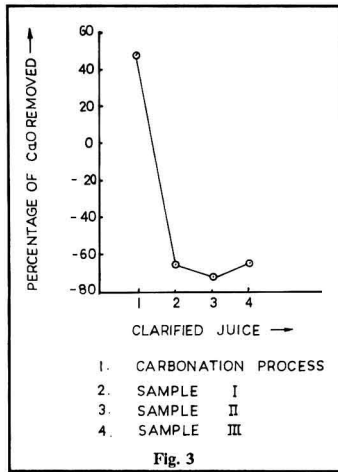


and III were 1.05, 1.20 and 1.73 units, as against 4.69 units achieved by carbonation. The purity rise achieved by Brünche-Olsen was negligible at only 0.2 units. The greater effect of the carbonation arises from the higher amount of lime used (10% by volume of milk-of-lime against 3% for sulphitation). Because of the cost of this additional lime the sulphitation process is preferred, even in cane sugar factories.

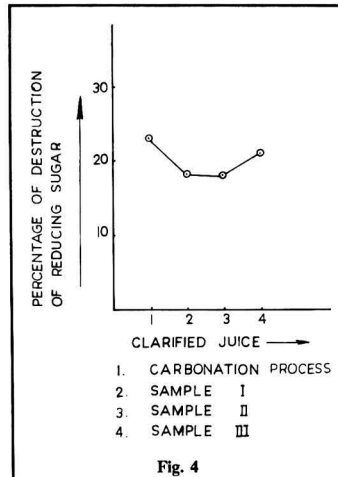


The calcium content of the original juice, measured by titration with EDTA using Eriochrome Black T as indicator, was 4.602 g/litre as CaO. Comparable analyses of the clarified juices showed

that 47.18% of this was removed during carbonation whereas the calcium contents of the sulphited juices were higher by 66.75, 74.34 and 65.30%, respectively, for Samples I, II and III (Figure 3). A similar phenomenon is observed in the case of cane juice clarification by carbonation and sulphitation.

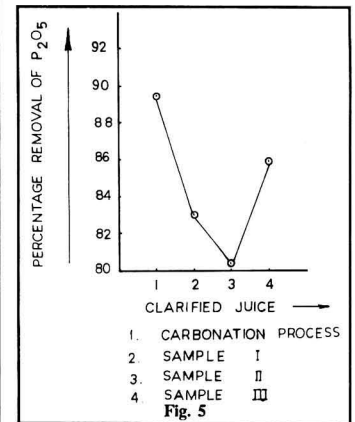


Reducing sugars, determined by Fehling's solution titration, was 3.45% on Brix in the raw beet juice and was reduced by 23.19% in carbonation. Destruction by sulphitation was lower, at 18.26, 17.97 and 20.87%,



respectively, for samples I, II and III (Figure 4). This smaller loss of reducing sugars is considered an advantage for sulphitation over carbonation.

Carbonation was found to remove 89.4% of the original phosphate content of the raw beet juice (1.156 g/litre/100°Brix, determined by uranium acetate titration using potassium ferrocyanide as indicator). Removal by sulphitation was 82.95, 80.29 and 85.85% for Samples I, II and III, respectively, as shown in Figure 5. Thus the two clarification processes were not significantly different in this respect.



Pectin in juice was measured by the alcohol precipitation method of Schneider & Bock<sup>5</sup> and removal by carbonation was found to reach 94.67%, against 81.33, 77.33 and 74.67% for sulphitation of Samples I, II and III. These effects are illustrated in Figure 6.

Interfering nitrogen, measured in terms of the blue colour given with copper acetate<sup>6</sup>, was removed to a much greater extent by sulphitation (35.83, 37.18 and 38.11% for Samples I, II and III, against 13.40% by carbonation), as illustrated in Figure 7.

Colour, as measured with Klett-Summerson photoelectric colorimeter, was reduced by 91.37% in carbonation, whereas sulphitation of juice samples

5 In Browne & Zerban: "Sugar Analysis", 3rd Edn. (Wiley, New York), 1955, 1182-1183.

6 Knowles: "Practical course in agricultural chemistry" (Macmillan, London), 1947, 103.

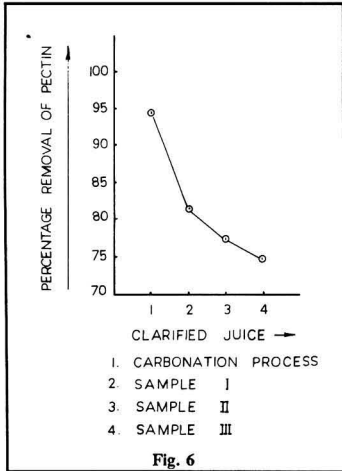


Fig. 6

I, II and III removed 84.58, 86.41 and 86.32%, respectively (Figure 8).

**Conclusions**

The results of our experiments show that clarification of beet juice by sulphitation is possible provided phosphate addition and preliming are carried out. The addition of phosphate equivalent to 100 mg P<sub>2</sub>O<sub>5</sub> per litre (in

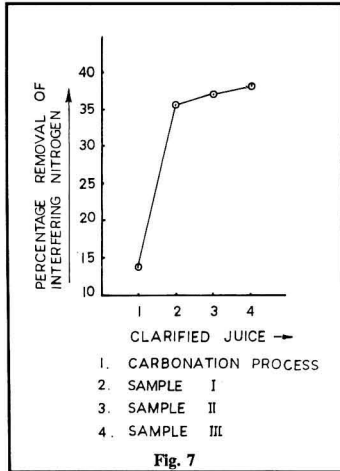


Fig. 7

our experiments bringing the original content of 216 mg to 316 mg/litre) gives the lowest mud volume of the three addition levels examined, indicating fully compacted muds having a high rate of settling. There is no need to increase the addition above this level as the quality of the clear juice is more or less the same with higher additions while the mud volume is unnecessarily increased

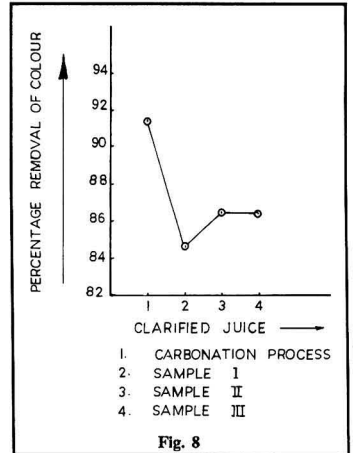


Fig. 8

and costs are higher.

**Acknowledgements**

Sincere thanks are due to Ganganagar Sugar Mills Ltd. for providing facilities in their factory for conducting the experiments. I am grateful also to Professor Ram Kumar, Director of the National Sugar Institute, Kanpur, for permission to publish this paper.

## CITS 18th General Assembly, 1987

In addition to those summarized earlier in our pages<sup>1</sup>, the following papers were presented at the 1987 meeting of the Commission Internationale Technique de Sucrerie in Ferrara.

**History of the sanitary state of R.T. diffusers** (J. Degeest and J. Debroux)

Calculation of profitability, such as the real benefit that can be realised by the introduction of a heat exchanger for cossettes and juice, or the choice of the means of acidification in the diffuser, require a very precise qualitative and quantitative knowledge of the degradation products of sucrose during its extraction.

To gain this, the thermochemical, enzymatic and microbiological degradation of sucrose have been studied. The thermochemical degradation of sucrose into reducing sugars will not exceed 40 mg % Brix under normal conditions of diffusion, and glucose and fructose increase at the same rate (the G/F ratio = 1). The lactic and acetic acid contents remain the same. The activity of invertase, present in the sugar beet and responsible for the enzymatic degradation, is highest at temperatures between 50° and 60°C, while it becomes inactive at temperatures higher than 70°C. The enzyme hydrolyses sucrose into glucose and fructose according to a G/F ratio of

1.3 - 1.4. Biocides are poor inhibitors of invertase activity; on the other hand, hypochlorite and SO<sub>2</sub> are very efficient. Microbiological degradation of sucrose can, as a function of the temperature, proceed in two stages. Invertase of microbial origin first of all decomposes the sucrose into glucose and fructose and the micro-organisms then consume part of these sugars for their metabolism. According to our studies, the bacteria in the first place transform the glucose mainly into acetic acid. Microbial activity is accompanied by a reduction of nitrates to nitrites.

1 I.S.J., 1987, 89, 104 - 111.

### **Hyperpressing of pulps and cossettes** (F. Pouillade, J. Vetter, R. Plever and -. Delalandre)

Current pressing technology produces pressed pulp with a dry substance content limited to 30% or so. Study on a laboratory scale of pulp behaviour under pressure has led to the application of new principles: separation of the mass in multiple thin layers by a cloth medium which permits drainage of the expressed liquid; and operation with much higher pressure than that used up to now by means of elastomeric membranes transmitting hydraulic pressure. Using a prototype of industrial dimensions in service at Nassandres during the last campaign, the process permitted obtaining pulps with dry matter contents higher than 50%. Further, relative to screw presses, there is an important saving in mechanical power. Obtaining of results of this level with the pulp has raised again the question of the interest in extraction by pressing compared with the current diffusion process. A series of pilot trials was carried out in this regard in 1985 and 1986. The pre-scalded coss-

ettes were treated once by hyperpressing. The pulp obtained, mixed with a small quantity of pure water, was submitted to a second pressing. For a slightly smaller total volume of juice produced than that obtained by the conventional process, the extraction yield is of the same order. After liming and carbonatation the thin juice produced is of a quality comparable with that of juice obtained by diffusion.

### **Kinetics of drying with hot air of hyperpressed beet pulp** (A. Lebert, M. Salgado, B. Guerin and R. Plever)

A large number of experiments have been made using thin and thick beds of pulp in order to provide a data base currently being used to construct a mathematical model of a pulp dryer for use in dehydration of hyperpressed pulp. This method has already been put into practice successfully for the calculation of maize dryers and it is hoped that it will be successful with a relatively deformable product such as beet pulp.

### **Corrected sugar content of beets that were harvested**

### **after topping** (H. Zaorska, K. Szwajcowska and K. Lisik)

Beets were topped and left in the soil for 4, 7, 11 and 13 days before harvesting, when their composition was compared. Climatic conditions during the growing period were favourable and there was no rain at the time of the harvest. After 13 days in the soil the topped beets showed losses of 2% in the sugar and dry matter contents on beet, the  $\alpha$ -amino acid nitrogen content had risen by 40% and the cell juice and raw juice purity had fallen by up to more than 1%. The purification effect during extraction was reduced by more than 2%, the corrected sugar content was about 2% lower, and the alkalinity coefficient (Wieninger & Kubadinow) fell by more than 20%. Storage of the beet roots during two months caused a drop in the technological value, especially in the case of beets prematurely topped and left for some days in the soil. Leaving topped beets in the soil, even in dry weather, causes a distinct reduction in their technical value.

## **ICUMSA News**

It is now just over one year since the 19th Session in Cannes. In that time many changes have been made which affect the future directions of ICUMSA. At the time of my election to the Presidency there was also a clear call for some reforms which would make our Commission more effective as it approaches the 21st Century. One of the first actions of the new administration was the formation of a Special Committee, chaired by the President and assisted by Professor Mantovani and Mr. Faviell. This Committee produced proposals which were debated and modified by interested National Committees and finally voted upon and approved by the Executive Committee.

### *Reorganization of Subjects*

In order that the Commission gives the highest priority to matters affecting analytical methods used by industry and commerce, it has been decided to have nine General Refereeships devoted specifically to those areas in which ICUMSA methods are most used. The General Referees appointed to these subjects will be responsible for keeping in touch with user laboratories and the requirements of the trade, as well as technical advances which might lead to new methods. Their referee's reports will bring forward issues which call for resolution with respect to all analytical methods used in the analysis of the product designated by their subject. One

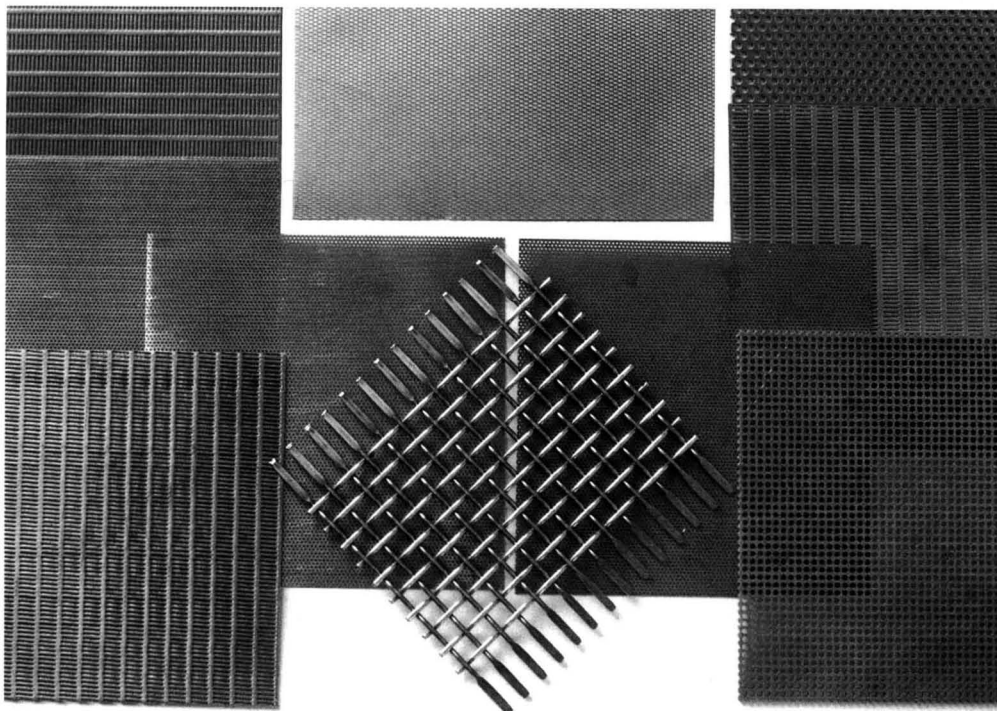
of the consequences of this new organization is that analytical methods for a particular constituent can vary from product to product but it is incumbent upon referees to aim for uniformity wherever possible. One could say that the new system will be "end-user" driven. As an organization we cannot foist something on an unwilling customer. His interests should be the vital concern of the General Referee looking after the particular subject of interest.

Supporting the General Referee will be twenty-one Refereeships of the type we have become accustomed to. These refereeships deal with: (a) fundamental properties like density, refractive index,





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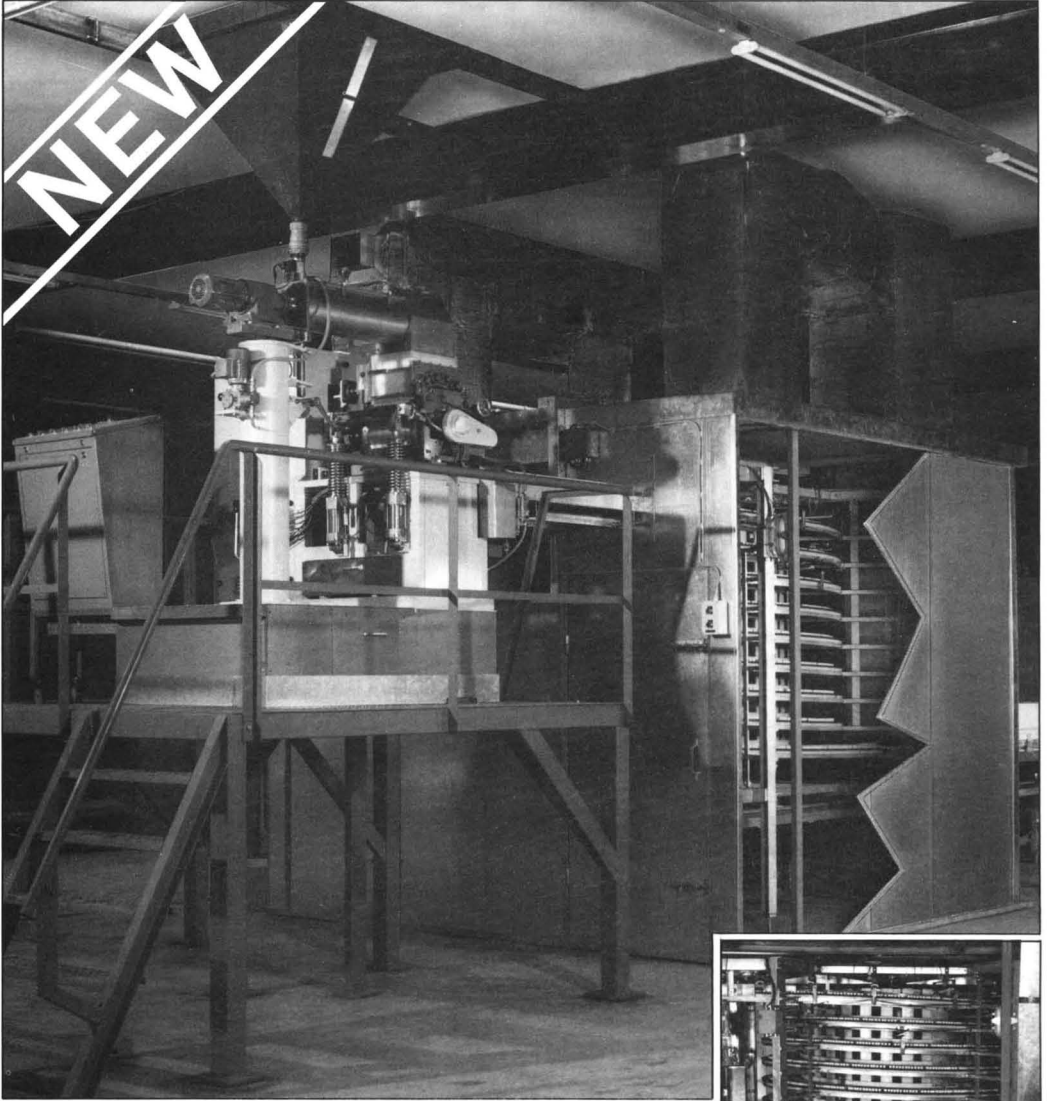
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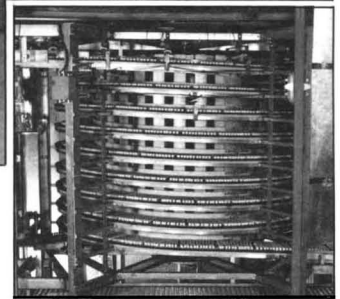


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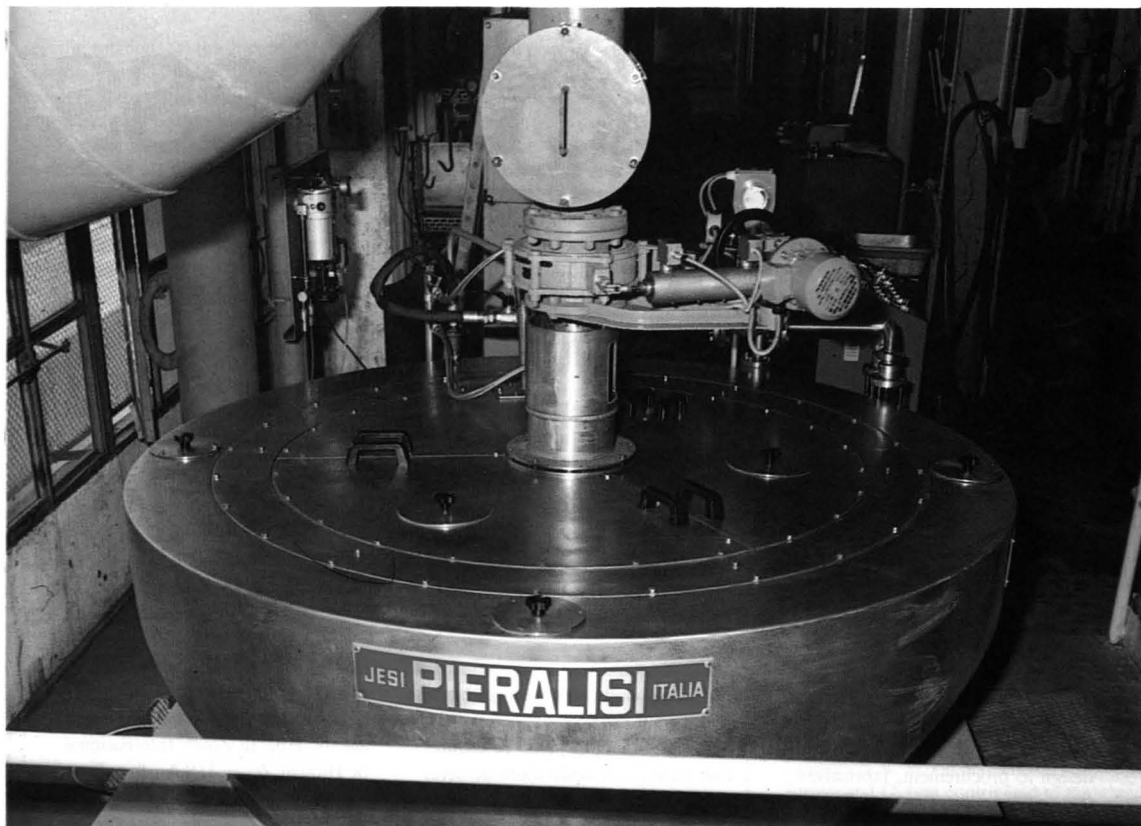
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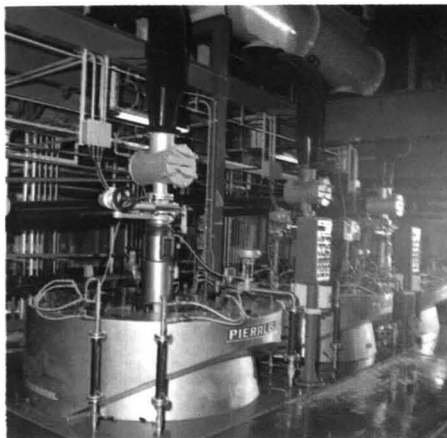
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specific rotation, (b) the constituents commonly analysed like sucrose, reducing sugars, ash, dry substance, (c) important analytical techniques like polarimetry, spectrophotometry, HPLC methods, and (d) some miscellaneous subjects needed for the good order of the Commission like constitution and by-laws, method format, collaborative testing, apparatus and reagents. It is expected that much of the work of these refereeships will come from the recommendations produced by the General Referees's subjects. For example, if a need for a new non-toxic clarifying agent for the polarization of sugar products emerges because of

environmental concerns, this will be identified by the General Referees of the various products affected. The work which needs to be done will be directed to those subjects best qualified to tackle the task. There are of course many other examples of how work will be initiated but it is the hope that the new arrangements will allow priorities to be debated so that scarce resources are better used.

#### Referee Appointments

The new refereeships and the Referees appointed to them are set out in Table I. Where there are gaps, the refereeship is still being discussed with the nominee and an announcement will

be made later. The new Referees and National Committees are now seeking the assistance of people to serve as Associate Referees. If any readers would like to contribute to the work of the Commission they should contact their National Committee or the Referee of the subject of interest.

#### Re-allocating 19th Session Recommendations

The work of the Commission till 1990 is set out in the Recommendations approved at Cannes. The next task to be undertaken is the re-allocation of these Recommendations among the new Referees. The President proposes to appoint a Steering Committee to oversee this reallocation as well as the setting of priorities because it is not expected that all the work involved could be completed by the next Session. Members of this Steering Committee will be announced later.

#### Working Group on Collaborative Studies

A working group headed by Dr. Margaret Clarke and assisted by Drs. H. Schiweck, R. Madsen, J. de Geest, A. Emmerich, R. Wood and Messrs A. Brown and C. Ivin contributed to the proposals put to the recent IUPAC workshop on harmonization of collaborative studies (see Appendix). ICUMSA accepts that, for the future, it must keep in step with standards required by fraternal organizations if mutual acceptance of each other's methods is to be expected. It is expected that comprehensive proposals for collaborative testing will be put to the 20th Session based on the findings of the working group. With the appointment of Mrs. Mary An Godshall as Referee for the new Subject 3, the work on collaborative testing will now be undertaken there, but in close consultation with Dr. Clarke.

#### New Methods Book

Plans to produce a new methods book are underway. One of the early tasks will be agreeing on a format for methods and whether methods should be put out in a bound volume or alternatively, in loose leaf form in a binder.

Table I. List of Refereeships

#### General Refereeships

1. Raw sugar (cane & beet)	R. J. McCowage	(Australia)
2. White sugar (cane & beet)	C. W. Harvey	(Britain)
3. Refined sugar products other than white sugars	R. Plews	(Britain)
4. Molasses (cane & beet)	D. S. Martin	(Britain)
5. Cane	A. Brokensha	(South Africa)
6. Beet	W. Mauch	(Germany)
7. Cane sugar processing	M. A. Clarke	(USA)
8. Beet sugar processing	J. P. Lescure	(France)
9. Starch derived sweeteners		

#### Refereeships

1. Constitution and by-laws	M. R. Player	(Australia)
2. Apparatus and reagents	S. A. Brooks	(West Indies)
3. Method format, collaborative testing and statistical treatment of data	M. A. Godshall	(USA)
4. Polarimetry	A. Emmerich	(Germany)
5. Quartz plates	K. Zander	(Germany)
6. Spectrophotometry	G. Mantovani	(Italy)
7. Colour, turbidity and reflectance measurement	S. Akoglu	(Turkey)
8. GLC method	N. Kubadinow	(Austria)
9. HPLC method	K. J. Schäffler	(South Africa)
10. Enzymatic and immunological methods		
11. Density	H. Wagenbreth	(Germany)
12. Rheology	R. Broadfoot	(Australia)
13. Refractive Index	K. Rosenbruch	(Germany)
14. Microbiology	R. Strauss	(Germany)
15. Reducing sugars	J. Laursen	(Denmark)
16. Ash	J. P. Ducatillon	(France)
17. Dry substance	G. Vaccari	(Italy)
18. Sucoase		
19. Oligosaccharides and polysaccharides	K. Thielecke	(Germany)
20. Ion selective electrodes and ion chromatography	P. Bourlet	(France)
21. Special Projects		



*Publications Committee*

The major task of producing the *Proceedings* of the 19th Session is complete and *Proceedings* will shortly be available from the Publications Department at a cost of £36 by air mail or £28 by surface mail.

The publication of ICUMSA News will initially take place three times a year in six sugar journals: *International Sugar Journal*, *Sugar y Azúcar*, *Zuckerindustrie*, *Sugar Journal*, *Industria Saccarifera Italiana* and *Listy Cukrovarnické*. Dr. Robert Pieck is editor, though responsibility for the material published is taken by the officers of ICUMSA.

Contributions by way of letters to the editor, comments on issues and personal notes are invited from the readership. In future, Referees will discuss important issues in their subject areas.

The Publications Committee is also undertaking the production of a history of ICUMSA before our centenary. Mr. Ron Plews has accepted the position of General Editor of this history. People interested in making a contribution should get in touch with Mr. Plews.

*Higher Levies*

In the recent ballot approving changes to the subjects of ICUMSA, it

was also agreed that the four-yearly levy should be increased by 50% so that the Commission could be more self-reliant with respect to its publications. In the past ICUMSA has relied heavily on the generosity of British Sugar plc in the publication of the *Proceedings* and the periodic publication of a book of methods. With the higher dues it is expected that the Commission will meet the true cost of producing its publications without needing to have individual sugar companies underwriting the costs before sales revenue comes to hand.

*Murray Player*  
President

*Appendix*

*ICUMSA Working Group on Collaborative Studies*

On May 4-5, 1987, the IUPAC Workshop on the Harmonization of Collaborative Analytical Studies met at the ISO Central Secretariat in Geneva. The ICUMSA Working Group was represented by R. F. Madsen (DDS), G. P. Steinle (Süddeutsche Zucker-AG) and R. W. Wood (M.A.F.F.).

Agreement was reached on the minimum requirements for a collaborative study, defined as an interlaboratory study in which each laboratory uses the defined method of analysis to analyse identical portions of homogenous materials to assess the performance characteristics obtained using that method of analysis.

Symbols and terms were defined; the minimum number of participating laboratories was set at 8, and the minimum number of materials at 5, with provision for smaller numbers under severely extenuating circumstances.

The identification of replicate samples was discouraged, and the use of split level design for sample selection, with blind duplicates (not announced in the study procedure) was encouraged.

Recommendations on statistical procedure included limits on the number of significant figures; the use of ANOVA as a compulsory analysis; and the following procedure (the subject of

extensive discussions) for calculation of precision estimates:

"The precision estimates are to be calculated (a) with no outliers removed and (b) with outliers removed by the following protocol:

9.1. Calculate the mean, repeatability relative standard deviation, and reproducibility relative standard deviation with no outlying laboratories removed, but utilizing only valid data.

9.2. Remove any laboratories that are flagged as outliers by the Cochran 1-tail test at  $P = 0.01$ .

9.3. Remove any laboratories that are flagged by the Grubbs and/or the double Grubbs (2 outliers at the same end or one at each end) 2-tail test at  $P = 0.01$ .

9.4. Stop outlier removal if more than 22% (2 of 9 laboratories) are removed. (The number of laboratories that would be removed if the procedure was continued may also be reported).

9.5. Recalculate the parameters as in 9.1 with the laboratories flagged by the preceding procedure removed.

9.6. The Grubbs tests should be applied only to laboratory means, not to individual values of replicated designs, since these values are not independent."

Form and content of a final report were outlined. Organizations may superimpose any additional requirements on the recommendations for their

specific needs.

The IUPAC report was circulated to the Working Group. During the CITS Congress in Ferrara, June 8 - 12, many members of the Working Group were present and met to discuss and approve these recommendations. These, along with specific recommendations from individual group members, will be included in the final report of the Working Group, which will be submitted in August 1987.

Copies of the IUPAC Harmonization Report are available from M. A. Clarke.

\* \* \*

**Australian sugar factory closure<sup>1</sup>**

On March 18, the Queensland State government rushed through legislation to force the immediate closure of Goondi Mill at Innisfail and the re-zoning of the mill's suppliers to Babinda and Mourilyan sugar factories, in accordance with the recommendations of the Sugar Milling Adjustment Committee. The action effectively torpedoed a Central Sugar Cane Prices Board hearing into the proposed closure of Goondi which had been convened to give all interested parties an opportunity to expose their opposition or support to the planned rationalization of the sugar industry in the Innisfail and Babinda districts. A \$A 12.8 million aid package provided by the Queensland and Federal governments will now be available to the Babinda Cooperative and Howard Smith Industries (owners of Mourilyan factory) to purchase Goondi from CSR Limited and to upgrade their production and transport facilities in order to handle the increased throughput.

<sup>1</sup> *Australian Canegrower*, 1987, 9, (4), 9.

# Facts and figures

## Canada sugar imports, 1986<sup>1</sup>

	1986	1985
<i>tonnes, raw value</i>		
Australia	572,938	475,804
Belize	0	25,138
Brazil	0	43,173
Colombia	396	14,130
Cuba	215,728	140,445
EEC	4,670	2,648
Fiji	0	18,990
Guyana	21,116	9,354
Korea, South	527	1,594
Mauritius	31,399	0
South Africa	141,956	186,941
Swaziland	142,437	110,981
USA	121,079	89,433
Zimbabwe	25,312	39,013
Other countries	560	302
<b>Total</b>	<b>1,278,118</b>	<b>1,157,956</b>

## Argentina sugar production, 1986<sup>2</sup>

The 1986 crop in Argentina closed with the lowest output for fifteen years, according to official statistics. From 13.8 million tonnes of cane only 947,000 tonnes of white sugar and 91,000 tonnes of raws were produced. The total of 1,038,000 tonnes, *tel quel*, compares with 1,088,000 tonnes the year before and 1,447,000 tonnes in 1984.

## Finland sugar monopoly to be broken<sup>3</sup>

The Finnish Trade and Industry Ministry is preparing new legislation to allow the free import of sugar, thus breaking the Finnsugar traditional monopoly of the market. The new law proposes that companies other than the state-owned company may import sugar, but the amount will be limited and Finnsugar will still import the bulk of industrial requirements. Domestic beet sugar provides 60% of consumption while prices, at around £1.20 per kilogram, are among the highest in the world.

## Indonesia sugar production, 1986<sup>4</sup>

Sugar production in the 1986 season in Indonesia reached 2,020,000 tonnes or 17% more than in the previous season, providing self-sufficiency. The increase arose from a 14.7% increase in the cane area to 316,000 hectares and, with a further increase to 325,900 ha this year, a further 5.45% increase in production is foreseen.

## Malaysia cane crop expansion<sup>5</sup>

After achieving an all-time record cane output of 850,000 tonnes in 1986, the industry appears poised to attain even higher levels in 1987 and 1988, according to the US Agricultural Attache in Kuala Lumpur. Improvements in yield and a gradual expansion in smallholder-planted areas are major factors influencing the upturn. Nevertheless, output is just a fraction of that of neighbouring Thailand and Malaysia is still only 15% self-sufficient in its sugar requirements. Being a high-cost producer and still suffering from

the collapse of two sugar plantation projects, Malaysia accepts the fact that it is more advantageous to import rather than to produce.

## Philippines sugar exports, 1986<sup>6</sup>

	1986	1985
<i>tonnes, raw value</i>		
China	0	94,841
Hong Kong	0	4,591
India	0	77,097
Japan	0	82,031
Korea, South	4,815	90,147
New Zealand	0	18,391
Sri Lanka	0	23,968
USA	225,307	203,779
<b>Total</b>	<b>230,122</b>	<b>594,845</b>

## ARTAS sugar congress postponement

The sugar congress which was to have been held in Réunion during October 19 - 24, 1987, has been postponed until a later date in 1988 owing to late submission of papers and difficulties resulting from the current restructuring of the sugar industry on the island. The congress will probably take place in October 1988 but an exact date will be announced later.

## Pakistan sugar convention

The 23rd Annual Convention of the Pakistan Society of Sugar Technologists was held in Lahore during July 25 - 27, 1987. It was attended by a record number of 700 delegates including visitors from the UK, USA, France, West Germany and Japan. A total of 44 papers were presented in the fields of agriculture, technology, engineering and by-products. Mr. H. A. Naqvi, General Manager of Kamalia Sugar Mills Ltd., was elected President for a term of two years, as was the General Secretary and Treasurer, Mr. Fazalur Rehman, General Manager of Crescent Sugar Mills, Faisalabad.

## Brazil sugar and alcohol production, 1986/87<sup>7</sup>

Brazilian sugar production in the 1986/87 season to April amounted to 7,983,000 tonnes, *tel quel*, of which 6,657,000 tonnes was white sugar and 1,326,000 tonnes raw sugar. Expressed in raw value terms, total production was 4,866,000 tonnes, up almost 200,000 tonnes from the year before. Domestic consumption amounted to 7,137,000 tonnes, white value, 1,121,000 tonnes or 18% up on the year before. Alcohol production in the 1986/87 crop year totalled 10,320 million litres, substantially down from the 11,810 million litres produced in 1985/86.

## Pakistan beet sugar production, 1987

Sugar production in Pakistan in the 1987 campaign reached 30,114 tonnes, white value, the highest level for eight years. The increase resulted from a 175% rise in the beet area, from 4302 ha in 1986 to 11,826 hectares, following an increase of 40% in the beet price set by the government. The beet sliced amounted to 319,300 tonnes this year,

as compared with 135,060 tonnes in 1986. The campaign, averaging 44½ days from mid-May to end-June, was longer than the 31½ days averaged in 1986. All four factories worked and sliced an average of 7900 tonnes/day against their rated total capacity of 7350 tonnes. Last year sugar production stood at 13,969 tonnes, white value. The beet sugar content was lower in 1987 at 9.43% against 10.33% in 1986 and sugar yield per hectare was lower at 2.55 tonnes against 3.25 tonnes in 1986.

## Barbados sugar exports, 1986<sup>8</sup>

In spite of a fall in exports to the US from 17,635 tonnes in 1985 to 12,089 tonnes in 1986, overall exports rose from 77,840 tonnes to 88,354 tonnes in 1986. Exports to Canada were also lower at 3512 tonnes against 6376 tonnes, and to the EEC from 53,750 to 51,632 tonnes. However, the USSR took 21,121 tonnes of sugar in 1986 against none in 1985. There were no sales to Central American destinations against 79 tonnes in 1985.

## New continuous pan in Australia<sup>9</sup>

Farleigh Mill at Mackay, Queensland, is spending \$A 1.25 million on a newly designed continuous vacuum pan which is expected to be in operation in the 1987 season. Its design represents months of research work by the Sugar Research Institute.

## Swaziland sugar exports, 1986<sup>10</sup>

	1986	1985
<i>tonnes, raw value</i>		
Canada	177,909	73,857
EEC	155,353	152,713
Morocco	15,875	0
Mozambique	2,479	17,442
Portugal	0*	109,468
Sri Lanka	10,964	0
USA	16,825	26,394
USSR	60,741	0
Other countries and unknown	57,660	0
<b>Total</b>	<b>497,804</b>	<b>379,874</b>

## Rwanda sugar project<sup>11</sup>

The African Development Bank will finance a feasibility study for the sugar project of Akagera, including a sugar factory with an 11,000 tonnes capacity. The sugar cane will be grown on more than 1000 irrigated hectares. Total cost of the operation is estimated at 280 million French francs (\$46 million).

- 1 *I.S.O. Stat. Bull.*, 1987, 46, (4), 9.
- 2 *Czarnikow Sugar Review*, 1987, (1761), 77.
- 3 *Public Ledger's Commodity Week*, May 16, 1987.
- 4 *Zuckerindustrie*, 1987, 112, 451.
- 5 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 228.
- 6 *I.S.O. Stat. Bull.*, 1987, 46, (4), 38.
- 7 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 259, 275.
- 8 *I.S.O. Stat. Bull.*, 1987, 46, (4), 5.
- 9 *Australian Cane Grower*, 1987, 9, (4), 4.
- 10 *I.S.O. Stat. Bull.*, 1987, 46, (4), 43.
- 11 *Amerop-Westway Newsletter*, 1987, (164), 18.

**Japan sugar imports, 1986<sup>12</sup>**

	1986	1985
	<i>tonnes, raw value</i>	
Australia	485,366	561,265
Colombia	35	24,613
Cuba	595,803	467,097
Fiji	0	30,103
Korea, North	1,232	0
Philippines	0	119,504
South Africa	342,688	393,144
Taiwan	49,183	74,233
Thailand	348,820	316,367
Other countries	23	78
<b>Total</b>	<b>1,823,150</b>	<b>1,986,404</b>

**Morocco sugar statistics, 1986<sup>13</sup>**

Moroccan sugar consumption in 1986 totalled 664,731 tonnes, white value, up 2.34% from the year before. Domestic sugar production, which rose by 12.7% against 1985, accounted for 60% of requirements, compared with 54% in 1985. The beet crop in 1986 amounted to 2,625,000 tonnes, up 16.9% from that of 1985 (2,244,600 tonnes). Sugar imports in 1986 totalled some 301,000 tonnes, raw value, compared with 238,000 tonnes imported in 1985.

**New continuous fermentation technology for Brazil<sup>14</sup>**

A new, continuous fermentation technology, developed jointly by Uhde GmbH and Hoechst AG, will have its first industrial-scale application at a distillery in São Paulo state. The process uses a special yeast strain for fermenting sugar juices to a must with an alcohol content of 7.5 - 8.5% which is then raised to 96 - 99.3% in a downstream distillation unit.

**New sugar factory for Nepal<sup>15</sup>**

China will help Nepal to achieve self-sufficiency in sugar by setting up a factory at Sunawal in Nawalparasi district, about 226 km south-west of Kathmandu. Laying the foundation stone of the plant recently, the Nepalese Minister of State for Industries and Finance said that the factory will produce 10,000 tonnes of sugar annually. Sugar production in Nepal rose from 15,000 tonnes, raw value, in 1984/85 to 19,000 tonnes in 1985/86, and is estimated to reach 30,000 tonnes in 1986/87.

**Philippines alcohol program<sup>16</sup>**

The Philippines Cabinet was expected to decide in June whether to implement a nationwide fuel alcohol program by July that would boost production to 150 million litres/year, 70 - 78 million litres more than current output, mainly exported for industrial and beverage use. Alcohol produced under the program would be blended into gasoline at a rate of 10% alcohol for the first 3 - 5 years, then increased to 20%. The government hopes the program will reduce oil imports, replace molasses with sugar cane as an alcohol feedstock

to stimulate its nearly moribund sugar industry, and improve air quality by removing most of the lead from the 1300 million litres of gasoline used. The linchpin of the program would be the construction of two plants, each with a capacity of 120,000 litres/day, estimated to cost \$8 million each, half of this to be furnished by the government and half, officials hope, by foreign investors in the form of equipment. There are now about 20 distilleries in the Philippines owned by the government, half of them near sugar areas. These would be converted to fuel alcohol, while the other ten would continue producing alcohol for export to Japan and South Korea. Three of the distilleries would be converted to fuel alcohol at a relatively low cost, while seven would need to install dehydrating columns for about \$1.1 million each.

**Trinidad sugar production, 1987<sup>17</sup>**

The 1987 sugar crop in Trinidad, which ended on June 9, reached only 85,551 tonnes of raw sugar, some 15,000 tonnes below the target set for the crop, according to Caroni Ltd., the country's sole sugar producer. 47,300 tonnes of this year's production has been shipped to the EEC and 6700 tonnes to the US.

**Limitations on Chinese sugar imports<sup>18</sup>**

China will not increase sugar imports substantially this year because of foreign exchange constraints and large stocks, in spite of falling production and rising domestic demand, according to traders. "In spite of rapid increases in domestic production over the past 30 years, imbalances between supply and demand continue to be extremely serious" stated the *Farmers Daily*, an official newspaper. It said that 1986 plantings fell owing to the removal of crop incentives, because technical and seed improvements had not been widely disseminated. Reuters reports that the 1986/87 sugar crop had been estimated at 4.82 million tonnes, down from 5.2 million a year earlier, and domestic consumption at 6 million tonnes/year.

**Malawi sugar expansion<sup>19</sup>**

An expansion of the Dwangwa Sugar Corporation sugar factory in Malawi, to cost \$1.6 million, is expected to increase sugar output in 1989 when it comes on stream. The factory's cane crushing capacity is to be raised to 2 million tonnes a year and sugar production from the current 60,466 tonnes to 172,000 tonnes a year. Malawi's sugar production rose to 168,000 tonnes in 1986 from 155,000 tonnes the year before.

**Taiwan sugar production, 1986/87<sup>20</sup>**

The 1986/87 campaign in Taiwan has closed with an output of 479,020 tonnes. On the assumption that this is a tel quel figure, with most production being in the form of white sugar, it equates to around 520,000 tonnes, raw value. Some 10,000 tonnes have recently been shipped to the USA, which fills this year's quota; the balance should be sufficient to fill domestic needs which over the past three years have been running at just over 40,000 tonnes a month, but clearly, with stocks at

less than 30,000 tonnes at the commencement of the present season, there will not be much to spare. The 1987/88 crop is expected to recover to around 600,000 tonnes, which should permit exports in the region of 100,000 tonnes.

**Fiji sugar harvest interruption<sup>21</sup>**

The Fiji Sugar Corporation has advised cane farmers to stop harvesting at once and is laying off all factory workers until July 31, according to the Corporation's chairman. Resumption of crushing, halted because of mill stoppages and sabotage attempts, would then be reconsidered, he added.

**Reduced Greece sugar estimate<sup>22</sup>**

Greek sugar production in 1987/88 is estimated at 210,000 tonnes, raw value, down from 325,000 tonnes in 1986/87. The decrease is due to a smaller beet area (28,500 ha vs. 44,000 ha) owing to freezing temperatures and snow at sowing time, followed by floods in March. A shortage of sugar is forecast which will result in an import requirement of 120,000 to 140,000 tonnes, substantially more than the quantity imported in recent years.

**Argentina sugar production, 1986<sup>23</sup>**

A total of 9,601,405 tonnes of cane were crushed in Argentina during the 1986 season to yield 946,844 tonnes of white sugar and 91,152 tonnes of raw sugar, i.e. a total of 1,037,996 tonnes, tel quel. Recovery was 10.811% against 10.044% in 1985. In addition, 4,244,207 tonnes of cane were crushed for the manufacture of alcohol, against 3,153,154 tonnes in 1985, and 2,592,480 hl of alcohol was produced against 1,900,400 hl. Exports of sugar in 1986 totalled 113,543 tonnes, including 7519 tonnes to Bulgaria, 8325 tonnes to Chile, 16,386 tonnes to Paraguay and the remaining 81,313 tonnes to the USA.

**Philippines sugar production, 1986<sup>24</sup>**

Philippines sugar production in 1986 fell to 1,514,105 tonnes from 1,664,845 tonnes in 1985, according to I.S.O. statistics.

**Alcohol from molasses in Greece<sup>25</sup>**

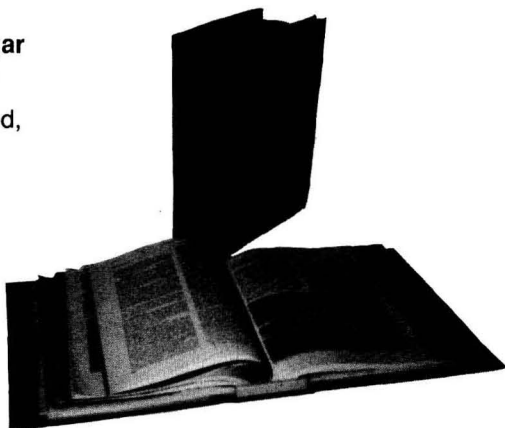
The Greek government has authorized the manufacture of alcohol from about 62,000 tonnes of beet molasses, almost half of the 132,000 tonnes produced in the 1986/87 campaign. Availability from the 1987/88 campaign is likely to be lower owing to the smaller beet area planted.

- 12 I.S.O. Stat. Bull., 1987, 46, (5), 30.
- 13 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 260.
- 14 GEPLACEA Bull., 1987, 4, (6), Sugar Inf. 1.
- 15 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 261.
- 16 *Amerop-Westway Newsletter*, 1987, (163), 16 - 17.
- 17 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 274.
- 18 *Financial Times*, June 3, 1987.
- 19 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 290.
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- 21 *Financial Times*, July 1, 1987.
- 22 F. O. Licht, *Int. Sugar Rpt.*, 1987, 119, 313.
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- 24 *Reuter Sugar Newsletter*, June 8, 1987.
- 25 *Biomasse Actualités*, 1987, (59), 2.

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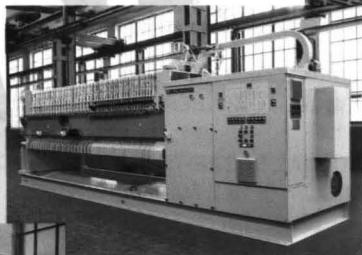
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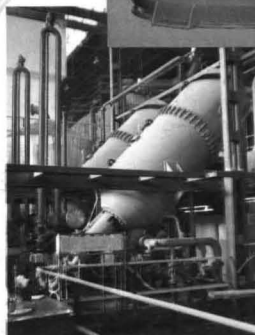
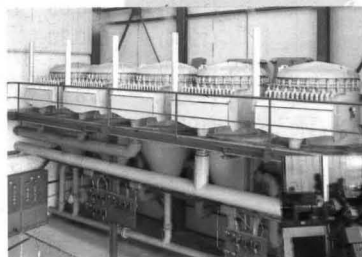
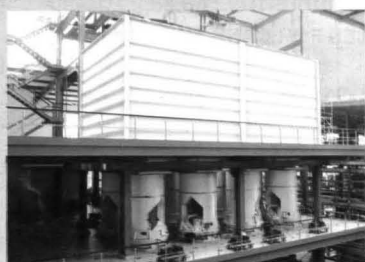
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