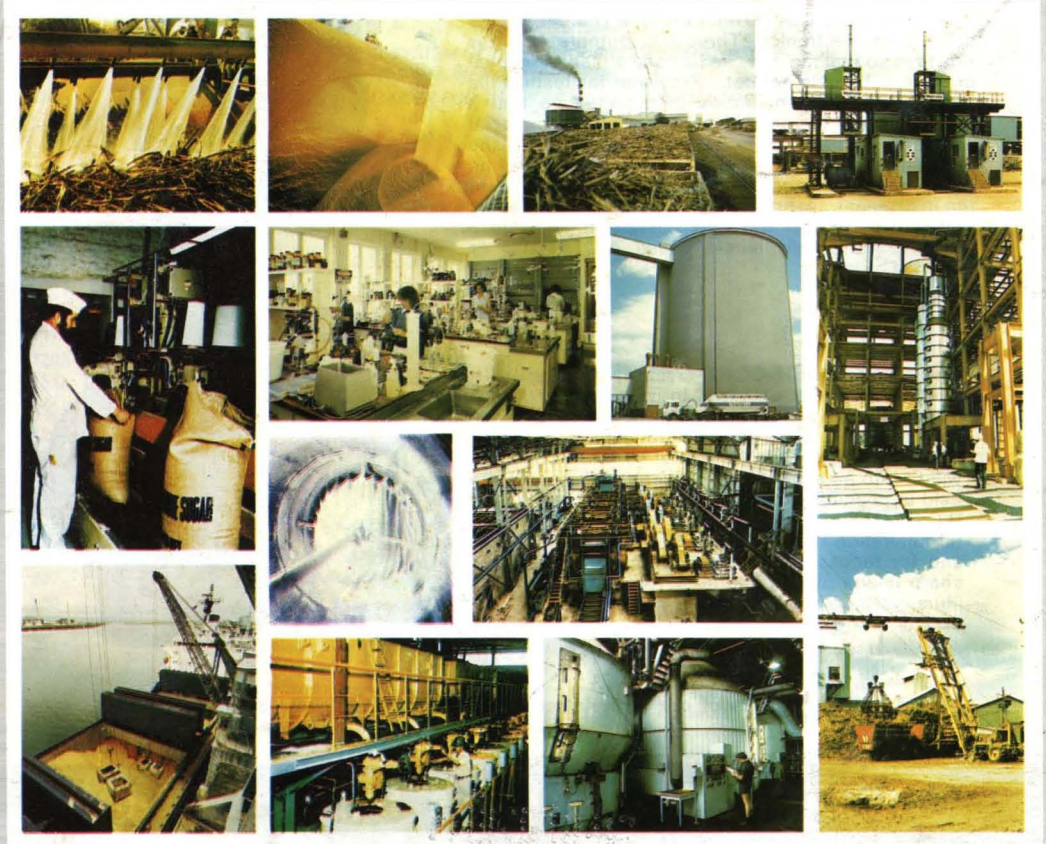
INTERNATIONAL SUGAR JOURNAL



VOLUME LXXXX/ISSUE No. 1079

NOVEMBER 1988

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News and views

World sugar balance, 1987/88

F. O. Licht recently published their fourth estimate[1] of the world sugar balance for the year to end-August 1988. The revised figures show that supplies are tighter than estimated earlier because of stronger than projected demand. Production is still estimated at around 105 million tonnes but consumption is now forecast to rise by 1.4% to 106.6 million tonnes against the previous estimate of 105.9 million tonnes. This means a deficit of 1.8 million tonnes which brings final stocks to 32.7 million tonnes or 31% of consumption. This is the lowest level since the last major bull market in 1980/81.

Initial reports indicate higher crops in Europe, Cuba, Brazil, Thailand, India, the Philippines and Australia in 1988/89 and output could jump to 108 - 109 million tonnes. Licht comments: "But, astonishingly enough, this would only suffice to keep the *status quo* as consumption must be expected to reach the 108 million tonnes mark. Also, there is hardly a year in which all goes well – which opens the possibility of another boomlet or even boom in 1988/89. The likelihood of a significant rise in sugar production should not blind us to the fact that we have entered a critical phase in which nothing is allowed to go wrong".

Reprieve for the Caribbean alcohol industry[2]

The Caribbean alcohol industry, once regarded as an alternative outlet for the region's troubled cane sugar producers, has been on the verge of collapse. Amid claims of increasing protectionism in the US, the main market for the region's alcohol, producers have been shutting up shop. In the face of increasing difficulty in gaining preferential access to the US market, Lica, a producer in Costa Rica owned by private and public interests, has closed down and a 40 million gallons/year plant in Jamaica, owned by a subsidiary of the island's state-owned oil company, has been idle since January.

The alcohol industry was regarded five years ago as part of the Caribbean's solution to the declining viability of its cane sugar production. The decision by several countries to encourage investment in alcohol was stimulated by the Caribbean Basin Initiative, a 12-year trade program implemented by the Reagan administration in January 1984, allowing countries designated by Washington to ship a range of products duty free to the USA. Alcohol was granted preferential entry as long as 35% of the value added accrued to CBI beneficiary states.

The producers met this criterion easily, using cane that was not needed for sugar production. But efforts to provide markets for corn producers in the US Mid-West were followed by representations to legislators in Washington, resulting in more difficult terms for Caribbean alcohol destined for the US market. The 35% regional added value criterion was raised to 60% and was to rise to 75% at the end of 1988. Caribbean governments and companies complained that the conditions are impossible to meet, and that meanwhile domestic US alcohol producers are being given significant subsidies to increase production.

After intense lobbying in Washington, the duty-free access will continue on the old terms until the end of 1989 while US government agencies carry out studies on the industry

Europe beet sugar production, 1988/89

It is too early to forecast European beet sugar production with a high degree of accuracy, but F. O. Licht have produced initial estimates based on areas and beet test results at the end of August[3]. The crops in Western Europe appear to be in good condition but, although virus yellows is reported from many areas and the lack of chlorophyll in the leaves should mean no sucrose formation, the tests indicate an above-average crop, perhaps owing to warm weather and plentiful rain in the summer.

What little information is available from East Europe indicates an average or even below average crop. The key question is whether the USSR will be able to repeat last year's excellent performance and Licht has been conservative in its forecast for the coming campaign. The net result, shown in the table below, is for an increase in EEC outturn more than counterbalanced by reductions elsewhere in Western Europe and in East Europe to give a total down slightly on last season.

	1988/89	1987/88
	tonnes, raw value	
Belgium	935,000	874,000
Denmark	540,000	422,000
France	4,080,000	3,973,000
Germany, West	3,200,000	2,963,000
Greece	280,000	197,000
Holland	1,065,000	1,064,000
Ireland	207,00	242,000
Italy	1,750,000	1,868,000
Portugal	5,000	5,000
Spain	1,122,000	1,072,000
UK	1,420,000	1,335,000
EEC	*14,604,000*	*14,015,000*
Austria	380,000	390,000
Finland	135,000	64,000
Sweden	409,000	274,000
Switzerland	130,000	123,000
Turkey	1,595,000	1,784,000
Yugoslavia	680,000	913,000
West Europe	*17,933,000*	*17,563,000*
Albania	45,000	40,000
Bulgaria	105,000	110,000
Czechoslovakia	590,000	770,000
Germany, East	715,000	760,000
Hungary	530,000	533,000
Poland	1,670,000	1,823,000
Rumania	430,000	450,000
USSR	9,600,000	9,800,000
East Europe	*13,685,000*	*14,286,000*
Total Europe	31,618,000	31,849,000

International Sugar Organization

A meeting was held in September of the Market Evaluation, Consumption and Statistics Committee of the ISO, which has replaced the Consumption and Statistics Committees established under previous agreements. The Committee examined a paper prepared by the

1 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 417 - 424.
2 *Financial Times*, June 30, 1988; August 18, 1988.
3 *Int. Sugar Rpt.*, 1988, **120**, 437 - 442.

Secretariat's Economic Division which showed how the importance of export earnings from sugar had declined slightly overall, although it was still crucial to the economies of some countries. Another paper illustrated the growth in the proportion of sugar trading which is now in white sugar; it has risen to 37% for the two past calendar years, much of it originating in the EEC.

World sugar production is expected by the ISO to rise by 4.75 million tonnes to 109.25 million tonnes in 1988/89, partly in response to higher prices but mainly as a result of better weather in most principal growing areas. Consumption is expected to rise further, from 106.7 million tonnes this year to 108.4 million tonnes in 1989.

World sugar prices

After a month of high prices in July, partly the consequence of speculation and high prices for other commodities, a price correction followed in August. Selling in what was regarded as an overbought market forced severe drops in values and the London Daily Price of raw sugar fell from $309.40 per tonne on August 1 to $280.60 by August 17. With indications of a good EEC beet sugar crop in prospect, the slide continued, although Czarnikow's indications of low stock levels and a number of raw sugar purchases prevented too steep a fall.

By the end of August the LDP had reached $264.20 per tonne and a minor recovery took place to $274.40 on news of some likely falls in production. However, good beet tests were reported and previous forecasts of a possible shortfall in production in 1988/89 seemed to be contradicted. The absence of expected sugar purchases by the USSR and China led to a weakening of prices in September and the LDP fell sharply from $268.20 on September 16 to $247.20 two working days later, after which it drifted between $239.40 and $254, ending the month at $245.40.

During the same period the LDP(W) was under greater pressure and remained lower than the raw sugar price throughout August, although the difference shrank from more than $20 to only $2.20 by the end of the month. For the first half of September, the difference remained small and variable – sometimes positive and sometimes negative – while white sugar values were much more stable than those of raw sugar during the second half, and the LDP(W) ended the month at $249.50, representing a premium of $4.10 over the LDP.

US sugar import quota for 1989[4]

More and more consideration is being given to the possible size of the 1989 import quota. The USDA's Economic Research Service on September 14 in its *Sugar and Sweetener Situation and Outlook Summary* has estimated 1988/89 US sugar production from beets at 3.42 million short tons and from cane at 3.38 million tons, a total of 6.8 million short tons or 7 million tons converted to a fiscal year. (Because some California beet crops commence prior to October 1, an adjustment must be made from crop year to fiscal year, especially when there is a significant difference in the size of the crop in successive years.

With requirements forecast at 8.35 million tons (up about 100,000 tons from 1987/88) an initial import quota of upwards of one million tons can be expected with further increases possible during the course of the year as market conditions warrant. This level will be influenced by official beet sugar production reports during the processing period from October 1988 and to some extent by the third quarter 1988 consumption data. Because of these unknowns it is expected that the proclamation of the 1989 import quota will likely be delayed until the last moment – the December 15 data legally mandated for the announcement.

Tate & Lyle further expansion

Part of the attraction of the Staley company for Tate & Lyle was its one-third interest in the European corn sweetener company CST Group, so that, with its own third, Tate & Lyle secured a majority. Under an agreement with the third shareholder, a Luxembourg investment company, Tate & Lyle sold part of its Staley holdings to it for $175.2 million, while still retaining a majority holding. GST owns Amylum and Tunnel Refineries as well as three other starch sweetener companies in Greece, Holland and Spain, with 55% of the EEC quota for HFS. The net cost of the 90% of Staley which Tate & Lyle now own is $1080 million and the company has launched a $100 million four-year note, the proceeds of which will reduce this cost.

On September 26 it was announced that Tate & Lyle and its 50.15%-owned subsidiary, Redpath Industries Ltd., had, through their jointly-owned subsidiary Refined Sugars Inc. of Yonkers, New York, bought the Amstar Sugar Division from Amstar Corporation for $305 million. Amstar has refineries in Baltimore, Brooklyn and New Orleans and, in view of this purchase, the Yonkers refinery is to be closed and sold. This is expected to realise more than $100 million and will meet part of the cost of Amstar while new shares in Tate & Lyle will be placed on the market to raise a further £55 million.

More challenges at GATT to US sugar policy[5]

The European Community has challenged a US exemption from GATT rules affecting agricultural imports. The EEC has also informed GATT it will raise the subject of the new US trade bill at the next meeting of the ruling GATT council. The EEC will ask the council to set up a dispute settlement panel to examine a 1955 US farm waiver, it was said. The waiver allows the United States president to impose fines or quotas on imports of certain commodities which would interfere with US products protected by a domestic

continued on page 208

4 *Czarnikow Sugar Review*, 1988, (1777), 139.
5 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 499.

ICUMSA News

Editor: R. Pieck
(Klein Spanuit 9, B-3300 Tienen, Belgium)

Message from the President

In the May ICUMSA News[1] we commented on the methods which seemed appropriate for the analysis of raw sugar, white sugar and molasses. Following discussion with the respective General Referees we are able to report their thinking with respect to the analysis of cane, beets and their processing together with refined products other than white sugar.

Subject G5: Cane

Mr. A. Brokensha, General Referee, reports that the full-width hatch method of sampling will be tested with the intention of seeking tentative status at the 20th Session. The method of cane analysis which will be pursued is the wet disintegrator cum indirect fibre method which gained tentative status at the 19th Session. As regards the fibre assessment, work will also be carried out on an independent direct method and the two fibre methods (direct and indirect) will be compared.

There are competing methods of sampling and analysis which are set down for further investigation. The combination of core sampling and analysis using the hydraulic press method is practised in many countries and work is to continue on these methods.

The GLC method for determining sucrose in cane juice presently enjoys tentative status (19th Session) and effort will be directed towards meeting the format and testing requirements so that it can achieve Official status. Because HPLC presents the opportunity to determine sucrose in cane juice without the derivatization needed for GLC, it also represents an important competing method and will be further investigated.

Efforts will also be directed towards finding a suitable non-toxic reagent to replace the lead salts currently used for clarifying cane juice samples prior to polarimetric analysis.

Subject G6: Beet

The General Referee, Professor W. Mauch, summarizes the position with respect to beet analysis. At present ICUMSA does not have any methods for sampling beets and preparing brei. Given the obvious importance of these preparatory operations, effort will be made in the present session to standardize a method.

In the routine method for determining sucrose content, parts of the method have official status while other parts have either tentative or no status at all. It is clearly desirable to resolve these shortcomings so that a single methodology acceptable to all users can gain official recognition. There also exist two isotope dilution methods with official status for determining sucrose content. These methods, the Hirschmüller & Hörning procedure and that of Sibley *et al.*, are regarded as basic methods because they fundamentaly determine sucrose but are very time-consuming. Sucrose determination by gas chromatography is another basic method which enjoys tentative status. It would seem desirable to adopt a single official basic method. In this way ICUMSA would be recommending the most appropriate method for accurately measuring sucrose in beets.

Concerning the measurement of α-amino nitrogen content there are two methods – the official ninhydrin method and the tentatively adopted blue number method. Here too it would be desirable to settle on one or the other to be the officially recognised method.

There are a number of determinations important to the analysis of beet but which have no ICUMSA methods. The Referee is keen to entertain discussion on methods for dry substance, ash, potassium and sodium, raffinose, invert sugar, saponin, total non-sucrose, and the macro-molecular and colloidal substances content. He also believes there may be a place for tests to determine mechanical properties of beet like shear strength, cutting quality, elastic properties and so forth.

Subject G7: Cane sugar processing

Dr. Charles Tsang, General Referee, has considered carefully the recommendations of the 19th Session and drawn up a list of substances for which analytical methods should be selected as suitable for cane sugar processing. In process syrups and liquors, methods for determining sucrose, glucose and fructose, ash, colour and tri-, oligo- and polysaccharides are sought. Standard methods for determination of sugars in bagasse, filter mud and scums, and process effluents require investigation. The determination of moisture in bagasse is important in sugar milling. The Referee would welcome discussion about the need for physical measurements such as density of products and crystallization rate in process syrups.

Subject G8: Beet sugar processing

The General Referee, Mr. J. P. Lescure, has consulted with his Associate Referees and produced a comprehensive outline of proposed activities for the 20th Session. The main thrust will be to propose methods for chemical balance purposes. The most important role of the technologist in a factory is to be able to account for the substances entering the process in beets and leaving the process in pulps and molasses. The development of analytical methods for sugar products will be undertaken by other referees. Because the use to which the analyses are put differs from the requirements for the commercial transactions of buying and selling beet and molasses, it is felt that the methods for beet sugar processing should be appropriate to that particular application. Because the requirements for reproducibility between factories do not have the same importance as in commercial transactions, the Referee questions whether the same rigour and expense of collaborative testing is required. He proposes that collaboration might involve fewer laboratories so that only the strict technical requirements are satisfied.

The high priority tasks to be attempted in the current session involve collaborative testing of competing methods for sucrose determination in

1 *I.S.J.*, 1988, **90**, 110 - 112.

beet cossettes, thick juice and molasses. Two HPLC methods, GLC and polarimetry will be investigated.

As a result of reallocating recommendations from the 19th Session, collaborative testing of a number of other methods will be discussed and undertaken only if resources permit. The next most important goal after the chemical balance will be the nomination of methods for reducing sugar in process materials, the determination of pectins and polysaccharides extracted during diffusion and eliminated to a greater or lesser extent in juice purification, and the measurement of sulphur dioxide, ammonia and formaldehyde for factory control purposes.

Subject G3: Refined sugar products other than white sugars

The General Referee, Mr. R. W. Plews, reports having received a good response to his invitation to appoint Associate Referees. Representatives from eight countries – Australia, Canada, Cuba, France, Germany, South Africa and U.S.A. – have expressed interest in participating in the work on this subject. Because the subject is new and since its scope had not been defined previously, discussion is taking place to decide what particular products should be dealt with here. At the same time, methods which are currently in use for the analysis of refined products are being discussed with a view to deciding which ones should be promoted for which products. Methods under consideration include Karl Fisher moisture, fructose and glucose by enzymatic methods, sucrose by GLC, HPLC analysis using reverse-phase cation exchange columns, polarimetry, reducing sugars, ash, non-sugars, betaine, particle size, colour and microbiological methods. Some of these methods already enjoy official status while others hold tentative status. In any event, once methods appropriate to the analysis of particular refined products have been selected, there will be a need for collaborative testing to establish repeatability and reproducibility values in accordance with the new requirements of Subject 3.

Collaborative testing programs

Subject G1: Raw sugar

The General Referee for Subject G1, Mr. Robert McCowage, indicates that, while present methods will be examined to see if any conform to recently announced IUPAC requirements for collaborative testing, he expects such tests to be conducted on analytical methods for determination of reducing sugars, sulphated ash, conductivity ash, moisture content, colour, pH and fine grain in raw sugar.

All Associate Referees for Subject G1 will be invited to participate in collaborative testing of these procedures. Others are invited to contact the General Referee directly if they have an interest in participating. It is intended to circulate one set of sugars on which all the above tests would be undertaken. Accordingly, collaborators with an interest in any number of the above procedures can be accommodated.

Subject 15: Reducing sugars

The Referee for Subject 15, Mr. J. Laursen, is planning two collaborative test programs to pursue Recommendations to investigate the Luff-Schoorl method and the sucrose correction factor for the constant volume modification of the Lane & Eynon method.

The planned test for the Luff-Schoorl method will involve two samples each of beet and cane molasses and one sample of Quentin process beet molasses. A comparison with the Lane & Eynon method will be conducted with the same samples.

The sucrose correction factor for the Lane & Eynon method will be collaboratively tested using a single sample of sucrose with an invert content of less than 10 mg/kg. Factors will be determined for the addition of zero to 20 g of sucrose in 2 g increments.

For this latter test program the Referee is looking for at least eight participating laboratories, this being the number advised by the Subject 3 Working Group on Collaborative Studies. Any laboratories wishing to participate in one or other or both of these studies, but which have not already indicated, are urged to contact the Referee without delay at A/S De Danske Sukkerfabrikker, 5 Langebrogade, P.O. Box 17, DK-1001 Copenhagen K, Denmark (Telephone +45-1546130, Telex 31430 dansuk dk, Fax +45–1540044).

Retirement

Miss Mary O'Sullivan is now retired from Irish Sugar plc and has announced her resignation from the chairmanship of the Irish National Committee and as Vice President of ICUMSA. Mr. Tadg Quill has been nominated as new chairman of the Irish National Committee. The commission deeply appreciates the contribution Mary has made over many years, especially her involvement in hosting the 18th Session in Dublin. We all wish her a long and happy retirement.

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support program. The waiver, which is examined each year by the GATT's member nations who can cancel it collectively, covers cotton and certain cotton products, peanuts, most dairy products, sugar, syrups and some sugar products. Australia and New Zealand have also criticised the US waiver, saying it was intended only as short-term assistance.

The United States has responded that the waiver is on the negotiating table during the 105-nation Uruguay round, launched four years ago to break down trade barriers in 14 areas. Australia and the EEC delegation have also signalled their intention to challenge a "headnote" to the US tariff schedule giving Washington the right to impose quota restriction on foreign sugar.

Jamaica sugar crop, 1987/88[1]

Jamaica's sugar production in 1987/88 reached 220,803 tonnes, raw value, up some 33,000 tonnes from the year before, and the best harvest since 1980.

1 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 432.

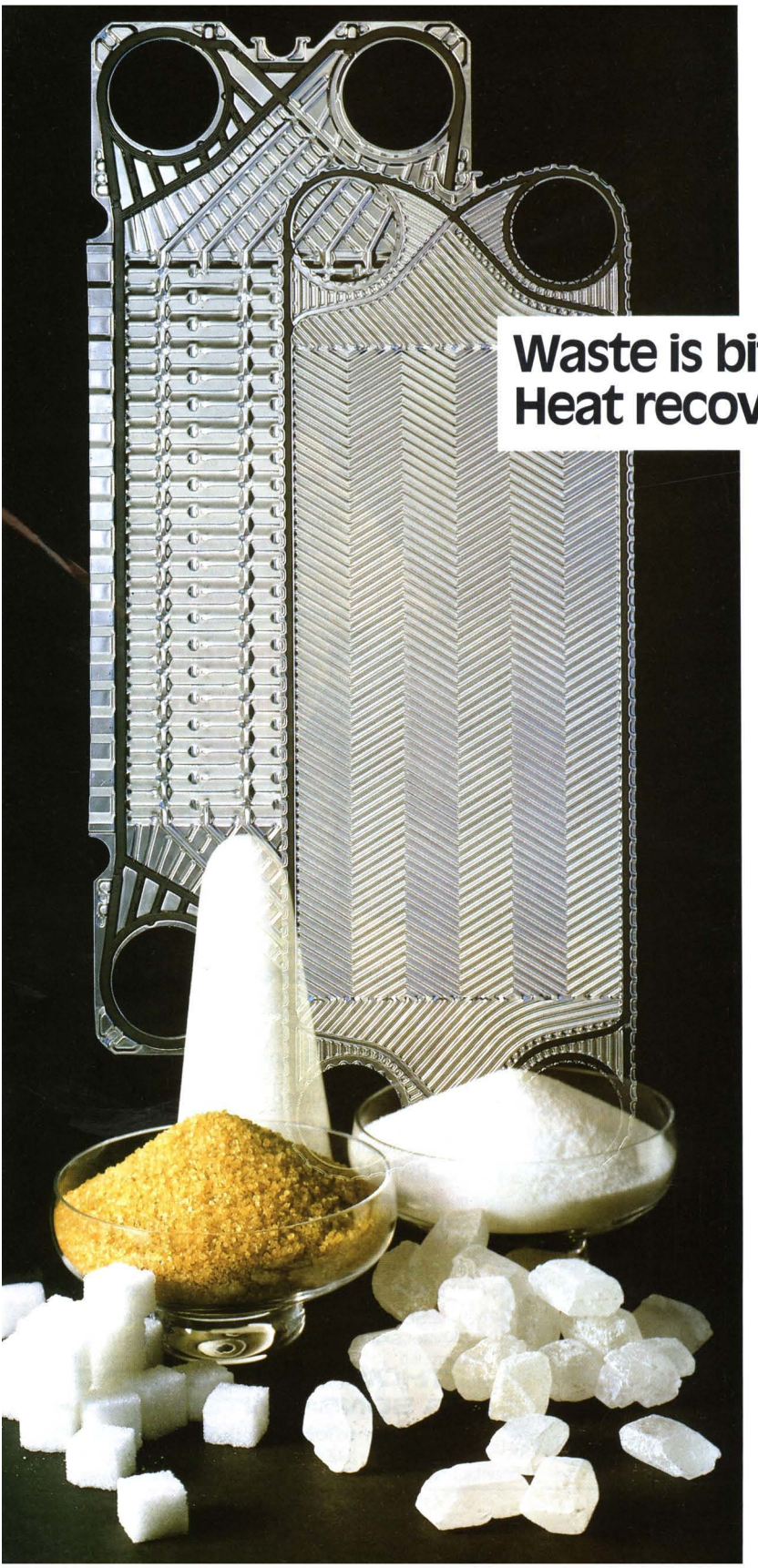

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Plate heat exchangers in sugar processing

Experiences gained in the past five years

By Werner Zeh
(GEA Ahlborn, Sarstedt, West Germany)

History

Although plate heat exchangers have been manufactured and applied in thermal processes since the late 1920's, they have only appeared in sugar factories since the early 1970's. Their first applications were the heating of thin juice before evaporation and the heating of extraction water and syrups. In recent years, plate heat exchangers have been widely adopted in sugar factories for very different applications; this was made possible by the extensive development and further up-grading of this type of heat exchanger. Nowadays, two different types of plate heat exchangers are available and successfully installed in many sugar factories:

1. conventional plate heat exchangers having metallic contact points from plate to plate, and
2. special "free-flow" plate heat exchangers having a wide, open gap from plate to plate.

Both of these models have construction and function in common.

Construction

The frame consists of a fixed plate, a follower, a support beam, a guide rail, the compression bolts and – most important – the plate pack (Figure 1). This plate pack comprises a number of pressed heat exchanger plates. The number and arrangement of these plates depends on the required thermodynamic performance.

Function

The plate pack consists of a series of plates which are arranged in a way to form flow passes. Each plate is equipped with its gasket which prevents mixing of the two media employed for the heat exchange as well as sealing off to the atmosphere. The heat transfer of the two media, which are generally in counter flow, occurs through the plates as a result of the temperature difference between the two media. Whenever possible, the pipe connexions are positioned on the fixed plate of the frame (Figure 2), thus creating a single-pass installation of the plates. If there is only a slight temperature difference between the two media, or if the product has to have a high velocity, a multi-pass installation (Figure 3) is required.

W. Zeh

Conventional plate heat exchangers

This well-known type of plate heat exchanger, having metallic contact points from plate to plate, is used for the heating or cooling of clean liquids having no suspended particles, solids or fibres. Such liquids include: clearing liquor without solids, concentrated juice, condensate/ heating water, condenser water, effluent water without solids, fresh extraction water, ingredient water, molasses, syrups, and thin juice.

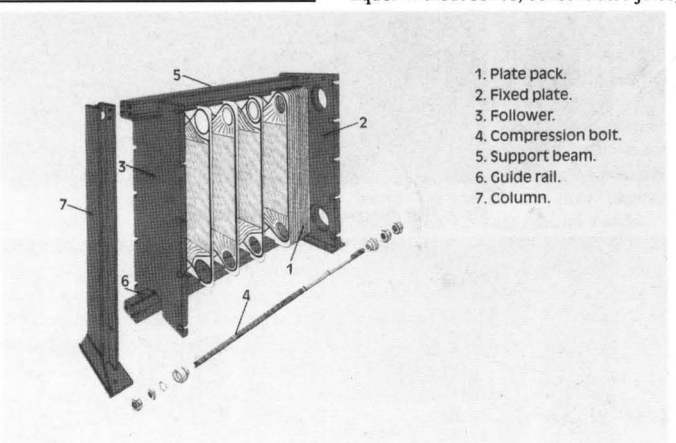

Fig. 1

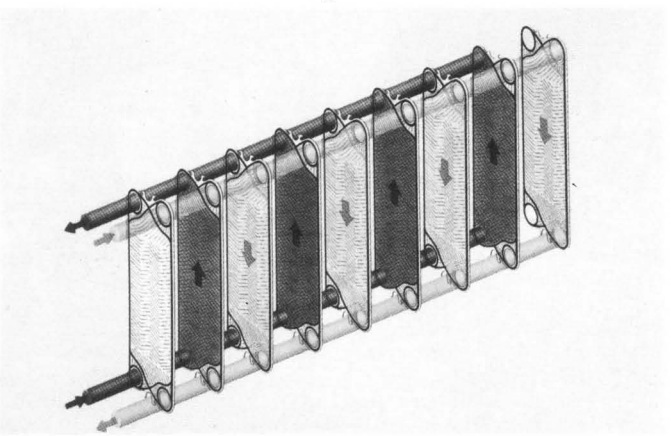

Fig. 2. Flow diagram, single-pass installation

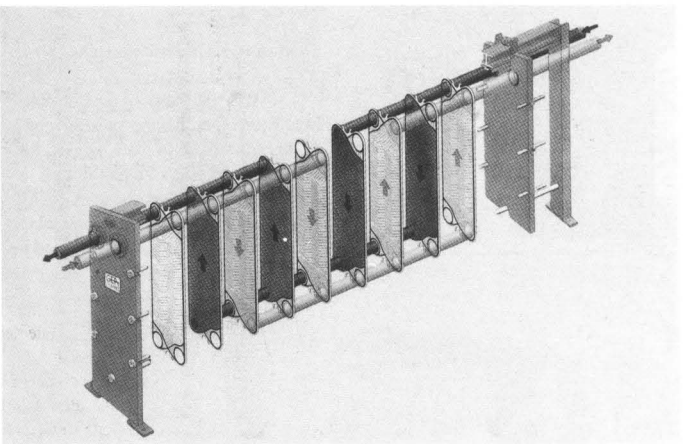

Fig. 3. Flow diagram, multi-pass installation

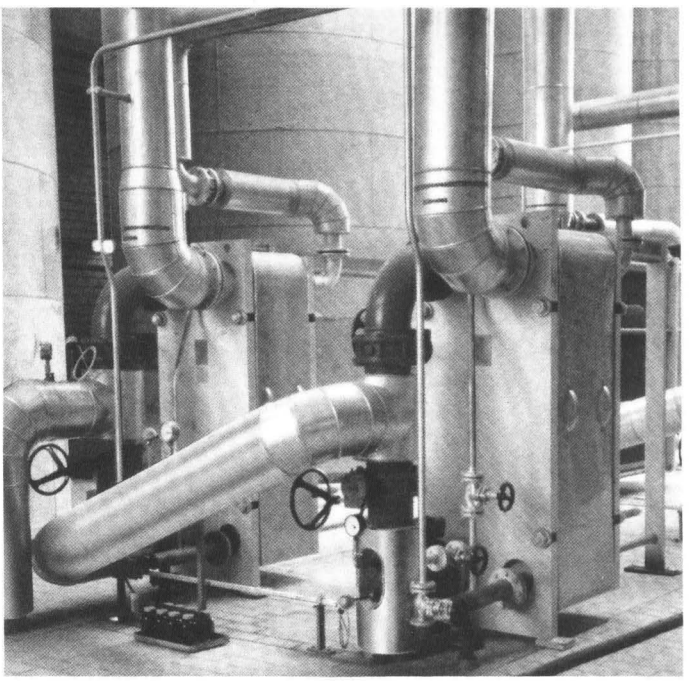

Fig. 4

For all these applications the plate heat exchangers generally work continuously throughout the campaign without the need of cleaning.

The heat transfer values obtained throughout the campaign are as follows:

For clearing liquor without solids:
1100 - 1450 kcal/m²/hr/°C

For concentrated juice:
750 - 1250 kcal/m²/hr/°C

For molasses:
400 - 1200 kcal/m²/hr/°C

For syrups:
750 - 1250 kcal/m²/ hr/°C

For thin juice:
3300 - 3600 kcal/ m²/hr/°C

The relatively large variation in these heat transfer values is a consequence of the various heating agents applied, e.g. hot water, condensate, vapours and steam.

The aim to reduce the consumption of primary energy, in most beet sugar factories fuel oil, has resulted in very close temperature approaches. There are, for instance, preheaters in the evaporation stage which constantly operate at a difference of only 1°C between the inlet temperature of the vapours and the outlet temperature of the thin juice. As the vapours applied for heating contain a certain percentage of non-condensable gases, which would block a part of the heat exchange area, it is vital that these non-condensable gases are vented out of the plate heat exchanger (Figure 4).

"Free-flow" plate heat exchangers

Since about four years ago this especially developed plate heat exchanger, having a wide, open gap from plate to plate, has entered service in many sugar factories (Figure 5). More than 200 installed heat exchangers have proven their capability to heat or cool circulation juice, clearing liquor with solids, heavily polluted waste water, limed juice, mixed juice, press water, raw juice, and sugar solutions containing crystals, for example massecuite.

Also for these applications a continuous operation has been achieved throughout the campaign, in most cases without back-flushing or intermediate cleaning, whereby the following heat transfer values have been realised.

For circulation juice:
1450 - 1750 kcal/m²/hr/°C

For clearing liquor with solids:
1050 - 1250 kcal/m²/hr/°C

For limed juice:
1700 - 2100
kcal/m²/hr/°C
For press water:
2200 - 2600
kcal/m²/hr/°C
For raw juice:
1900 - 2300
kcal/m²/hr/°C

In order to attain the above heat transfer values continuously and possibly to ensure that the plate heat exchangers work throughout the campaign without being cleaned, it has been necessary to design them with a multi-pass plate arrangement (see Fig. 3). The resulting velocity of the liquid is in the range of 0.65 - 0.85 m/sec in the plate gap. The pressure loss resulting from this plate

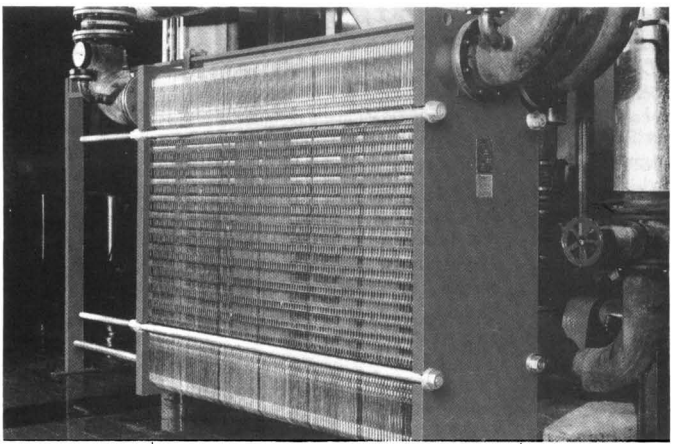

Fig. 5

arrangement is, depending on the number of plates installed, in the range of 8 - 12 metres, water gauge. Compared with conventional tubular heat exchangers, both types of plate heat exchanger described above have significant advantages, including compact design and low weight, high heat transfer values, low price, and large heat exchange surface per unit volume.

Conclusion

Nowadays, plate heat exchangers are accepted and successfully operated in sugar factories around the world. The special "free flow" plate heat exchangers have introduced a wide variety of applications formerly reserved to conventional tubular heat exchangers against which they offer convincing advantages.

Conference on sugar processing research

The 1988 conference in this series, co-sponsored by Sugar Processing Research Inc. (SPRI) and the Southern Regional Research Centre (SRRC) of the US Department of Agriculture, was held at the Meridien Hotel in New Orleans, Louisiana, during September 25 - 27. Some 90 delegates registered during the first day and were offered a reception in the evening. Technical sessions began on the following morning, with a welcome from the President of SPRI, Neil Pennington, who introduced John Barquette, Director of SRRC, which supports the work of SPRI. He then called on the first speaker, Professor Leslie Hough, winner of the 1988 SPRI Science Award, whose presentation, "Sucrose, sweetness and sucralose", described the chemistry of sucrose in relation to sweetness and reviewed the relationship between structure of sweet-tasting molecules and their properties. Substituted saccharides and congeners were also reviewed and the development of sucralose (4,1'6'-trichloro-4,1'6'trideoxy-galacto-sucrose) – a material resistant to acid hydrolysis, non-toxic and non-metabolizable but 650 times sweeter than sucrose – described.

John Williams of Tate & Lyle Research then presented a paper on the use of HPLC colour analysis to investigate the mechanism of resin decolorization, and Kevin Schäffler of the Sugar Milling Research Institute on South Africa gave an account of an investigation into acetic acid production in cane diffusers and its resultant effect on vapour pipe corrosion. Mary Ann Godshall of SPRI then spoke of work at SPRI on the application of dialysis and gel permeation chromatography for separation and analysis of high molecular weight colorants in refinery materials, the effects of various adsorbents and UV and visible spectral characteristics of isolated fractions.

A yellow pigmented bacterium, *Pseudomonas paucimobilis*, had been found in sugar liquors at Redpath Sugars Ltd. in Toronto in 1987 and Brian Dewar described work carried out there to investigate its origin, sources of contamination and its elimination.

After lunch, under the chairmanship of Leif Ramm-Schmidt of Finnish Sugar Company, a paper was presented by Professor Geoffrey Richards of the University of Montana which described the effects of impurities on the degradation of sucrose under conditions where little or no water was present. Earl Roberts of SPRI then described work to explain the presence of up to 4% mannose in the hydrolysis products from dextrans isolated from raw sugar and cane. These studies indicated that the

mannose residues are part of the dextran molecule and that such dextrans are formed by wild strains of *Leuconostoc mesenteroides*, while a laboratory strain, B-512F, produces dextran containing only glucose.

Margaret Clarke of SPRI then presented two papers, the first describing studies in cooperation with SRRC on the structure of a fructose polymer synthesized from sucrose in beet and cane juices. The second paper described work done in collaboration with the Sugarcane Research Unit of USDA at Houma, Louisiana, on the changes in composition of the polysaccharides formed in different varieties as a consequence of frost damage.

Recent experience with a new anti-foam oil in beet sugar factories was described by Simon Radford of Tate & Lyle Process Technology, after which Peter Rein of Tongaat-Hulett Sugar discussed experience in South Africa on the flotation clarification of syrup in both raw sugar factories and refineries. The benefits to massecuite viscosity and sugar quality were described and a laboratory procedure for assessing the clarification achieved; the latter permits optimization of the process on a small scale before installing a full-scale plant. The last paper of the day, presented by Margaret Clarke of SPRI, described work on the structure of some cane sugar colorants of plant origin, comprising polysaccharides with phenolic residues; these contribute to colour and are carried through even to the highest quality refined white sugar.

Leon Anhaiser of Imperial Sugar Company took the chair on the following morning, when the first paper, presented by Professor Giorgio Mantovani, described the application of near infrared spectroscopy to the analysis of sucrose and dry substance in very small samples of solid and liquid sugar factory materials and confirmed the applicability of earlier calibration curves. The same technique has been applied to measuring starch, moisture and invert sugar in pulverized and agglomerated products, and the correlation of such measurements with those obtained by traditional procedures were described by Sandra Stevens of California & Hawaiian Sugar Company.

Automatic methods based on flow injection analysis have been developed for the accurate determination of sugar in beets and show significant differences from pol values. The determinations use four different enzymes systems, and Jan Tjebbes from Sockerbolaget of Sweden described the development of the method and its application to beet analysis and breeding.

High performance liquid chromatography (HPLC) has become well established as a laboratory tool for analysis of sugar but SPRI has been concerned with trials of the technique in sugar factories, and Charles Tsang described some of the results obtained on measurements of sugar loss in wash water from bagasse and filter cake, in waste water, analysis of juices, etc.; he also described its application to measurement of trisaccharides in sugar samples.

Bruce D. Wells of Calgon Carbon Corporation reported how relative efficiency tests and pore size distribution analysis had been found to correlate better with Canesorb performance in the refinery than the traditional methods using iodine and molasses adsorption which have now been suspended. Water adsorption from humidified air by dry bone char has been found to be linearly related to colour removal as found by a batch test. Chung Chi Chou of Amstar Sugar Corporation announced this finding and discussed the significance in relation to the mechanism of colour adsorption on char.

After lunch, Stanley Bichsel of American Crystal Sugar Co. took the chair and introduced Ernesto Betancourt of Colonial Sugars Inc., who described the installation and successful operation of a Langreney type continuous pan installed at the Gramercy refinery in Louisiana. Richard Priester, of Savannah sugar refinery then discussed the way in which, by equipment modifications, it has been possible to reduce labour requirements in the bone char and carbon decolorization stations to one man per shift.

Acceptable reproducibility and accuracy for process control purposes have been found for a method of determining soft sugar moisture content by the use of an infra-red dryer in combination with a balance. The procedure, described by Fred Goodrow of Amstar Sugar Corporation, requires only 10 minutes against 6 hours for the usual vacuum drying method and requires minimal supervision of the equipment.

Raymond Dickey, of Refined Sugars Inc. presented an update on low-grade syrup crystallization in which the effects of a number of variables (invert:non-sugars ratio, massecuite purity, crystal number and volume, and crystal axis length ratio) on exhaustion were determined. Mark Holle of American Crystal Sugar Company then described a laser device which can be used for rapid determination of crystal size distribution in a liquid suspension and may be applicable to optimizing automation of pan boiling. The last paper of the conference was an account by August Bailey of SPRI which described a rapid method for separating crystals from mother liquor in a centrifugal tube device whereby a representative sample of mother liquor was collected and this was able to provide a means of assessing the massecuite very quickly.

The conference closed on the evening of September 27 with a banquet for delegates during which the Science Award was made to Professor Hough and the Presidential gavel passed from Mr. Pennington to Stanley Bichsel.

On the following day, a workshop was held on the theme of white sugar quality. Two panels of speakers from various refineries and sugar users spoke on aspects of white sugar production and the effects of ash, colour, grain size and moisture, etc. on sugar quality. Joseph Dowling of Refined Sugars Inc. presented the results of a questionnaire returned from nine US and six non-US

continued on page 221

The CCC system of continuous cooling crystallization

By G. Vaccari, G. Mantovani and G. Sgualdino
(University of Ferrara, Italy)

Introduction

At the 18th General Assembly of the C.I.T.S., held in Ferrara in June 1987, we proposed and discussed the possibility of utilizing crystallization process schemes of more than one step which allow us to obtain sugar directly from thick juice[1]. This concept already taken into consideration in the past[2,3], was reconsidered by us either on the grounds of laboratory tests we carried out[4] or for energy saving reasons. In fact, our laboratory tests indicated that less drastic crystallization conditions than those normally met during the traditional boiling process can allow us to obtain crystals with a lower ash and colour content. This idea of cooling crystallization has also been studied in years past by other researchers[5-10].

On the grounds pointed out above, and the aim of achieving a true continuous cooling crystallization, we set up in one of the sugar factories of the firm Eridania Z.N. of Genova a pilot plant fed with standard syrup, and able to produce one tonne of white sugar per day. This pilot plant was an intermediate step in the industrial realization of a continuous cooling crystallization process able to produce directly commercial white sugar starting from thick juice.

Description and operation of the pilot plant

A diagram of the pilot plant is shown in Figure 1. The standard syrup concentrated in the boiling pan 1 was discharged into the tank 2 as soon as it reached the Brix conditions determined as a function of its purity quotient and the feeding temperature of the crystallizer, which data were processed through a computerized program set up for the optimization of the feeding conditions[11]. These conditions provide that the juice enters the crystallizer with a supersaturation of about 1.02. However, taking into account the discontinuity of the concentrated juice supply system, at each discharge of the pan – that is every 4 - 5 hours – the contents of the tank 2 were

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analysed, and the juice Brix was, if necessary, varied by appropriate additions of water on the basis of the calculated data. Of course, in the case of an industrial installation, this operation would be eliminated by using a preconcentrating tank programmed for continuously feeding the crystallizer with syrup under strictly standardized conditions. This solution would also avoid the concentrated juice being maintained for long periods at high temperatures so causing a colour increase. In fact, in the pilot plant, the juice remained in the tank for 4 - 5 hours on average at about 80°C, and suffered on average a colour increase from 4000 - 5000 I.U. at the exit of the pan to 6000 - 7000 I.U. entering the crystallizer.

The flow of the concentrated juice entering the crystallizer was maintained constant by means of the pump 4 run at variable speed. The average flow was about 200 litres/hour, and corresponded to a residence time inside the crystallizer of about three hours. The temperature of the juice entering the crystallizer ranged in general between 78° and 80°C, whereas the temperature at the exit was about 40°C. The purity quotient of the juice was on average around 90. The intermediate temperatures, at about one-third and two-thirds from the point where the juice entered the crystallizer, remained around 65° and 50°C, respectively. Inside the tank 8, collecting the magma, the temperature further decreased to 40° and 30°C so that centrifuging was carried out at this last temperature. In an industrial-type plant this tank will be eliminated since the cooling will be completed inside the crystallizer which will be better designed. The magma leaving the crystallizer will enter the centrifugal directly.

The crystallizer cooling water had a constant temperature of about 20°C, and a flow of about 100 litres per hour, distributed between the outside jacket and the inside shaft. The temperature of the water leaving the plant was about 60°C.

As far as the crystallizer 7 is concerned, to obtain the required heat exchange surface it was necessary to cool not only the outside jacket but also the inside stirring baffled shaft which rotated at 10 turns per minute. For improving the stirring conditions, a number of baffles were located on the cylinder wall. Under these conditions the crystallizer works as a plug-flow reactor where the crystallization reaction occurs. The simplicity of the system is clear; it is essentially a heat exchanger.

The concentrated juice entering the crystallizer was mixed with a slurry of seed in isobutyl alcohol fed through the peristaltic pump 5. The slurry stored in the tank 6 was prepared by adding a gram of seed to one litre of alcohol. The flow of the slurry was maintained at about 0.6 litres per hour. Obviously, in an industrial plant the concentration of seed in the isobutyl alcohol will be

Paper presented to the 29th Tech. Conf., British Sugar plc, 1988.

1 Mantovani *et al.: Proc. 18th Assembly C.I.T.S.*, 1987, 621 - 633.
2 de Vries: *Sugar*, 1957, **52**, (4), 27 - 30.
3 Accinelli: *Ind. Sacc. Ital.*, 1964, **57**, 183 - 197.
4 Mantovani *et al.: Ind. Sacc. Ital.*, 1985, **78**, 7 - 14, 79 - 86; 1986, **79**, 99 - 107; *Zuckerind.*, 1986, **111**, 643 - 648.
5 Austmeyer & Marwede: *Zuckerind.*, 1987, **112**, 193 - 201.
6 Austmeyer: *ibid.*, 1985, **110**, 875 - 883.
7 Hempelman: Thesis (TU Braunschweig), 1985.
8 Austmeyer: *I.S.J.*, 1986, **88**, 3 - 7, 23 - 29, 50 - 55.
9 Austmeyer: & Frankenfeld: *Zuckerind.*, 1987, **112**, 36 - 45.
10 Schliephake *et al.: ibid.*, 1987, **112**, 269 - 273.
11 Cuel: *Ind. Alim. Agric.*, 1984, **101**, 591 - 597.

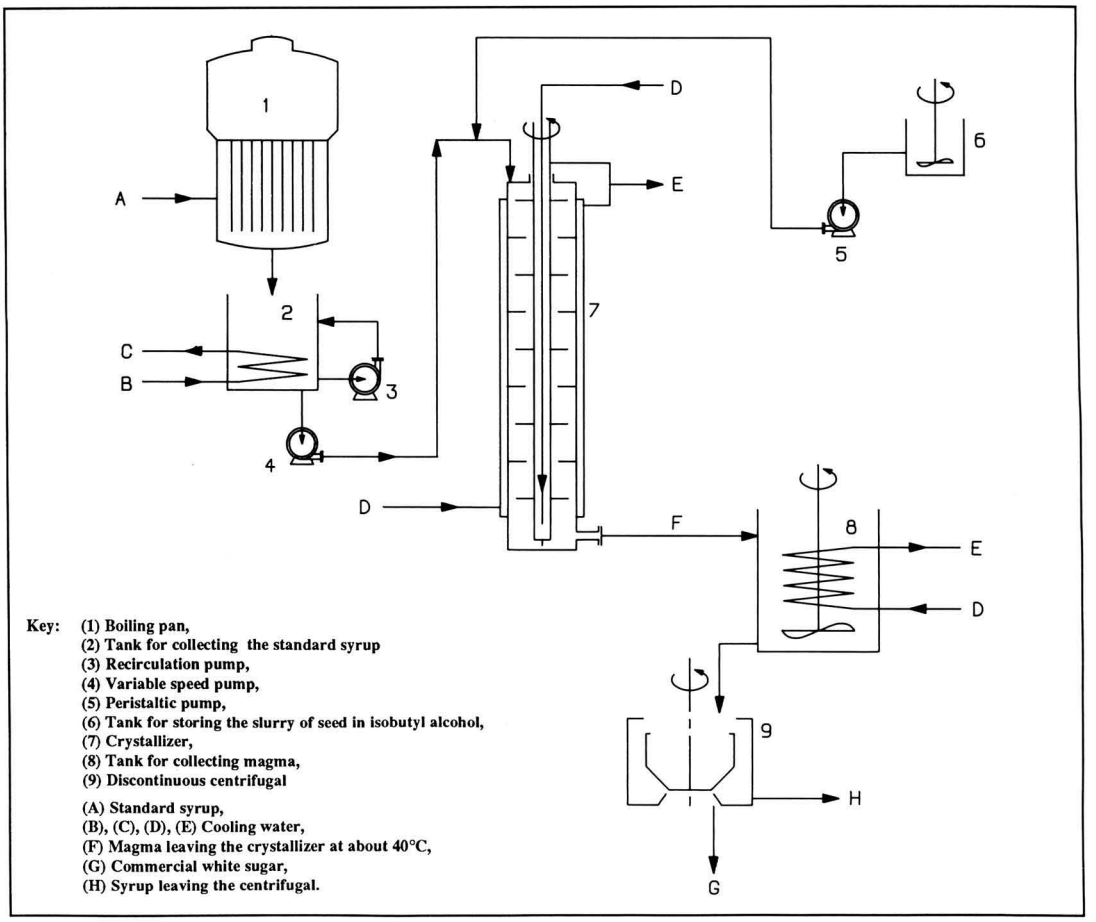

Fig. 1. General scheme of the pilot plant

higher.

The magma collected in the tank 8 was periodically centrifuged, using a discontinuous centrifugal 9 and washing with water and vapour. The start of the water washing was also carried out after the complete drainage of the syrup for 15 - 30 seconds. The final washing with vapour was carried out for periods which varied from 15 to 30 seconds.

The magma consistency before centrifugation, which was measured by means of a special device (Figure 2), gave values of about 10 - 11 milliamperes which on average correspond to the value of a massecuite in a pan at about half-way through the strike. Taking into account the fluidity and the low consistency of the magma, which are due to the fact that crystallization is carried out without evaporation, in general the centrifugal was charged with lower amounts than those of normal massecuite so that the amount of sugar collected after every cycle was on average around 60 kilograms. Having in mind this low consistency of the magma, the employment of continuous centrifugals is suggested for a plant of industrial design although these still present some problems as far as crystal breakage is concerned.

Since the water for washing in the centrifugal left the nozzles at a rate of about 20 litres per minute it was possible to calculate the average amount of water employed relative to magma and the amount of dissolved crystals; these ranged from 1 to 3% water on massecuite and from 10 to 20% of dissolved sugar, respectively. Obviously, the higher the amount of washing water used the better were the sugar characteristics, even if this improvement was maintained within low limits.

ISJ Abstracts

Cane sugar manufacture

Laboratory comparison of antimicrobial activities of biocides Boraquat C-50 B and ammonium bifluoride against cultures isolated from sugar syrups

B. Z. Lashkari, M. Y. Ambardekar and A. Shah. *Bharatiya Sugar*, 1987, **13**, (1), 105, 107, 109, 111, 113 - 114.

Details are given of tests to determine the comparative activities of the two title biocides against micro-organisms (7 aerobic bacteria, 2 anaerobic bacteria and 2 yeasts) isolated from syrup samples. The new preparation, Boraquat C-50B, proved far more effective than ammonium bifluoride and in most cases reduced the counts by >99% as against a kill of 0 - 42.8% in all but two cases using the bifluoride.

Control of sugar cane biodeterioration

H. K. Dubey and R. C. Tewari. *Bharatiya Sugar*, 1987, **13**, (2), 41 - 43.

DNPT [1,3,5,7-tetrazo-3,7-dinitroso-1,5-endomethylene bicyclooctane] was tested as a bactericide, with the particular aim of controlling *Leuconostoc mesenteroides* in expressed juice. At a dose of 40 ppm it reduced the count in juice stored for up to 24 hours by 98.7% and proved considerably more effective than three other bactericides tested. DNPT was also found to be effective as a flocculant by increasing the settling rate of juice in clarification.

Studies on the adsorption of sugar colorants

S. C. Sharma and P. C. Johary. *Bharatiya Sugar*, 1987, **13**, (2), 53 - 60, 65 - 66.

See *I.S.J.*, 1988, **90**, 13A.

Promotion of new system designs and process techniques in the sugar industry - impediments and solutions

H. C. Sood. *Bharatiya Sugar*, 1987, **13**, (2), 67 - 72.

A survey is presented of modern developments in sugar factory equipment and processing as well as treatment of vinasse and the Biostil continuous fermentation process, and reasons for the reluctance of Indian sugar manufacturers to adopt them are examined. Means of overcoming the various obstacles are suggested.

Electronic instruments for use in processes at sugar mills and alcohol distilleries

Anon. *GEPLACEA Bull.*, 1988, **5**, (3), 7 pp.

After a brief description of the general concept of an automatic control system, the various process parameters that lend themselves to automatic control are examined and the advantages obtained are indicated. Included are cane feed to the mills and the amount of imbibition water, juice level in tanks in the clarification station and in evaporators, juice pH and heating temperature, evaporator steam feed and Brix, boiling control on the basis of conductivity and massecuite level, and control of boiler parameters. Brief reference is made to automatic control in alcohol distilleries.

Alternative systems of waste water treatment suitable for a sugar mill

Y. Kurniawan and M. Mochtar. *Gula Indonesia*, 1987, **13**, (3/4), 17 - 25 *(Indonesian)*.

The chemical composition of waste water at four sugar factories in East Java is tabulated and compared with the permissible limits. Generally, the BOD_5 levels at 20°C and the COD levels are shown to be well in excess of requirements. The reductions in BOD_5 that are obtainable by various methods of waste water treatment are indicated, and descriptions are then given of the different methods, including activated sludge, aerated lagoon and anaerobic digestion systems. Important factors to be considered in the choice of scheme are discussed. While data from the literature indicate the suitability of each system under given conditions, it is considered that laboratory and pilot tests will need to be carried out so as to design a scheme that will be easy and reliable to operate under Indonesian conditions and meet official requirements.

A new sugar factory at Yedashe, Burma

Anon. *Sugar y Azúcar*, 1988, **83**, (3), 11 - 12, 14.

Information is given on the 1500 tcd factory at Yedashe about 300 km north of Rangoon. Designed for the production of plantation white sugar, the factory is provided with equipment supplied by the Japanese firm, Tsukishima Kikai Ltd., including a 4-mill (12-roller) tandem and a 5-roller pressure feeder-type mill with individual turbine drives, a quadruple-effect evaporator with pre-evaporator, four calandria pans with stirrers, two vertical continuous crystallizers, five fully-automatic batch centrifugals for high-grade massecuites and five continuous machines for low-grade work. Decolorization is by double sulphitation.

An approach to adjusting the liming process of Jamaican raw sugar factories

J. Jaddoo and H. Bourzutschky. *J.A.S.T.J.*, 1981, **42**, 83 - 88.

By comparison with one-stage cold and hot liming, fractional liming to an initial pH of 6.5 and then to 7.5 with heating between both stages increased the settling rate and reduced the mud volume when tested on juice from stale cane or where the trash and hence colloidal clay contents were excessive. However, further studies were required so as to give more conclusive results.

Nuclei preparation and automatic granulation for optimum crystal content

M. Hylton and L. Lewin. *J.A.S.T.J.*, 1981, **42**, 88 - 97.

Slurry prepared by recrystallization of nuclei from a saturated sugar solution was more consistent and rapid than dry or wet milling of icing sugar used to obtain regular small nuclei; however, while the recrystallization method is economically advantageous, it is unstable over a prolonged period and depends on accurate control of supersaturation at the required level. Boiling control based on conductivity was the simplest and most effective means of obtaining consistently good crystallization. The experiments confirmed the relationship between crystal content and final molasses purity and the effectiveness of true seeding in providing a desired crystal content in low-grade massecuite.

Mill settings

B. G. Smith. *J.A.S.T.J.*, 1981, **42**, 97 - 103.

Advice is given on the setting of feed and delivery rollers and trash plate with milling data from Worthy Park used as illustration of the effectiveness of optimum adjustment.

Preliminary tests with a descaling agent at Worthy Park sugar factory, Jamaica

H. Bourzutschky, D. S. Mkwawa and M. F. Armstrong. *J.A.S.T.J.*, 1981, **42**, 104 - 116.

While Keller & Bohacek KEBO-DS-26 chelating agent at 15 ppm reduced the thickness of scale and syrup colour in the 1st effect of a quintuple-effect evaporator, the need to produce a syrup of 65°Bx made it difficult to monitor the performances of the other effects; although the evaporator appeared to operate well as a result of treatment, heat transfer was still below the desirable level.

Combustion and flue gas analysis

N. G. Osbourne. *J.A.S.T.J.*, 1981, **42**, 116 - 130.

Dry flue gas contains carbon dioxide, oxygen and nitrogen if combustion is complete plus carbon monoxide in the case of incomplete combustion. Combustion efficiency is easily predicted from analysis of CO_2, O and CO. The basic combustion requirements and the value of flue gas analysis are discussed and various techniques for gas analysis summarized with experimental results from two Jamaican sugar factories used as illustration.

Milling and diffusion in Mauritius

J. F. R. Rivalland. *Rev. Agric. Sucr. Maurice*, 1984, **63**, (2/3), 22 - 30 + iii.

Saint Antoine is the only factory in Mauritius to have a diffuser; it is a Saturne machine of 150 tch capacity preceded by one mill and followed by two dewatering mills, and was installed in 1971. The performance of the station is given for the period up to 1984 in the form of diagrams. Comparison of typical maintenance and running costs shows that the approximate proportional costs per tch of a 110 tch diffuser/mill combination are lower than those of mills of 95, 125 and 175 tch capacity. The maintenance costs of a diffuser with or without mills in Australia are also compared with those in Mauritius. While diffusers consume less high-pressure steam, they use more low-pressure (exhaust) steam as a consequence of the additional heating of the recirculation juices and because of the higher imbibition % fibre associated with diffusion; a considerable amount of additional exportable power is possible from the passage of high-pressure steam through turbo-alternators and use of the exhaust steam for diffusion. Four possible systems for increasing the crushing capacity of a factory are examined; they are: (i) replacement of the existing mills with a new mill tandem, (ii) replacement with a diffuser + dewatering mills, (iii) operation of a diffuser in parallel with the existing mill, and (iv) a 15% increase in mill capacity.

The new mill tandem at Grand Bois sugar factory

E. Hugot and A. de Viliers. *Rev. Agric. Sucr. Maurice*, 1984, **63**, (2/3), 31 - 34 + i *(French)*.

Prior to 1984, the 5-mill tandem at Grand Bois comprised units of various roller dimensions and grooving; the performance was considered inadequate, with a bagasse sugar content in 1983 of 2.4% and a moisture content of 48.66% at 95.47% reduced extraction. The tandem was modified, with 3 of the previous units being incorporated in the new system (but two of them in different positions), a 5th mill introduced from another factory and a new Fives Cail-Babcock 4-roller unit installed as 1st mill. A description is given of the new 1st mill, which is a self-setting unit with a delivery roller of the same dimensions as the other three. Super-imbibition of 200 - 220% on fibre involves recycling half of the juice from the 2nd mill to the top of the Donnelly chute at the 1st mill, which has an extraction of 75% and gives a bagasse of 52% moisture content (corresponding to a final bagasse moisture of 46%). The Preparation Index is 89 - 92.

Factors affecting accurate determination of weight and quality in raw sugar. The economic significance of poor-quality raw sugar

M. C. Steele. *J.A.S.T.J.*, 1982, **43**, 91 - 105.

The importance of accurate weighing of raw sugar before and after shipment is discussed and illustrated by an example of inaccurate weighing (because of poor maintenance of the equipment) at a refinery which resulted in a substantial financial settlement awarded by an arbitrary laboratory against the refiners. Possible sources of error in polarimetric evaluation of raw sugar are also examined, followed by a look at raw sugar refining quality and how it can be affected by various types of impurity; the value of inter-laboratory comparison of polarimetric results and factors affecting analytical procedures for raw sugar quality evaluation are indicated.

Beet sugar manufacture

Comparative analysis of mathematical definitions of the rate of sucrose crystallization

M. A. Karagodin. *Period. Polytechn. Chem. Eng.*, 1987, **31**, (3), 179 - 186; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (6), Abs. 6 R493.

Results are given of an analysis of mathematical definitions of the sucrose crystallization process, showing their merits and faults. It is considered advisable to develop a more precise equation of the crystallization rate which more fully takes account of the correlation between process variables. A new equation is presented which defines the crystallization process in impure solutions and which may be used for engineering calculations.

A microprocessor-based controller

F. V. Negoda, O. I. Voronyanskii, A. P. Ladanyuk, V. D. Vitvitskii and A. Ya. Romanyuk. *Sakhar. Svekla*, 1988, (1), 21 - 22 *(Russian)*.

Remikont R-100 is a new microprocessor-based modular control system designed for multitask process control and having available a library of 25 algorithms. During the 1986 campaign it was tested on diffusion control at Rakitnyanskii sugar factory; the parameters involved were temperature in the different zones of the diffuser and of the SO_2-treated water, the cossettes:water ratio, level in the head section and the hydrodynamic load. Data were also fed to a central station for purposes of process optimization. Despite a number of problems, the system operated much better than conventional controls, with a noticeable reduction in temperature response time and increased uniformity of temperature in the first two zones; the controller was highly sensitive to changes in the input signal. The system operated throughout the campaign without any malfunction.

Experience in the operation of sugar factories on three-massecuite boiling schemes

A. P. Pustokhod, T. F. Burlyai and N. I. Khomutetskaya. *Sakhar. Svekla*, 1988, (1), 53 - 54 *(Russian)*.

Of the 20 sugar factories in the Kiev and Chernigov regions of the Ukraine, 10 have operated a 3-massecuite scheme since 1974 while the others have used 2-massecuite boiling. Comparison of average data for the two schemes shows that the 3-massecuite scheme gives better molasses exhaustion and hence lower molasses sugar as well as a sugar of lower colour. Even where, in reconstructed factories, there has been only partial conversion to 3-massecuite boiling (with additional pans and centrifugals but no massecuite distribution trough and no low-grade crystallizer), improvements are possible using a specially devised method for low-grade boiling which is outlined.

Automation of the juice purification section

A. A. Gotsun, V. I. Strel'nikov, A. A. Slavyanskii and A. R. Sapronov. *Sakhar. Svekla*, 1988, (1), 55 - 56 *(Russian)*.

Outlines are given of the schemes at Chishminsk sugar factory for control of filtered 1st carbonatation juice liming, for pH control in 1st and 2nd carbonatation (as well as a method for periodical cleaning of electrodes with HCl) and for control of the 1st carbonatation juice filter-thickener station. Benefits of the measures include a reduction in unknown losses, the exclusion of gravity settlers and a decrease in consumption of filter cloths, milk-of-lime and electricity.

Modification of a beet washer

A. G. Lyabakh. *Sakhar. Svekla*, 1988, (1), 57 *(Russian)*.

Weeds and trash are removed from a beet washer by spilling over (under the action of two directed water sprays) into a rotary perforated drum which allows the water to drain into a vertical chute directly beneath it while the impurities fall freely into another (inclined) chute ahead of the water discharge as the drum revolves. Advantages of the system are indicated.

Control of raw juice liming

L. I. Pankin *et al. Sakhar. Svekla*, 1988, (1), 58 - 60 *(Russian)*.

A typical means of preventing fluctuations in juice residence time is based on automatic maintenance of a given level in the cold liming tank (where fractional liming is used), but this has a number of snags. Experiments were conducted on a system in which the aim was to keep the flow of limed juice constant; variation in raw juice flow and hence in 1st carbonatation juice recycle to preliming caused a change in the level in the cold liming tank which, however, was insignificant provided the flow of limed juice over a short period of time (5 - 15 min) was equal to the sum of the mean raw juice flow, recycle juice and milk-of-lime (even when raw juice flow varied with considerable frequency but the amplitude had no effect). In the case of inequality between the flow of limed juice and that of the other components, the operator altered the target flow. This system was found to have a number of advantages over level control, which was not very sensitive to change in a large cold liming tank. Programmed control based on change in limed juice flow in proportion to the level in the cold liming tank has been proposed but would be practical only with complete evaporator automation.

Investigation of the treatment of water from gas scrubbers

A. I. Sorokin and B. N. Valovoi. *Sakhar. Svekla*, 1988, (1), 62 - 64 *(Russian)*.

Experiments and statistical analysis of their results were used to determine optimum conditions for removal of solids from gas scrubber water.

Effect of nitrogenous fertilizer on (beet) storage

M. Loilier and B. Noe. *Sucr. Franç.*, 1988, **129**, 93 *(French)*.

The effect of N application rate on beet quality at harvest, respiration losses during storage and on beet quality after storage was determined for four rates (75, 125, 175 and 225 kg/ha, where 125 kg/ha was the recommended amount). The beets were washed and their leaves removed before storage for 41 days at 10°C. While storage losses did not differ significantly with variation in N rate, the sugar content fell and the molasses sugar rose in both fresh and stored beets with increased N application; thus, the recommended N rate was optimum in regard to financial return, storage and beet quality.

IRIS control of the evaporator station

J. C. Giorgi, B. Portales and P. Crevits. *Sucr. Franç.*, 1988, **129**, 97 - 101 *(French)*.

Experiments conducted at Lillers sugar factory on control of a sextuple-effect evaporator are reported. The system included three modules: (1) controlling pressure by regulating that in the 1st effect and bleeding the maximum amount of vapour compatible with the steam flow needed for a constant value in the 5th effect; (2) stabilizing Brix by injecting supplementary juice, where necessary, into the 1st effect, after the 3rd effect and before the 5th effect; and (3) slowly adjusting the final Brix to a target value by imposing a given vapour flow to the condenser if necessary, or imposing a minimum flow of expanded steam. After some teething troubles, particularly erratic behaviour of the 3rd effect (which necessitated modification to the control algorithm), the overall system functioned satisfactorily from November 30 to the end of the campaign, with uniform final Brix.

Further tests on flowmeters in the sugar industry

B. Portales, P. Crevits and D. Maes. *Sucr. Franç.*, 1988, **129**, 103 - 108 *(French)*.

Tests were conducted on measurement of flow of raw and thin juice using six electromagnetic and five mass flowmeter models; the experiments were conducted at juice temperatures of 70°C and 90°C and a pressure in the range 0.5 - 7.0 bar, and lasted a total of 43 days (7 days to determine performance of the mass flowmeters with raw juice, and 36 days to test the reliability, particularly of the electromagnetic models, with thin juice. Results (which do not identify the particular models) are tabulated and indicated in the form of diagrams; they showed that both types performed satisfactorily with thin juice but less so with raw juice because of the presence of colloids which caused errors that were particularly random in the case of the mass flowmeters.

Development and distribution of the Cleopatra system in the sugar industry

G. Windal, A. Deleurence and H. Lavogiez. *Sucr. Franç.*, 1988, **129**, 111 - 114 *(French)*.

Over a number of years, the Cleopatra data management system has been introduced for use by minicomputer in 15 French sugar factories; since 1986 the software has been available on microcomputer, and three factories have adopted it, two for management of laboratory data and one for calculation of boiler heat balances. Details are given of the major components of the system which is available in two versions and for which the demand within the French sugar industry has greatly increased.

Complementary studies on the possibility of storing sugar syrups over a long period

G. Vaccari, W. Scheda, G. Sgualdino and G. Mantovani. *Ind. Alim. Agric.*, 1988, **105**, 141 - 147 *(French)*.

Studies carried out in 1985[1] were continued in 1986; 27 tonnes of thick juice were transferred from a large storage tank to a 35-tonne tank at 25°C, and 80 kg of formalin added (the juice had already been treated with disinfectant in the large tank). The temperature remained at 10°C during November/March and then progressively climbed to 30°C in August. Analyses of samples taken each month showed only slight falls in pol and Brix and a more pronounced increase in colour; the extent of degradation rose with temperature and was particularly marked at 30°C. Colour formation was inhibited by pretreatment with sodium bisulphite which tended to have a bacteriostatic effect, marked juice stability being observed where it was maintained at ambient temperature as against 30°C. Microbial activity was also more pronounced at the higher temperature. Lactic acid proved to be unsuitable as an indicator of bacterial activity.

Improving purification processes

V. Z. Semenenko, N. I. Zharinov, V. G. Zhizhina, L. V. Khivrich and A. I. Kovtun. *Sakhar. Svekla*, 1988, (2), 42 - 44 *(Russian)*.

Examination of 1st carbonatation juice liming showed that it should be carried out at 85 - 95°C so as to minimize sucrose degradation and lime salts in 2nd carbonatation juice, reduce heat losses and optimize the filtration rate and should last no more than 7 min with good-quality juice and 11 min with poorer juice in order to minimize lime salts. There is no need to "ripen" juice to promote removal of temporary hardness salts (carbonates) in 2nd carbonatation where 1st carbonatation juice is limed, particularly since this could protract the overall purification process by up to 15 minutes. Recycled 2nd carbonatation mud is almost pure $CaCO_3$ and so causes less reversible transfer of non-sugars in main liming than recycled 1st carbonatation mud; moreover, the smaller amount of 2nd carbonatation mud recirculated to preliming and 1st stage cold liming allows these processes to be conducted at optimum temperature, and preliming efficiency will be higher if the mud feed point corresponds to the lowest

1 Vaccari *et al.*: *I.S.J.*, 1986, **88**, 103A.

juice conductivity (equivalent to pH_{20} 8 - 9.2). Lime added to 1st carbonatation juice is also of benefit where settlers pre-coated with mud or automatic filters are used for 2nd carbonatation juice. Activation of 2nd carbonatation mud by liming before it is recycled to preliming enhances its adsorptive properties but is not recommended where raw juice has a high colloid content. A factory experiment showed that addition to 2nd carbonatation juice of 200 - 300 ppm (on beet) polyacrylamide activated with sodium triphosphate at 50 - 60°C permitted optimum settling while having no negative effect on juice processing quality when recycled in the mud to preliming.

Re-utilization of filter cake

D. V. Ozerov, A. R. Sapronov and Kh. Kh. Battalov. *Sakhar. Svekla*, 1988, (2), 45 - 46 *(Russian)*.

Heating filter cake at 550 - 650°C in the absence of oxygen yields a blac powder containing 4 - 5% by weight of an active carbon fraction plus CaO and MgO and $CaCO_3$. It achieved a maximum of about 75% colour removal from raw juice containing 15% sugar and 1.25% molasses when added at 10% by weight compared with approx. 100% decolorization using 5% Super-Norit carbon and only 10% decolorization with 5% filter cake. Addition of the powder at 1.8% to preliming and at 1.6% to fractional cold and hot liming reduced thick juice colour and lime salts and raised the purity while cutting lime consumption by 28.7% compared with conventional liming without the calcined filter cake.

A cold liming tank

L. I. Pankin, N. A. Kurinnoi, A. R. Sapronov, V. M. Leshchenko and I. A. Nesteruk. *Sakhar. Svekla*, 1988, (2), 46 - 47 *(Russian)*.

A juice-lime mixer placed between the preliming tank and the tank for 1st stage cold liming takes the form of a vertical cylindrical vessel with a central rotating shaft carrying hollow perforated discs in which blades at 45° extend up from the floor of each disc and blades extend down from the ceiling at the same slope but in opposite direction, the formation alternating with each disc. Juice plus lime enter at one side and towards the bottom of the cylinder and flow up into the first disc and are mixed by the blades; the juice is thrown up towards the next disc and is sucked in through the perforations to continue the flow as in the first disc, and so on. As a consequence of alternation of the staggered arrangement of the blades in the discs, the number of discs pushing the juice towards the discharge point as it flows up the vessel is one more than the discs pushing the juice in the opposite direction, so that there is no flow resistance. Results of tests showed an active alkalinity that was constant within experimental error. The mixer drive is rated at only 2 kW.

Experience in regeneration of filtration septa

A. I. Kolomiets, Ya. O. Kravets and L. P. Zarundev. *Sakhar. Svekla*, 1988, (2), 47 - 48 *(Russian)*.

Regeneration of septa in various types of filter, using e.g. HCl or sulphamic acid, is discussed and results of tests conducted at Yagotin factory on candle filters and filter-thickeners are reported. Chemical cleaning coupled with pulsatory removal of cake using compressed air is a method that has proved successful with candle filters and is applicable with other filter types. Centrifugal action to remove cake in Funda disc filters has not been sufficiently efficient and the metal gauze septum has become clogged with incrustation. HCl treatment has given good results with synthetic fibre cloths in candle filters at Odessa refinery; these handle sulphited raw sugar remelt liquor and are subject to considerable incrustation.

A catchall for massecuite droplets from vacuum pans

N. D. Khomenko and V. K. Marchukovskii. *Sakhar. Svekla*, 1988, (2), 48 - 49 *(Russian)*.

A massecuite entrainment separator takes the form of a vertical cylindrical vessel through the top section of which passes the pipe carrying pan vapour to the condenser. A vertical baffle somewhat longer than the diameter of the vapour line and suspended from the roof of the vessel alters the direction of flow of the vapour and causes it to decelerate, whereupon (because of their greater density) the massecuite droplets fall to the conical bottom of the vessel and pass through a valve into a lower vessel of the same capacity as the upper vessel. When the lower vessel is full, the valve closes and a bottom valve opens to discharge the contents. The massecuite from *A*-pan vapour is transferred to the melter, that from *B*-pan vapour is included in the material for *A*-massecuite boiling, and the material from *C*-pan vapour is used for *B*-massecuite boiling. The system has operated reliably and efficiently at Shpikov sugar factory.

Investigation of sucrose hydrolysate purification with active carbons

L. I. Tanashchuk *et al. Rpt. Kiev. Tekhnol. Inst. Pishch. Prom.*, 1987, 10 pp.; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (7), Abs. 7 R435.

Purification of sucrose hydrolysates with active carbons was studied with the aim of using them for chromatographic separation of glucose and fructose. The adsorption of monosaccharide degradation products and colouring matter were investigated. Optimum conditions for purification of the hydrolysates with OU-B active carbon were: 15 - 20 minutes' treatment at 65°C with 2% carbon on weight of dry solids. Three-stage purification of hydrolysates obtained on KU-2-8 ion exchange resin removed 92% of the monosaccharide degradation products absorbing light in the U.V. band; 78% decolorization was achieved.

Sugar refining

Removal of the principal groups of colorants during phosphatation

V. V. Chopik, E. González R. and A. Fariñas B. *CubaAzúcar*, 1986, (Jan.-March), 8 - 12 *(Spanish)*.

In the period since 1964 the colour removal achieved during phosphatation of raw sugar liquor at the Martínez Prieto refinery section has fallen from 23.7 to 7.7% in 1983. This is attributed to operational difficulties but also to change in the nature of the colorants present. Study has shown that the greatest elimination in phosphatation is that of caramels and the least the alkaline degradation products from reducing sugars, with melanoidins intermediate. The last two groups have been favoured by recent changes. Since they are found mainly in the molasses film on the raw crystal, the use of some form of affination is recommended.

Removal of polysaccharides and improvement of filtrability by the application of quaternary amines

V. V. Chopik and A. Fariñas. *ATAC*, 1986, **45**, (2), 41 - 44 *(Spanish)*.

Removal of polysaccharides and the corresponding increase in filtrability of raw sugar liquor with traditional phosflotation and that combined with the use of polyacrylamide flocculants and the introduction of dimethyldialkyl ammonium chloride ("Talofloc") have been studied. The last showed an appreciable reduction of polysaccharides and a notably better increase in filtrability.

The use of mathematical models in the crystallization process

F. Defacqz. *Paper presented at Ann. Meeting Sugar Ind. Technol.*, 1988, 8 pp.

Mathematical models are needed to establish data essential for dimensioning equipment where plants are being modernized, particularly if the proposed modifications affect the energy system. Requirements of a mathematical model are: a performance that surpasses that of the plant, high accuracy and reliability and faithful representation of the actual situations, taking into account as many factors as possible relative to the process itself and the condition of the plant. Within the context of energy conservation studies, an overall view of the plant is essential; this requires analysis of the different sections and of their influence on the energy system. The crystallization section is of major importance in this regard; a detailed study of it permits optimization of the various operations and identifies those areas where energy can be saved. The crystallization section at Raffinerie Tirlemontoise is used as an illustration of the application of mathematical models; the station is completely automatic, using a 4-strike boiling scheme to produce about 900 tonnes of sugar and 500 tonnes of molasses per day from thick juice and 2nd green syrup obtained from sugar factories within the same group (the green syrup of 72 - 74 purity and 75°Bx being the residual product from white sugar factories which do not produce molasses). Factors affecting the operation of the crystallization section include the ratio and qualitative parameters of the thick juice and green syrup and the proportion of lst and 2nd refined sugar to be produced. Allowing for these factors, production of sugar of a requisite quality and optimum molasses exhaustion depend on regulation of a number of operating parameters; it is shown, by way of examples, how any change in a parameter leads to changes in the energy consumption as well as in the quality of the products. An example is also presented which demonstrates how a mathematical model helps the operator by showing whether a particular course of action will give the desired results once set-points have been adjusted as required.

Production and refining of Hawaiian high pol, very low colour sugars

D. M. Humm. *Paper presented at Ann. Meeting Sugar Ind. Technol.*, 1988, 15 pp.

A study of the manufacture and refining of very high pol (VHP) raw sugar (having a pol of 99.17 and containing a maximum of 1200 ICUMSA units of colour, 0.20% moisture and 0.63% dry non-sucrose solids) showed that 6 out of the 12 Hawaiian factories could produce sugar of the requisite quality without major restructuring and would provide enough to meet the refined sugar market requirements of Crockett refinery. Recommended process changes included replacement of a 3-massecuite boiling system (as used in all Hawaiian factories) with a *B*-magma system (a modified 3-boiling scheme involving mingling of *B*-sugar with syrup to form a magma that is used as footing for the *A*-strike from which all the commercial sugar is produced); this system generally yields a larger crystal of high pol and low colour. Although Hawaiian cane varieties give a high-purity juice, harvesting methods used cause high levels of insoluble solids which place a considerable load on the clarifiers and mud filters; hence, for some factories syrup and/or filtrate clarifiers were recommended that would increase the removal of suspended matter and colloidal impurities (some of these colour precursors) as well as providing a slight reduction in colour. Changes envisaged at the refinery included elimination of affination, slight increase in the amount of phosphoric acid added in clarification and provision for addition of a colour precipitant when necessary to increase decolorization, use of only one char house to carry out liquor decolorization (with possible use of existing granular carbon filters and a small regeneration furnace for supplementary decolorization when required), modifications to the soft sugar production scheme and elimination of remelt operations (as a consequence of the absence of affination). The cost savings resulting from reductions in labour, process and equipment maintenance materials, energy and sugar losses are discussed and new or modified process facilities required for VHP sugar processing are indicated.

Starch based sweeteners

On-line high-performance liquid chromatography

G. Fallick. *Anal. Proc.*, 1987, **24**, (4), 108 - 110; through *Food Sci. Tech. Abs.*, 1987, **19**, Abs. 8 L 68.

Successful application in corn syrup production of a totally integrated HPLC system (originally designed for laboratory use) modified to suit on-line analysis (including sample acquisition, conditioning and automated injection without operator intervention) is described. Isomerization of glucose to fructose during production of HFS was monitored. The system used a high-sensitivity differential refractometer and a single-stroke, positive-displacement pump. It was placed in an environmental cabinet in order to provide temperature stabilization and to protect the instrumentation from possible spillage and regular washdown.

Calcium chloride complex formation of glucose syrups and their fractions

G. Pasin and G. G. Birch. *Food Chem.*, 1986, **19**, (2), 149 - 158; through *Ref. Zhurn. AN SSSR (Khim.)*, 1987, (21), Abs. 21 R393.

Studies revealed that $CaCl_2$ forms complexes with components of glucose syrups, especially with higher sugars; the properties of complexes formed with syrups obtained by reverse osmosis were examined in the case of six samples containing 0 - 45% glucose and 15 - 89% higher sugars. The complexes were dried under vacuum at 65°C. Analysis of samples from syrup of low DE showed that increase in the Ca chloride concentration from 0.1 to 0.3 g/g carbohydrate in 100 ml water was accompanied by a reduction in the specific rotation, osmotic pressure and conductivity of the solutions while their viscosity rose. However, the specific rotation and conductivity of complexes formed with syrup of high DE (68) hardly changed.

Production of high fructose syrup as sweetening agent from corn starch and bagasse

G. L. Shukla and K. A. Prabhu. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, G.41 - G.48.

Glucose isomerase produced by cultivation of *Lactobacillus* sp. on bagasse acid hydrolysate (giving a level of activity of the enzyme in the cells that was as good as in a medium containing xylose and glucose) was immobilized and used to produce HFS from corn and bagasse hydrolysates; glucose conversion to fructose was 38% and 39% in the case of the corn acid and enzyme hydrolysates but only 28% and 20% for the corresponding bagasse hydrolysates.

Determination of the DE and Brix values of starch hydrolysates obtained by different processes of starch hydrolysis in laboratory conditions

V. Dordevic. *Ind. Secera*, 1986, (1 - 2), 33 - 36; through *S.I.A.*, 1988, **50**, Abs. 88-125.

Starch syrups were hydrolysed by acid, acid-enzyme and enzyme-enzyme methods. Tests showed that the specific rotations of the hydrolysates were related to the degree of starch degradation. There was a direct relation between specific rotation and total reducing sugars content for hydrolysates obtained by the acid method, but not for those obtained by the enzymatic method.

A computer-aided automatic refractometer designed for the measurement of dry substance in starch hydrolysates

L. E. Fitt. *Intell. Instrum. Comput.*, 1987, **5**, (3), 127 - 134; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (2), Abs. 2 R441.

An assessment is presented of the performance of computerized automatic refractometer in the analysis of samples of glucose-fructose syrup (containing 42, 55 and 90% fructose), glucose syrups (of 28, 45 and 64 DE) and maltose syrups. The dry solids contents were determined as well as the mean square errors and relative deviations.

High-fructose syrup - a potential nutritive sweetener

P. L. Soni and H. W. Sharma. *Res. and Ind.*, 1986, **31**, (2), 144 - 147; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (3), Abs. 3 R487.

The features of the conventional method of HFS manufacture from starch by fermentative hydrolysis and subsequent treatment of the glucose with isomerase are examined. The advantages of HFS over sucrose are noted: reduced number of calories, high bacterial stability, and increase in the quality of end-products (which are of stronger taste) from HFS. Tests were conducted on glucose conversion to fructose by treatment of glucose syrup (of 95 - 96 DE) with a strong anion exchanger (Duolite A-7 and Kastel A-501D); anion exchange treatment of a glucose solution of 40 - 42% concentration lasted 12 - 18 hr; K_2HPO_4 was added to maintain a pH of 8.9 - 9.1. The HFS obtained was filtered, decolorized and analysed; it contained 40 - 42% fructose and 58 - 60% glucose. The performance of the anion exchanger fell after 60 cycles at 60°C and after 30 cycles at 70°C.

Proposal for the manufacture of high-fructose corn syrup (HFCS) as a sweetener for soft drinks

G. L. Shukla and K. A. Prabhu. *Proc. 50th Ann. Conv. Sugar Tech. Assoc. India*, 1987, G.17 - G.24 + diagram.

A small-scale plant for manufacture of HFS by isomerization of glucose (produced by wet milling of maize) using a glucose isomerase obtained from *Lactobacillus* sp. is described and the economics are calculated for a daily production of 500 kg.

Starch/sugar - competition for sweetener market in Europe

T. Cronin. *Zuckerind.*, 1988, **113**, 283 - 288.

See *I.S.J.*, 1988, **90**, 18A.

Laboratory studies

Determination of tin in wines and sugar beets by means of atomic absorption spectroscopy with hydride generation

G. P. Molinari, M. Trevisan, P. Natali and A. A. M. Del Re. *J. Agric. Food Chem.*, 1987, **35**, 727 - 731; through *Anal. Abs.*, 1988, **50**, Abs. 3F63.

For determination of Sn in beet samples, portions were digested initially in a Buchi 445 digestor using sulphuric and nitric acids; the solution, filtered if necessary, was analysed by hydride-generation atomic absorption spectroscopy with sodium borohydride as reagent in 0.7M acetate buffer, and detection at 286.3 nm (full instrumental details are given). The effects of buffer, HCl and reaction time on the results were investigated. A method for determination of organic Sn is also presented. The method is applicable to samples containing 3.3 ppb or less total Sn or 0.33 ppb or less organic Sn.

Determination of reducing sugars with 2,4-dinitrophenol

M. Muranyiova and A. Smelik. *Listy Cukr.*, 1988, **104**, 56 - 60 *(Czech)*.

A modification of the method of Zagorul'ko *et al.*[1] is described which was used to determine reducing sugars in beet brei and refined sugar. The reagent used was 1 g of 2,4-dinitrophenol dissolved in 100 ml distilled water with 20 ml of 2M NaOH and 30 g sodium potassium tartrate and made up to 200 ml in a measuring flask. For reducing sugars concentrations in the range 0.1 - 1.0 mg/ml, 1 ml of the reagent was used to prepare a calibration curve, and spectrophotometric measurement of absorbance was made at 490 nm. For beet brei analysis, 150 ml of distilled water was added to 104 g of the brei together with 7 ml neutral lead acetate, followed by heating on a water bath for 30 min at 80 - 85°C; after shaking a number of times and cooling to 20°C, to 100 ml of the filtrate was added 20 ml $Na_2HPO_4,12H_2O$ and made up to 200 ml. The value of reducing sugars % was 0.5y, where y was the value (mg/ml) on the calibration curve. For refined sugar, a 40% concentration was used, and the value found was 0.25y. Results were in good agreement with those given by the Ofner method. For beet brei, the method is valid down to 0.05% reducing sugars, while the lowest concentration in refined sugar is 0.012%.

A new method for estimation of polyphenols in cane juice

V. Dubey and M. Prasad. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, C.15 - C.19.

A method for determination of polyphenols in raw cane juice is based on the formation of a coloured complex between magnesium chloride and phenolic compounds with absorption maxima at 610 nm, gallic acid being used as standard. The method is shown to be more accurate than that of Smith & Gregory[2].

Determination of traces of zinc, cadmium, lead and copper in white sugar by anodic-stripping voltammetry and a modified oxygen-flask combustion technique

T. M. Karadakhi, F. M. Najib and F. A. Mohammed. *Talanta*, 1987, **34**, (12), 995 - 999; through *Anal. Abs.*, 1988, **50**, Abs. 4F16.

Up to 1.5 g of sample could be ignited in a modified 10-litre combustion flask (described) containing a borosilicate glass sample cup (25 mm × 18 mm) with perforated walls. An oxygen flow of approx. 0.5 litres/min provided safe and complete combustion. Effective sample size could be increased by successive combustions. A sample (50 ml) of the combustion absorbent (25 ml of 0.5M HNO_3) was made approx. 0.1M in HNO_3 and adjusted to pH 4 with solid Na acetate before anodic-stripping voltammetric measurement of Zn, Cd, Pb and Cu with use of a hanging mercury-drop electrode, metal deposition at – 1.2 V and differential pulse scanning the positive direction at 10 mV/sec with a modulation amplitude of 25 mV. The stripping current was measured before and after each of five additions of 0.01 ml of a solution containing 100 µg/ml of Zn and Cu and 10 µg/ml of Cd and Pb. Recoveries of 250 µg of added metal were 90% for Cd and at least 99% for Zn, Cu and Pb. Analysis time with a single 1.5-g combustion was approx. 50 min.

Inter-laboratory analyses

P. Devillers, J. P. Ducatillon and J. P. Lescure. *Sucr. Franç.*, 1988, **129**, 125 - 130 *(French)*.

Comparison was made between results obtained by a large number of laboratories in determining sugar crystal size, conductivity ash, colour and SO_2 (the colour and ash values being added to individual assessments of appearance to provide points under the EEC system, in which 42 laboratories participated); 36 laboratories were involved in granulometry determination, while 16 measured the SO_2 content. The results are discussed.

Sucrose crystal growth kinetics in the presence of some peculiar impurities

G. Mantovani, G. Vaccari, G. Sgualdino, D. Aquilano and M. Rubbo. *Sugar J.*, 1988, **50**, (11), 4 - 6.

Studies showed that the growth rate of sucrose crystals fell with increase in the amount of CaO added to the solutions; even as little as 0.2% CaO w/w caused >50% decrease in the growth rate of all faces by comparison with a pure solution, while 0.5% CaO caused 93 - 98% reduction. The magnitude of the effect of the amount of CaO was not constant between faces. Further studies involving dissolution of the crystals suggested that the effect of the CaO was due to the formation of complexes between calcium and sucrose.

1 *I.S.J.*, 1980, **82**, 256.
2 *Proc. 14th Congr. ISSCT*, 1971, 1415 - 1425.

By-products

Feeding MSBF (molassed sugar beet feed) in ewe concentrates in the practical situation

J. Harland. *British Sugar Beet Rev.*, 1988, **56**, (1), 71 - 72.

Trials in which pregnant and lactating ewes were fed on rations of varying composition, including ones containing molassed beet pulp, showed that the performance of those fed on the pulp was as good as if not better than those fed on a conventional compound. Although farmers had expressed concern at the risk of prolapse in ewes fed on bulky rations (beet pulp being considered as such) in late pregnancy, it is now generally accepted that it is not the physical bulk of the diet which is important but rather the maintenance of a regular flow of nutrients through the digestive tract so as to prevent rumen distension and stasis; stasis occurs as a consequence of a fall in pH, which leads to a reduction in activity of the cellulytic bacteria and hence prevention of fibre digestion, so that the size of the rumen increases. It is felt that beet pulp can be of value in buffering conditions in the rumen and ensuring optimum conditions for forage digestion, whereas cereals or starch-based feeds, particularly if fed once a day, can lead to a rapid fall in pH.

The production of baker's yeasts in molasses alcohol distilleries

N. I. Derkanosov and A. I. Andrukh. *Ferment. i Spirt. Prom.*, 1987, (6), 4 - 5; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (5), Abs. 5 R365.

There has been a sharp fall in the manufacture of baker's yeast associated with a reduction in alcohol production. At Veselopanskii distillery an accelerated technique has been developed for production of high-quality pressed yeasts suitable for drying; the process permits a considerable increase instead of a decrease in product yield, even where alcohol production from molasses is reduced by 60 - 70%, and can provide a high yield of carbon dioxide (for use in non-alcoholic beverages) and of fodder yeasts without detriment to alcohol quality.

Enzyme production by anaerobic fermentation of pressed beet pulp

K. Buchholz and H. J. Arntz. *Zuckerind.*, 1988, **113**, 204 - 208 *(German)*.

Batch fermentation experiments were conducted on pulp in a 150-litre stirred reaction vessel using, as inoculum, a slurry of mixed cultures adapted to the substrate; 92% of the pulp was degraded after 140 hr. Samples of the suspension of substrate and micro-organisms were screened and microfiltered to remove solids, after which ultrafiltration yielded a stable enzyme concentrate. Detailed analysis revealed the secretion of a wide range of polysaccharide-degrading extracellular enzymes, particularly pectinases, pectin lyases, arabanases, galactanases and cellulases but no galacturonic acid; under suitable conditions their concentrations were considerably greater than in continuous fermentation hydrolysis. The formation of oligosaccharides as intermediate products suggested the occurrence of enzyme induction and repression.

Studies on thermotolerant yeasts

R. Kar and L. Viswanathan. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, G.15 - G.20.

Eight thermotolerant yeasts (*Candida tropicalis, C. krusei* and *Pichia ohmeri*) isolated from various sources were found to grow well at temperatures in the range 30 - 42°C, with one strain of *C. krusei* growing at up to 45°C; the growth of all eight was luxuriant on all the common media used. Subsequent studies demonstrated their potential for industrial application in alcohol and single-cell protein production from molasses and cane juice.

Utilization of bagasse for the production of protein-rich edible mushroom

P. Thangamuthu. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, G.21 - G.35.

A scheme is described for growing edible mushrooms from a spawn using bagasse as substrate; bagasse was found to give a better yield than paddy straw or waste paper.

Chemical cleaning of scales in distilleries

S. K. D. Agarwal. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, G.36 - G.40.

The use of HCl plus Rodine-213-Special inhibitor to remove scale from the tubes in two horizontal condensers at a distillery is described.

Ethanol production from unclarified cane molasses. III. Screening of yeasts for capacity and temperature tolerance

D. S. Dahiya, S. S. Dhamija, B. S. Yadav and P. Tauro. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, G.49 - G.56.

Of four strains of *Saccharomyces cerevisiae* screened for their capacity to produce ethanol at 25°C in either single- or double-strength yeast extract, peptone, glucose and agar broth containing 30% sugar, the best (HAU-21) yielded up to 16.2% ethanol within 3 days; however, in a molasses medium containing 30% sugar and supplemented with N and P, the same strain could produce only approx. 11.4% ethanol in 3 days and a maximum of 13.2% in 6 days at 25°C, while productivity at higher temperatures (up to 40°C) was not very high. Nevertheless, its performance is still considered acceptable in view of the reduction in effluent loads that results from the use of molasses of high Brix.

Standardization of conditions for increasing biomass in the inoculum medium for ethanol production

S. Sharma, M. C. Bardiya and P. Tauro. *Proc. 49th Ann. Conv. Sugar Tech.*

Assoc. India, 1986, G.57 - G.64.

Experiments are reported which were aimed at standardizing conditions for increasing the yeast biomass in the inoculum medium for alcohol production from cane molasses using Strain 21 of *Saccharomyces cerevisiae*. Results showed that the biomass concentration could be significantly increased by including 0.1% corn steep liquor or 0.25% yeast extract in the initial build-up of inoculum, while shaking during this initial period also caused a considerable rise in concentration to a limit that was probably associated with the inherent characteristics of the molasses medium.

A new phenomenon of rapid deterioration of sugar cane molasses during storage and its control

S. K. D. Agarwal. *Proc. 49th Ann. Conv. Sugar Tech. Assoc. India*, 1986, C.1 - C.5.

At an Indian distillery, the Brix of cane molasses in a storage tank fell from 90° to 80° and the total reducing sugars from 50 to 43% within a week; they fell to 76° and 41%, respectively, during the next two days. The deterioration was associated with the development of a 4 - 5 mm thick film of fungi on the surface. The problem was solved by adding a commercial product, Antifoam-Special-7421.

Utilization of sucrose as an industrial bulk chemical - state of the art and future implications

H. Schiweck, K. Rapp and M. Vogel. *Chem. & Ind.*, 1988, (7), 228 - 234.

A survey is presented of sucrose, fructose and glucose derivatives and their possible applications in the food and chemical industries, the utilization of invert sugar and isolation from it of glucose and fructose, the production of hydroxymethyl furfural from fructose and its uses as a multi-functional compound, and fermentation processes based on sucrose and other sugars; 38 references are given to the literature.

Ethanol as a source of energy

M. Fleurant and J. R. Harel. *Rev. Agric. Sucr. Maurice*, 1984, **63**, (2/3), 101 - 114 + iv.

Although it is calculated by stoichiometric analysis that molasses should yield 280.4 litres of ethanol per tonne under local conditions, the actual yield was only 225 litres/tonne (equivalent to only 84.5% conversion) despite the use of sophisticated equipment and tight process control. Possible reasons for the poor performance are listed, and efforts to optimize the fermentation process are described. The steam and electricity consumption in fermentation and distillation is analysed and the possibility of improving the energy balance by incinerating the vinasse is considered; both this and the possible incineration of molasses to produce steam and power would yield a considerable quantity of ash (and it is not known if molasses could be burnt efficiently). The conclusion is that it is economically more advantageous to export molasses and to use the currency to buy fuel oil for energy generation rather than rely on fermentation to alcohol in Mauritius.

Utilization of cane molasses for fat production by yeasts

B. S. Yadav and D. S. Dahiya. *Proc. 50th Ann. Conv. Sugar Tech. Assoc. India*, 1987, G.7 - G.16.

Use of urea as nitrogen source in cane molasses fermentation by *Rhodosporidium toruloides* and *Candida curvata* helped to raise the lipid accumulation to 35.7% (w/w) and 38.1%, respectively, with a biomass accumulation of 9.5 and 11.2 g/litre, respectively, after 72 hours' incubation; however, although increasing the C:N ratio raised the lipid accumulation to 40.0% in the case of *R. toruloides* fermentation, it reduced the final accumulation to 33.1% with *C. curvata*.

Studies on synthesis of 5-hydroxymethyl 2-furancarboaldehyde (HMF)

A. Kulkarni, H. M. Modak and S. J. Jadhav. *Proc. 50th Ann. Conv. Sugar Tech. Assoc. India*, 1987, G.35 - G.39.

See Kulkarni *et al.: I.S.J.*, 1988, **90**, 107A.

Effect of age of inoculum on growth and reduction in chemical oxygen demand (COD) values during distillery waste treatment by bacterial strains

S. Kumar, P. K. Agrawal and L. Viswanathan. *Proc. 50th Ann. Conv. Sugar Tech. Assoc. India*, 1987, G.41 - G.44.

The growth of six bacterial strains in vinasse and their COD-reducing performances were investigated; cells were grown for 16, 32, 72 and 96 hours before inoculation into the fresh medium. Inoculum obtained after 32 hours' growth of cells gave the best bacterial growth in the vinasse and gave the greatest reduction in COD.

Paper chromatography of volatile organic acids accumulated during distillery waste treatment by bacteria

S. Kumar, P. K. Agrawal and L. Viswanathan. *Proc. 50th Ann. Conv. Sugar Tech. Assoc. India*, 1987, G.45 - G.48.

The main products of bacterial treatment of vinasse (see preceding abstract) were found to be CO_2, volatile acids and biomass; large quantities of volatile acids accumulated as the COD and BOD fell, and an attempt has been made to identify them. The presence of formic and acetic acids throughout the growth period in most of the strains indicated incomplete metabolization by the bacteria.

Sucrose derivatives - sugar as hydrophilic building block

M. Kunz. *Zuckerind.*, 1988, **113**, 273 - 278 *(German)*.

Utilization of the hydrophilic properties of sucrose to produce chemical interme-

diates for the manufacture of polymers and tensides is discussed. While monoesterification experiments with various sophisticated reagents gave mixtures of sucrose derivatives having different degrees of esterification, a 2-stage biochemical/chemical technique yielded hydrophilic polyhydroxy compounds suitable for use as intermediates. Details are given.

Polymers based on carbohydrates

H. Giehring. *Zuckerind.*, 1988, **113**, 279 - 282 *(German).*

An account is given of polymer synthesis from sugars, particularly sucrose and glucose, by chemical conversion or fermentation; products mentioned include polyurethane foams, polysaccharides such as Ficoll (of application in various chemical processes), polydextrose, dextran, pullulan and xanthan.

Photostimulation of microbial synthesis of citric acid on media containing various carbon sources using light of different wavelengths

I. A. Eremina and L. N. Chebotarev. *Izv. Vuzov, Pishch. Tekh.*, 1988, (1), 97 *(Abstract only).*

It was found that light of 410 nm wavelength had the greatest effect on the accumulation of the product obtained by growth of a fungus on a medium containing sucrose as carbon source and that visible light had the greatest stimulating effect on microbial synthesis of citrate on media preferably containing glucose and sucrose; a sufficiently high yield of the target product was provided at a relatively small deficiency of the sugars.

The hydration properties of carbonate waste from sugar manufacture

S. P. Olyanskaya, I. A. Oleinik, E. N. Shirokikh and K. I. Bazhal. *Izv. Vuzov, Pishch. Tekh.*, 1988, (1), 111 *(Abstract only).*

The interaction between water and the surface of carbonate muds and of pure calcium carbonate was investigated and recommendations were made regarding conditions for carbonate mud drying. The study is of interest to workers in industrial and scientific fields.

Continuous production of fermentation alcohol: a new process proven on an industrial scale

H. M. Deger, B. Dorsemagen, N. Hofer, M. Klein and G. Wöhner. *Chem.-Ing.-Techn.*, 1987, **59**, 863 - 867; through *Ref. Zhurn. AN SSSR (Khim.)*, 1988, (7), Abs. 7 R357.

An industrial plant for continuous production of alcohol by fermentation, using a process developed by the West German firms Hoechst AG and Unde, was installed in Brazil in 1986; it consists of two lines, each producing 75,000 litres per day. The process involves aerobic fermentation under non-sterile conditions using *Saccharomyces cerevisiae* X-1121. Subsequent 2-stage rectification yields 94 - 96% alcohol containing a mixture of acetaldehyde, methanol, acetone, ethyl acetate and C_5 alcohol at 1, 20, 23, 13 and 5 g/100 kg alcohol. The alcohol concentration in the fermentation product is up to 8.2% by volume and the alcohol yield 95.3% of theoretical.

Present status of the sugar cane by-product industries in India

M. Rao. *GEPLACEA Bull.*, 1988, **5**, (5), 5 pp.

Despite the size of the Indian sugar industry, with nearly 400 sugar factories, by-products utilization is limited since some 93% of the sugar produced is consumed domestically and there has been no need to insulate the industry against falling world sugar prices. However, bagasse is used for paper and cardboard manufacture, and accounts are given of the activities at the 10 small paper mills operating in the country and at the three large mills that are in operation (two in Tamil Nadu and one in Karnataka). A plant for the manufacture of furfural from bagasse produces enough to meet the needs of two oil refineries where it is used as a solvent. Currently, 165 distilleries in India produce some 600 million litres of ethanol from molasses; half of the quantity produced is used as a raw material for chemicals manufacture, while the other half is used for the manufacture of alcoholic beverages. Mention is also made of the manufacture of ephedrine hydrochloride (a nasal decongestant) and of phenylacetyl carbinol (also used in medicine) from molasses.

Evaluation of various alternatives for the treatment of sugar cane harvesting residues for beef cattle. I. The effect of NaOH or NH_3 treatments on *in vitro* digestibility of some fibrous residues

R. Stuart. *Cuban J. Agric. Sci.*, 1988, **22**, 55 - 61.

Investigation of the effects of NaOH and ammonia on *in vitro* dry matter digestibility of green and dry cane leaves and bagasse pith is reported; the ground material was mixed 1:1 (dry basis) with a solution containining 0, 2, 4, 6 and 8% NaOH or 3% ammonia (by weight of cane material). Results showed that digestibility rose with increased NaOH, while ammonia treatment gave a value midway between that given by 2 and 4% NaOH.

Digestive indicators in pigs consuming high final molasses levels with the addition of fibre. I. Apparent digestibility

N. Rodriguez, R. Boucourt and S. Riveri. *Cuban J. Agric. Sci.*, 1988, **22**, 75 - 80.

The apparent digestibility of a diet containing final molasses and protein concentrate was lower than for the same diet to which Bermuda grass hay meal had been added to provide fibre. The hay supplement also caused a reduction in water intake.

These calculations, although approximate, were carried out on the basis of the analysis of the magma entering the centrifugal and the syrup filtered in the laboratory. Moreover, the data concerning the weighing of the sugar produced and the measurement of the volume and density of the total syrup analysed in the laboratory confirmed that its exhaustion was practically optimum.

In Tables I and II are shown analytical data concerning one of the control tests we carried out, and the calculated theoretical figures.

Table I. Analytical data from one control test

	Standard liquor	Mother syrup	Run off
Massecuite, tonnes/hour	100.00	67.20	72.05
Dry substance, tonnes/hour	82.00	49.20	53.03
Sucrose, tonnes/hour	73.14	40.34	44.17
Purity	89.20	82.00	83.30
Brix	82.00	73.21	73.60
Supersaturation coefficient	1.0429	0.9932	
Saturation coefficient	0.9703	0.9712	
Residual supersaturation coefficient	1.0748	1.0227	
Temperature, °C	82.0	34.0	
Saturation temperature, °C	86.8	36.5	
Crystals grown, tonnes/hour		32.80	
Dissolved crystals % initial crystals		11.68	
Washing water % massecuite		1.02	

Under optimum operation conditions the sugar produced in the plant fell within the EEC 2nd category, quality variations depending upon the amount of washing water. In general, by using water amounts around 2.5% on massecuite and dissolving about 15% crystals we obtained sugar with about 5 EEC points for colour in solution, from 8 to 10 points for ash, and from 5 to 6 points for colour type. We should like to point out that the operating conditions of the plant were particularly unfavourable, especially concerning the colour of the feed syrup which, as emphasized above, ranged between 6000 and 7000 I.U. By using higher quality syrups we would expect to be able to obtain white sugar with superior characteristics. In fact, the colour increase of the syrup during cooling crystallization is negligible in contrast to what occurs in the traditional crystallization in a vacuum pan.

The sugar leaving the centrifugal had a moisture content ranging from 1.5 to 2%. Since a proper conditioning system was not included in the pilot plant, the sugar was dried in air, and consequently a certain percentage of conglomerates was formed. The measured values of MA and CV, which ranged around 0.4 - 0.6 and 30 - 40%, respectively, must therefore be taken only as indicative figures. In Figures 3 and 4 are shown the crystals present in the massecuite. In Figures 5 and 6, the crystallizer and the tank collecting the magma are shown.

Table II. Theoretical data from the crystallization test of Table I

	Standard liquor	Mother syrup
Mass, tonnes/hour	100.00	67.10
Dry substance, tonnes/hour	82.00	49.10
Sucrose, tonnes/hour	73.14	40.24
Purity	89.20	81.96
Brix	82.00	73.17
Supersaturation coefficient	1.0429	0.99
Saturation coefficient	0.9703	0.97
Residual supersaturation coefficient	1.0748	1.0200
Temperature, °C	82.0	34.0
Saturation temperature, °C	86.8	36.25
Crystals grown, tonnes/hour		32.90

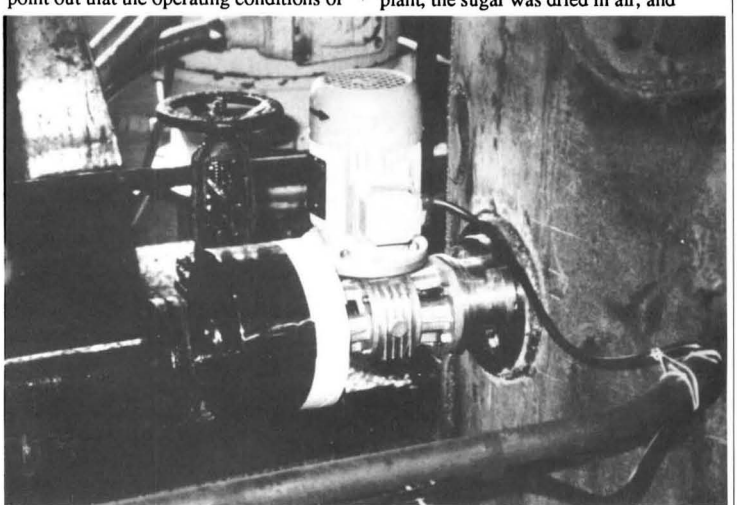

Fig. 2. Consistency measurement apparatus set up on the tank collecting the magma leaving the crystallizer (8 in Fig. 1)

Conclusions

From the whole experiment the following points can be drawn:

(i) The data obtained with the pilot plant confirm what was seen in the laboratory tests, i.e. that it is possible to obtain white sugar of commercial quality directly from thick juice even if the latter has unfavourable characteristics as far as colour is concerned.

(ii) The difficulties met during the operation of the pilot plant will be overcome by setting up a proper auto-

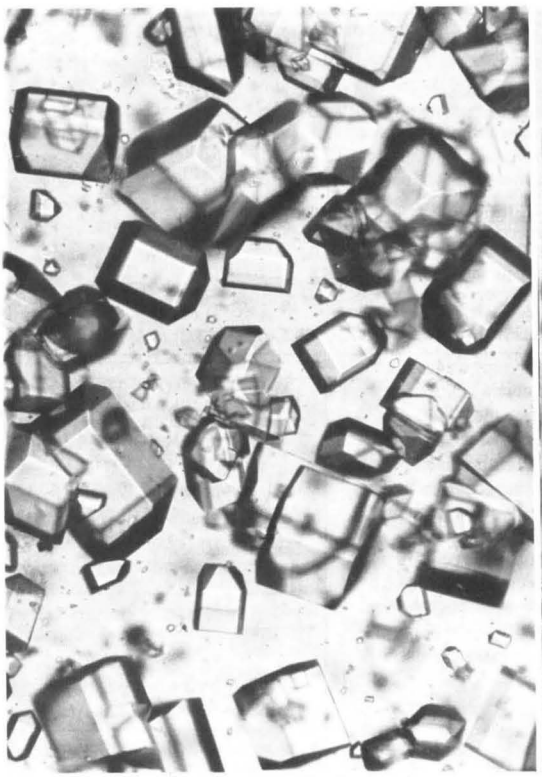

Fig. 3. Magma crystal leaving the crystallizer

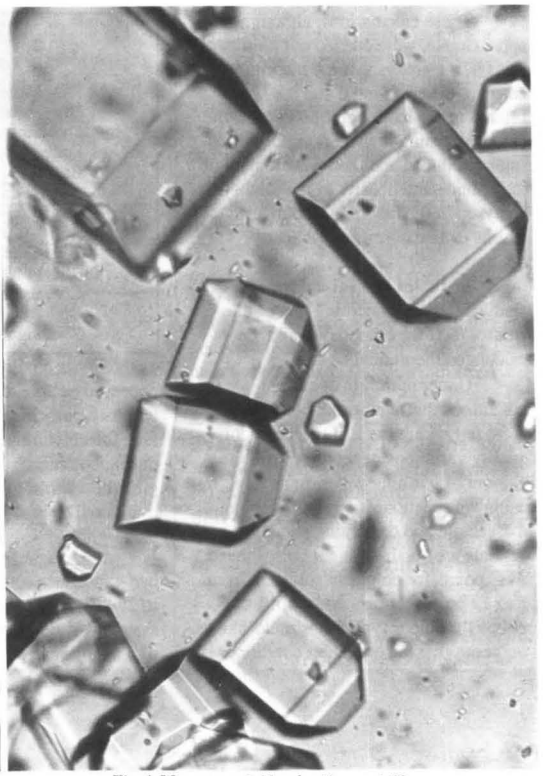

Fig. 4. Magma crystal leaving the crystallizer

matic control system for feeding and cooling the industrial crystallizer.

(iii) The correct and continuous addition of seed to the crystallizer proved to be very important for avoiding spontaneous nucleation inside the crystallizer and obtaining crystals with the required characteristics.

(iv) The results we have obtained confirm the possibility of realising on the industrial scale a *truly continuous* crystallization system which differs from the systems currently presented as "continuous crystallization" plants although they are continuous systems for growing magma preformed in a discontinuous boiling pan.

(v) Having in mind the type of magma obtained it is possible to use continuous centrifugals for the separation of white sugar. In this way the whole step of obtaining commercial white sugar becomes continuous.

Acknowledgement

We would like to thank very warmly the Technical Director of the firm Eridania Z.N. of Genova for the essential contribution given to our experiments. This contribution was fundamental for the design and setting up of the pilot plant, the constant assistance given during the operation as well as the final evaluation of the results obtained with the purpose of realizing an industrial plant.

Summary

Following favourable results obtained in laboratory tests, a continuous cooling crystallization pilot plant was set up in time for operation during the 1987 sugar campaign. The plant was fed with standard syrup, and was able to give one tonne per day of commercial white sugar of the 2nd EEC category. The standard syrup was pre-concentrated up to saturation at a temperature of about 80°C. After addition of seed, it directly entered the vertical crystallizer cooled with water. On cooling from 80°C to about 30°C during three to four hours, the crystallization process was completed and the magma obtained was directly centrifuged. This is a true continuous crystallization plant and not a plant of continuous growing of magma performed in discontinuous boiling pans as others currently in operation. The simplicity of the scheme easily lends

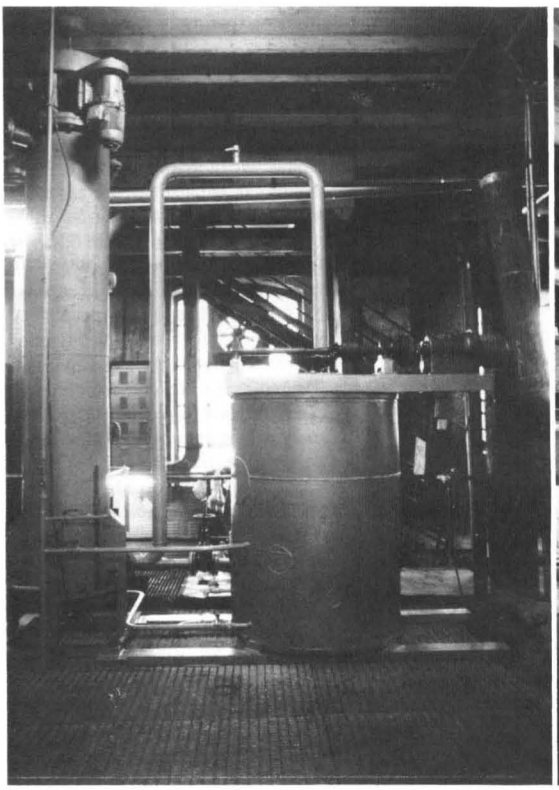

Fig. 5. Crystallizer (at the left), and tank collecting the magma

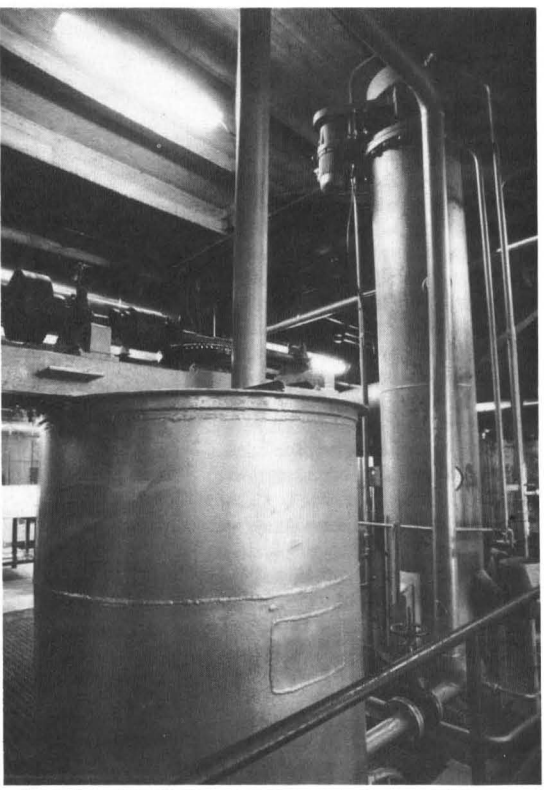

Fig. 6. Crystallizer (in the background), and tank collecting the magma (in the foreground)

itself to complete automation. The favourable results obtained indicate the possibility of successful realization on an industrial scale.

El sistema CCC de cristalización continua por enfriamiento

Después de los resultados exitosos obtenidos en las pruebas de laboratorio, se estableció una planta piloto de cristalización continua por enfriamiento justo a tiempo para empezarla a operar en la campaña del azúcar de 1987. La planta fue alimentada con jarabe standard y pudo dar una tonelada por día de azúcar blanco comercial de segunda clase EEC. El jarabe standard fue preconcentrado hasta saturación a una temperatura de alrededor de 80°C. Después de la adición de semilla, entró directamente al cristalizador vertical enfriado con agua. Al enfriar de 80°C a alrededor de 30°C durante tres a cuatro horas, el proceso de cristalización se completó y la masa cocida obtenida se centrifugó directamente. Este es una verdadera planta de cristalización continua y no una planta de crecimiento continuo de masa cocida llevada a cabo en tachos de cocción discontinuos como otras que están corrientemente en funcionamiento. La simplicidad del esquema se presta fácilmente para la automatización completa. Los resultados favorables obtenidos indican la posibilidad de una realización exitosa a escala industrial.

Le systéme CCC de crystallisation continue par refroidissement

Suite aux résultats favourables obtenus dans tests de laboratoire, on a construit un appareil pilote pour la cristallisation continue par refroidissement. Cet appareil était achevé à temps pour pouvoir opérer durant la campagne 1987. L'appareil fut alimenté avec du sirop standard et pouvait fournir une tonne par jour de sucre blanc commercial de seconde catégorie CEE. Le sirop standard fut pré-concentré jusqu'à saturation à une température d'environ 80°C. Après addition des grains, il entrait directement dans le cristallisoir vertical refroidi à l'eau. En refroidissant de 80°C à environ 30°C en 3 à 4 heures de temps, le processus de cristallisation

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A chemical index for the post-harvest deterioration of whole-stalk sugar cane

By G. R. E. Lionnet
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Introduction

The post-harvest deterioration of sugar cane can be a significant source of sucrose loss and, as such, has been investigated in most cane sugar producing countries. An important part of such investigations is the accurate measurement of the delay between burning (and/or cutting) and crushing. It should be realised, however, that the time delay by itself is of no significance – it is the deterioration that takes place which is important. Thus, to take an extreme example, beet may be harvested and left in the field for weeks under freezing winter conditions without serious consequences, whereas large losses will take place when harvested cane is left for a few days under tropical summer conditions.

In South Africa, cane delays are usually measured by a tagging system which involves entering dates and times on a tag attached to each consignment. Although the method gives delays directly, it is costly and labour intensive. Furthermore, experience has shown that tag recovery can be poor.

A chemical index of cane deterioration offers a number of advantages. First, it is independent of information retrieved through field or transport personnel. Second, it can be used to obtain time delays, if those are required, and third, it yields results which are directly related to deterioration or sucrose destruction.

Several workers have investigated the possibility of developing a chemical index for cane deterioration. Yeh[1] proposed a pol deviation index, another index based on starch and a flocculation test using lead nitrate. These tests are considered to be too dependent on specific cane quality parameters such as maturity, variety and cleanliness to be of practical value under South African conditions. Fulcher & Inkerman[2] showed that pH is not suitable and that dextran levels can be misleading. Bruijn[3,4] discussed the juice titratable acidity and showed that this quantity is not suitable because of large variation due to the

G. R. E. Lionnet

cane itself. The same conclusion was reached as far as the starch content was concerned. Kumar *et al.*[5] used the reducing sugar level to gauge the amount of deterioration. To be successful, however, all cane varieties in the areas supplying the mill should be sampled fresh and analysed to obtain the base-line. This would not be practical under South African conditions. Lionnet[6], using laboratory tests, showed that the concentration of ethanol in extracts from deteriorating cane was a function of time, temperature and cane variety. Furthermore, fresh cane was found to contain little or no ethanol, resulting in a zero base-line level. These findings were considered to be sufficiently promising to warrant further tests.

In South Africa industrial cane delays are usually measured by a tagging system which involves entering dates and times on a tag attached to each consignment. Data from the tags and the corresponding Direct Analysis of Cane (DAC) extracts were collected[6] over a period of three weeks at one mill. Subsamples of the DAC extract were frozen, taken to the Sugar Milling Research Institute and analysed for their ethanol content by gas chromatography. The data collected consisted of delay times, cane varieties, field location and daily maximum and minimum temperatures in the relevant region.

A regression of delay time against ethanol concentration (as ppm on Brix), average temperature (means of daily minimum and maximum, averaged for the delay period) and variety yielded a highly significant correlation coefficient indicating that the approach developed on the laboratory scale could be applied industrially. As a result of these findings full scale experiments were undertaken.

Experimental

Two sets of experiments were performed. The first set involved short-term tests at a number of factories, with the objective of investigating the suitability of the method over as wide a geographical area as possible. Seven factories, covering most of the South African cane producing areas, were selected. Two experimental procedures were followed. The first involved burning and cutting a field on day zero and delivering one or two consignments to the mill on several consecutive days. The information (e.g. delay time, cane variety, temperature, etc.) were therefore precisely known for these runs. The second procedure involved the random sampling of consignments at the factory weighbridge. If the sampled consignment carried the necessary information, that consignment was accepted for the test. Here there was no control on the accuracy of the information. The DAC extracts from the consignments of both procedures were sampled and analysed for ethanol by gas chromatography.

The second set of experiments involved a longer term assessment of the method, under industrial conditions. A gas chromatograph and the required peripheral equipment were installed in the laboratory of a factory and were ready for use in July 1987. Random samples of DAC extracts were filtered and analysed in duplicate. Ethanol standards, in the relevant range of concentration, were injected at regular intervals. Sampling and analysis were carried out throughout the crushing week by the laboratory staff and covered the period July to December 1987. Apart from the ethanol concentration, figures for the mean daily temperature, cane variety, cane purity and the Brix of the extract were also collected.

1 *Taiwan Sugar*, 1984, **31**, 11 - 13.
2 *Proc. Queensland Soc. Sugar Cane Tech.*, 1978, **41**, 161 - 169.
3 *I.S.J.*, 1966, **68**, 331 - 334.
4 *ibid.*, 1970, **72**, 195 - 198.
5 *Proc. Conv. Sugar Tech. Assoc. India*, 1984, **48**, 78 - 84.
6 *Proc. S. African Sugar Tech. Assoc.*, 1986, **60**, 52 - 57.

Results and discussion

The results of the first set of experiments are considered first. In all cases, burn-to-crush delays were available either from the organized tests or from the tags attached to the consignments. It was thus possible to regress delay time against the ethanol content of the extract, the average temperature during the delay period and the cane variety. This last factor was quantified by the use of the dummy variables V_1 and V_2 with $V_1 = 1$ and $V_2 = 1$ corresponding to the variety NCo 376, $V_1 = 1$, $V_2 = 0$ to NCo 293, $V_1 = 0$, $V_2 = 1$ to N 14 and $V_1 = 0$, $V_2 = 0$ to mixed or other varieties.

The equation used has the following form

$$\log_e(\text{delay time}) = a + b \times \text{EtOH} + c_1 \times V_1 + c_2 \times V_2 + d \times \text{Temp.} \quad \ldots\ldots\ldots \quad (1)$$

where a, b, c_1, c_2 and d are constants, delay time is in hours, EtOH is the content of ethanol in ppm on Brix in extracts, V_1 and V_2 are the variety dummy variables and Temp. is the average temperature during the delay, in °C.

The number of observations and correlation coefficient obtained when equation (1) was fitted to the data of each factory are shown in Table I.

Table I. Number of observations and correlation coefficients obtained at each factory. (1st set of experiments)

Factory	Number of observations	Correlation coefficients
A	55	0.78
B	19	0.99
C	40	0.81
D	17	0.88
E	77	0.75
F	19	0.87
G	10	0.76

These results show clearly that there is a significant relation between burn-to-crush delay on the one hand and ethanol content, variety and temperature on the other, as was to be expected from the results obtained previously. Furthermore, the results show that the approach can be used, at least in principle, over the whole South African cane producing area. A limitation of the above results is the small number of observations at the individual mills, which makes comparison between the mills difficult.

Data from all the mills were combined to yield equation 2:–

$$\log_e(\text{delay time}) = 5.806 + 9.317 \times 10^{-5} \times \text{EtOH} - 0.207 \times V_1 - 0.067 \times V_2 - 7.308 \times 10^{-2} \times \text{Temp.} \quad (n = 225;\ r = 0.75) \quad \ldots\ldots\ldots \quad (2)$$

Equation 2 was found to predict delay time, on average, within ± 40 hours of the measured value. Although this degree of precision is adequate for delays of 4 to 6 days, it was considered that improvement were required for the method to be of practical importance. Inspection of the results showed that, when a mill employs the equation based exclusively on its own data, the scatter is reduced. This was the reason for carrying out a second set of experiments at factory E involving 675 tagged consignments of cane. Some relevant information is given in Table II.

Table II. Ranges for some basic data for the second set of experiments, Factory E

	Min.	Max.	Mean
Cane purity	77	93	86
Average temperature* during delay, °C	11.5	25.3	17.7
Ethanol, ppm on Brix	315	25330	5185
Delay, hours	10	397	111

* Daily means of maximum and minimum temperature averaged for the delay period

Table III. Delays for 342 untagged consignments at Factory E, calculated by the approach based on ethanol

	Min.	Max.	Mean
Cane purity	75	92	85
Average temperature during delay, °C	12.1	26.4	18.7
Ethanol, ppm on Brix	600	28520	5085
Calculated delay, hours	26	416	108

The data in Table II show large ranges in all the variables, except that high temperatures were not reached.

Equation 3 was obtained from 675 sets:–

$$\text{Delay time} = 153 + 0.0214 \times \text{EtOH} - 14.2 \times V_1 - 6.80 \times V_2 - 5.26 \times \text{Temp.} \quad (n = 675;\ r = 0.74) \quad \ldots\ldots\ldots \quad (3)$$

Equation 3 predicts the delay time to within ± 22 hours of that given by the tags. Detailed investigations of the tagging systems at Factory E revealed that mistakes are sometimes made when times are entered on the tags. This must therefore also contribute to the ± 22 hours uncertainty found.

It should be noted that previous equations used a logarithmic term for time. It was found here that there was little or no difference if time or logarithmic time were used and the simpler term was therefore selected.

This set of experiments also involved the sampling and analysis of extracts from 342 untagged consignments. This part of the experiment thus represents a real life application of the approach since the delays are now unknown. Equation 3 was used to obtain the delays for these 342 consignments. Calculated delays and other relevant data are shown in Table III. Comparison of the data from Tables II and III shows good agreement.

The results obtained at Factory E, based on more than 1000 samples taken over a 6-months period, show an average delay of about 110 hours or 4.6 days. More detailed analysis of the data shows that the average delay was around 4 days during winter, when deterioration would be slow because of lower temperatures, but about 6 days in the later part of the period owing to the usual summer rain which caused delays in transporting cane from the fields.

This investigation has also shown that cane can deteriorate through

mechanisms not involving the formation of ethanol. Under South African conditions young cane and cane with ratoon stunting disease were found[7] to produce during deterioration levels of ethanol lower than expected. This, however, occurred in only about 5% of the total number of samples investigated and is therefore not considered to be a serious limitation.

Conclusions

A chemical method, based on the measurement of ethanol produced during deterioration, has been developed to estimate the burn (or cut) to crush delay of cane, under industrial conditions. The method gives the delay with an uncertainty of ± 20 hours. This level of precision is considered to be satisfactory since average delays under South African conditions were found to range from 4 to 6 days.

The gas chromatographic analysis is simple, relatively trouble-free and easily implemented in an industrial laboratory. The initial costs involve the purchase of the gas chromatograph and peripherals. Since the ethanol analysis by gas chromatography is extremely simple, both the initial and running costs are relatively low. These and labour costs would be easily compensated by even a small reduction in cane deterioration.

Summary

The usefulness of the concentration of ethanol in cane extracts as an indicator of burn-to-crush delay and thus of cane deterioration is investigated. It is shown that the delay of industrial consignments can be estimated to within ± 20 hours by using a model involving the ethanol concentration, the temperature and the cane variety. The method is relatively simple and is easy to implement in industrial laboratories. It is recommended that it should be used on a full-time basis.

Acknowledgements

The author would like to thank Mr. J. V. Pillay and Mr. K. J. Schäffler of the SMRI and the Illovo staff for their cooperation.

Un índice químico para el deterioro posterior a la cosecha de caña de azúcar de tallo entero

Se investiga la utilidad de la concentración de etanol en los extractos de caña como un indicador del retraso entre la quemada y la molienda y así del deterioro de la caña. Se muestra que el atraso de envíos industriales se puede estimar hasta dentro de las 20 horas usando el modelo que usa la concentración de etanol, la temperatura y la variedad de caña. El método es relativamente sencillo y fácil de echar a andar en los laboratorios industriales. Se recomienda usarlo todo el tiempo.

Un indice chimique pour la détérioration après récolte de canne à sucre à tige entière

On examine l'utilité de la concentration d'éthanol dans les extraits de canne comme indicateur du délai entre brûlage et broyage. En fait cela revient à examiner le délai pour la détérioration de la canne. On montre que le délai pour des arrivages industriels peut être estimé à environ 20 heures. On utilise pour cela un modèle faisant appel à la concentration en éthanol, à la température et à la variété de canne. La méthode est relativement simple et elle peut facilement être appliquée dans des laboratoires industriels. On recommande son utilisation à temps plein.

7 *Paper presented to 62nd Congr. S. African Sugar Tech. Assoc.*, 1988.

The CCC system of continuous cooling crystallization

continued from page 217

fut achevé et le magma obtenu fut directement centrifugé. Il s'agit ici d'une vraie installation de cristallisation continue et non pas d'une installation de croissance continue de magma réalisée dans des cuites discontinues, telle que généralement en opération. La simplicité du schéma permet facilement son automation complète. Les résultats favorables obtenus montrent la possibilité du succès d'une réalisation à échelle industrielle.

Das CCC-System von kontinuierlicher Kühlungskristallisation

Nach Erzielung von erfolgreichen Ergebnissen in Laborversuchen wurde eineVersuchsanlage für kontinuierliche Kühlungskristallisation zu Betrieb während der Rübenkampagne 1987 eingerichtet. Standardsirup wurde in die Anlage eingebracht, woraus 1 t/d Handelsweisszucker von EWG-Kategorie 2 erhalten werden konnte. Der Standard-sirup wurde bis zu Saturation bei ungefähr 80°C vorkonzentriert. Nach Saatimpfung kam der Sirup direkt in den wassergekühlten Vertikalkristallisator. Nach Kühlung von 80°C bis zu ungefähr 30°C während drei-vier Stunden war das Kristallisationsverfahren fertig und das erhaltene Magma wurde direkt zentrifugiert. Dies ist eine echt kontinuierlich arbeitende Kristallisationsanlage, nicht eine Station von diskontinuierlichen Vakuum-apparaten, in den Magma kontinuierlich wächst, wie in anderen gegenwärtigen Systemen. Wegen seiner Einfachheit eignet sich das System für Vollautomatisierung. Die gute Ergebnisse zeigen die Möglichkeit von erfolgreicher Verwirklichung im industriellen Massstab.

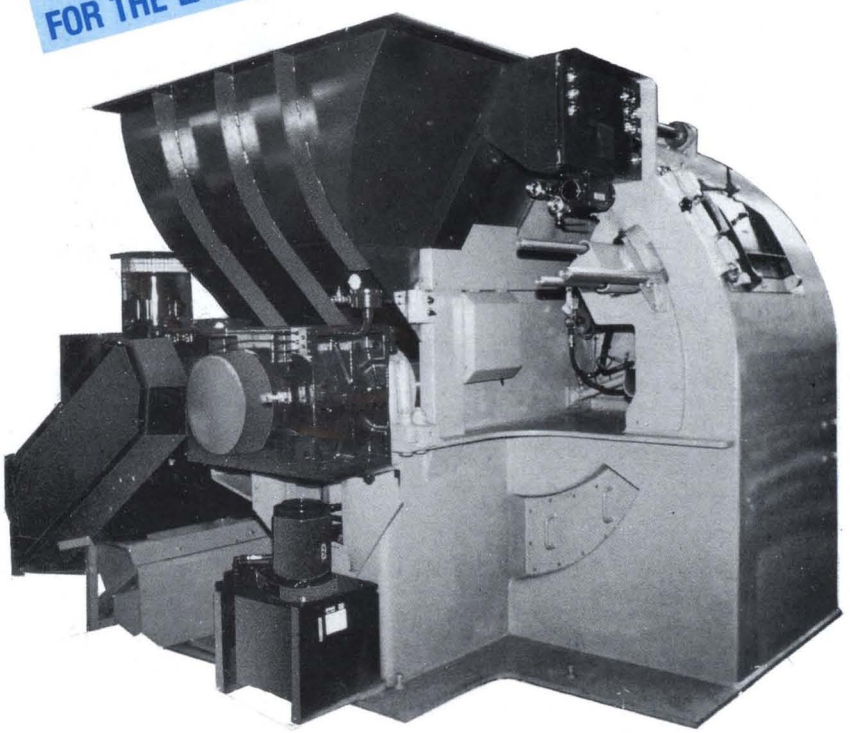
New sugar factories for India[2]

Two sugar factories are to be erected soon, each with a crushing capacity of 2500 tcd, in Pratapgarh and Bijnor districts of Uttar Pradesh. They will bring the number of factories in the state to 106.

2 *Indian Sugar*, 1988, **38**, 11.

Bringing new ideas is the essence of progress...

A CUT ABOVE THE COMPETITION FOR THE LAST 75 YEARS!



∅ 2000

- *SLICING WIDTH:*

600mm

- *NUMBER OF KNIFE-ROWS:*

60

- *CAPACITY:*

4000 TO 7000 T/day

∅ 1600

- *SLICING WIDTH:*

600mm

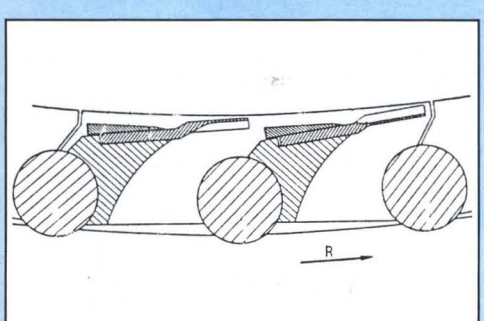
- *NUMBER OF KNIFE-ROWS:*

48

- *CAPACITY:*

2500 TO 5000 T/day

The genuine Drum beet-slicer from Maguin!



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Product news

Soil products from sugar industry wastes in St. Kitts

Tritech Capital Inc. has announced that it has received approval of a strong package of economic incentives from St. Kitts & Nevis for construction of a 20,000 tons/year soil products plant. The incentives package includes a twelve year tax holiday; duty exemptions; and profit, dividend, and capital repatriation rights. In return, the project offers the St. Kitts government a significant opportunity to diversify their economy beyond the sugar crop, which is its mainstay, and enhance the value of the crop itself.

The plant will utilize Tritech's proprietary biotechnical processes to convert problem wastes from the sugar industry into valuable soil conditioners and fertilizer products. These by-products in turn will enable the island nation to reduce environmental degradation, cut fertilizer imports, enhance the value of its sugar crop, and diversify its agricultural economic base beyond the sugar crop by development of vegetable, fruit and other alternative crops. The plant is to be constructed by Tritech's Baton Rouge-based wholly-owned subsidiary, GW Technologies Inc.

Tritech has applied for $500,000 in capital funding for the plant from the US Agency for International Development (AID) and hopes to commence plant operations with the start of the 1989 sugar harvest.

Conference on sugar processing research

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sugar refineries on the analyses and frequency of testing of granulated sugar. Other contributions included "Current status of SQC in sugar manufacture" by R. L. Knecht of C & H Sugar; "Statistical quality control (SQC) in the sugar industry by Lane Fitzgerald of Qualimetrics; and "Quality Assurance (in British Sugar)" by Graham Wilson.

On September 29 tours were available for delegates to visit the Gramercy refinery of the Colonial Sugars Division of Savannah Foods and Industries, and the Chalmette refinery of Amstar Sugar Corporation.

Cut friction, reduce weight, end corrosion

"Ultra slide" UHMW polyethylene is a versatile material which can be used in many kinds of conveyors and other applications. This ultra high molecular weight polymer resists abrasion and corrosion and has a low coefficient of friction. One-third the weight of aluminium, it outwears steel three to one and can be stamped, moulded, machined or extruded, making it ideal for a variety of products.

Further details:

Tandem Products Inc,
520 Industrial Drive,
Blooming Prairie MN, 55917,
USA.

Leaflets on vacuum pumps

Hick Hargreaves & Co. Ltd. have issued a set of leaflets covering their range of CHR and SHR liquid ring vacuum pumps. These leaflets give details of both single- and two-stage liquid ring vacuum pumps with capacities from 25 to 4250 m^3/hr.

Features of the pumps are ease of maintenance, low noise levels, and absence of contamination since they are oil-free. These vacuum pumps, together with larger sizes up to 10,000 m^3/hr, are designed and manufactured at the Hick Hargreaves works in Bolton, Lancashire, England. Copies are available on request from the company.

Thin juice softening by the NRS process

In ion exchange processes for softening of thin juice in beet sugar factories, the calcium ions in the juice are replaced by sodium ions. The resins must then be regenerated and this has been done conventionally with brine or, in the case of the Gryllus process, using the alkali ions originally present in the juice, concentrated in syrup or molasses. The former method requires considerable amounts of wash water while, with the latter, the Ca ions are restored to the regenerant.

The NRS process developed in Holland uses a solution of sodium hydroxide in thin juice for regeneration of the resin. At a temperature of 40 - 50°C and in the presence of sucrose, the calcium on the resin goes into solution as calcium saccharate and this when subjected to carbonatation yields sucrose and insoluble calcium carbonate. Thus no waste water is produced, no water is added, and thin juice is used for washing after regeneration and for backwashing. No sugar is lost and NaOH added has a decalcifying effect.

BMA installed a complete NRS treatment plant at Guadalcacín sugar factory in Spain for the 1987/88 season, together with tanks, pumps, heat exchangers and automatic controls. It operates efficiently even at a juice hardness of 500 - 800 mg CaO per litre and has exceeded performance expectations. Details are available from Braunschweigische Maschinenbauanstalt AG, P.O. Box 3225, D-3300 Braunschweig, Germany.

Screening, feeding and conveying

Locker Industries have a new brochure reviewing their wide range of mechanical handling equipment for the sugar and food industries. Screening, feeding, conveying and separation are among the processes for which they design and manufacture equipment.

Further details:

Locker Industries Ltd.,
P.O. Box 161
Warrington, UK.

Dust and fume control

A four-page leaflet in colour illustrating a wide range of dust and fume control equipment, including reverse jet filters, wet collectors and cartridge filters, is available from Carter-Midac, a division of Carter Industrial Products Limited, Bedford Road, Birmingham B11 1AY England.

Facts and figures

Italian sugar factory closure[1]

After expansion of its factory at Castiglion Fiorentino from 4000 to 8000 tonnes/day beet slicing capacity, the Zuccherificio Castiglionese company has closed its factory at Cecina. It was the smallest in the Italian industry at only 2200 tonnes/day. With this closure and that of the Eridania factories in Ferrara and Comacchio[2], the industry is reduced to 33 factories in operation.

Pakistan beet sugar production, 1988

As the Pakistan government raised the beet price to 375.09 rupees per tonne, irrespective of quality, the area under beet swelled from 11,826 to 13,706 hectares for the 1988 crop and a total of 455,927 tonnes of beet were processed as compared with 319,000 tonnes in 1987. Sugar production was a record at 37,843 tonnes, white value, or 20% more than the previous year's outturn. Beet yield increased from 27.0 tonnes per hectare in 1987 to 33.5 tonnes this year but the sugar content dropped from 9.44% to 8.30%. The campaign lasted an average of 70.25 days and throughput of the four factories averaged 7419 tonnes/day against an installed capacity of 7350 tonnes.

A/S De Danske Sukkerfabrikker 1987/88 report

The sugar sector of the DDS Group showed a lower profit than the previous year because, as a result of adverse weather, only 90% of quota sugar was produced. Sales were adjusted to lower output and low prices for animal feed and sugar. Assuming a normal harvest, the 1988/89 crop is expected to provide a better result. Considerably fewer orders than expected were received by the engineering division and unsatisfactory results at DDS-Engineering required staff cuts.

Cuba to sell bagasse paper technology

Cuba is negotiating the sale of its technology to make paper from bagasse to a number of countries including India and Pakistan. Bagasse is used in Cuba to produce 13,000 tonnes of paper and 30,000 cubic metres of partition panels a year, the latter at a factory which uses 70% bagasse and 30% cement.

US market stabilization price for sugar

The US Dept. of Agriculture has announced that the 1989 market stabilization price for sugar will be 21.80 cents per pound, raw value, up slightly from the 1988 level of 21.76 cents per pound. The market stabilization price represents the price at or above which producers would be more likely to sell their sugar in the marketplace than to forfeit it to the US Commodity Credit Corporation. It also is used to calculate penalties and liabilities under quota-exempt sugar programs conducted by the USDA. The new market stabilization price per pound is the sum of the price support loan rate for fiscal 1989 (18 cents), the adjusted average transportation costs for shipping raw sugar (2.97 cents), interests costs of repaying a sugar price support loan at full maturity (0.63 cent) plus a further 0.2 cent. The procedure for calculating the market stabilization price is specified in the Code of Federal Regulations.

Barbados sugar factories to close[3]

Two sugar factories in Barbados are in the process of being closed. A spokesman for Barbados Sugar Industry Ltd. said that the industry has more capacity than expected levels of production required. The Ministry of Agriculture is satisfied that capacity at the remaining four factories is more than adequate to satisfy the immediate and foreseeable needs of the industry. Barbados expects a crop of 80,000 tonnes of sugar this year, 5000 tonnes less than the target, and with minor expansion the remaining four factories could produce 100,000 tonnes. Additional mechanization is expected to be used in the north of the island next year to overcome labour shortages.

Fuel from cane leaves[4]

The Nimbkar Agricultural Research Institute at Phaltan, Maharashtra, India, has developed a process whereby cane leaves are heated in a reactor at 800 – 1000°C to give producer gas which is cooled, cleaned in appropriate scrubbers and may be fed direct to a small diesel engine. Some 24 – 35% of the biomass in the leaves remains in the reactor in the form of fine charcoal particles which are mixed with cowdung to produce smokeless briquettes for heating purposes. Work is continuing on the use of the producer gas as a fuel for use in gur manufacture.

Guatemala sugar exports, 1987[5]

	1987	1986
	tonnes, raw value	
Bulgaria	54,891	14,961
Ecuador	18,405	41,138
Indonesia	17,863	0
Jamaica	10,108	21,228
Morocco	0	14,152
Pakistan	0	11,909
Papua New Guinea	7,686	0
Peru	7,860	0
Portugal	0	4,043
El Salvador	246	0
Sri Lanka	27,064	27,417
Taiwan	14,960	0
Trinidad	20,216	21,514
USA	73,448	118,674
USSR	37,643	45,288
Venezuela	8,832	0
Unknown	0	53,047
	299,222	373,371

Spanish sugar economy modernization[6]

A pact to ensure the maximum possible advance in the Spanish sugar economy during the next four years has been signed by all those involved, from growers to end-producers. New technology will be sought for the purpose, new seed varieties are to be introduced, mechanization is to be increased and new growing and harvesting methods will be adopted. Consumption of sugar in Spain grew by 7% during 1987 in spite of a 12% increase in price and output is expected to rise to 1,120,000 tonnes, against an EEC quota of 1 million tonnes and the previous outturn of 991,000 tonnes. The beet area had increased from 66,000 to 80,000 ha, but heavy spring rains raised yields from unirrigated fields to the same as those which were irrigated.

Argentina sugar exports, 1987[7]

	1987	1986
	tonnes, raw value	
Bulgaria	37,085	7,519
Chile	8,487	7,864
Paraguay	6,739	18,278
USA	38,444	74,915
	90,755	108,576

Floods in China's cane area[8]

The worst flooding in centuries swamped 730,000 hectares of farm land in south-east China and was caused by torrential rain affecting 11 counties in Zhejiang province. In 1986 this province accounted for 5% of China's total sugar production.

Philippines sugar expansion[9]

Philippines sugar production in the1987/88 season was expected to reach 1,360,000 tonnes from 1,300,000 tonnes in 1986/87, and to increase to 1,600,000 tonnes in 1988/89, according to the National Federation of Sugarcane Planters. Encouraged by early rains and rising prices, planters have increased the area planted to cane by 15% to 260,000 hectares.

Iran sugar production, 1987/88[10]

Iran's sugar production in the 1987/88 crop year is now estimated at 710,000 tonnes, raw value, down more than 100,000 tonnes from the year before. Of the total, 577,000 tonnes (632,000 tonnes in 1986/87) are beet sugar and 133,000 tonnes (185,000 tonnes) cane sugar. Production in 1988/89 is estimated at 700,000 tonnes, including 470,000 tonnes beet sugar and 230,000 tonnes cane sugar.

Indonesian sugar imports forecast

Indonesia will import 141,000 tonnes of sugar in 1989 and 99,000 tonnes in 1990 as a consequence of the 1987 drought which badly damaged cane seedlings[11]. At least 125,000 tonnes were imported in the first half of 1988 and it has been estimated that at least a further 50,000 tonnes would be needed in the second half. The Agriculture Minister had said that 1988 sugar production could reach 2.1 million tonnes, below the original

1 *Zuckerind*, 1988, **113**, 632.
2 *I.S.J.*, 1988, **90**, 62.
3 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 410.
4 *Indian Sugar*, 1988, **38**, 10 - 11.
5 *I.S.O. Stat. Bull.*, 1988, **47**, (7), 2.7
6 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 429.
7 *I.S.O. Stat. Bull.*, 1988, **47**, (7), 1.
8 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 412.
9 *Reuter Sugar Newsletter*, July 8, 1988.
10 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 413.
11 *Reuter Sugar Newsletter*, July 21, 1988.

target but up from 2.07 million tonnes in 1987 and 2.01 million tonnes in 1986. The US Embassy in its annual agriculture report expressed the view, however, that 1988 production was likely to remain at the 1987 level which it estimated at 1.9 million tonnes; the embassy did not explain the discrepancy with government figures. The Minister said that plantings on Java are expected to fall by 50% from the present 140,000 hectares by 1994[12]. Many smallholders are switching to other more profitable crops such as cocoa and the government is being urged to raise official prices to encourage sugar cane planting. Meanwhile sugar development in the outer islands remains slow as the soils are less fertile.

ISSCT 20th Congress, 1989

Newsletter No. 3 has been published by the secretariat for the 20th Congress of the International Society of Sugar Cane Technologists. It confirms the dates of the Congress as October 12 to 21, with the main functions in the Anhembi Convention Centre in São Paulo, Brazil. Brief reports are provided on a meeting of the Technical Coordination Committee and ISSCT Workshops on weed science, mechanical harvesting and handling, and sugar cane pathology. A poster session will be available during the Congress to authors who wish to describe briefly their on-going research, etc., and guidelines and specifications are included for intending presenters. The Centre has 3000 square metres of indoor exhibition space as well as an ample outdoor area; these will be available to exhibitors of sugar and sugar cane equipment and services in the "Sugar Expo '89" which will be concurrent with the Congress. Copies of this and succeeding Newsletters will only be sent to people who register as members of the Society; this may be sought by sending $30 in US currency to the General Secretary-Treasurer, Prof. J. P. Stupiello, P.O. Box 532, Piracicaba, SP, Brazil 13400.

South African Sugar Technologists Association 1989 Congress

The 63rd Annual Congress of the S.A.S.T.A. will be held during June 5 - 8, 1989. The official opening and first technical session will be at the Elangeni Hotel in Durban and subsequent factory sessions on June 6 and 7 at the Experiment Station; the venue for the agricultural session has not yet been decided. Contributions from authors from other countries will be welcomed; brief synopses should reach the Secretaries by December 31 and complete papers by March 1, 1989. Further information may be obtained from the SASTA Secretaries, SASA Experiment Station, Private Bag X02, Mount Edgecombe, South Africa 4300.

Mexico sugar production, 1987/88[13]

The 1987/88 season in Mexico ended on June 21 after a shorter than usual crush. Because of adverse weather, the cane harvest amounted to 37,244,119 tonnes, against 41,372,482 tonnes in 1986/87, a fall of 9.98%. However, the cane quality improved substantially so that average recovery rose 9.05% to 9.64% in 1987/88 and sugar output reached 3,590,037 tonnes, white value, only 4.12% less than the 3,744,230 tonnes produced in the previous season. A wide range of varieties were grown, the most popular 18 (which included POJ 2878) occupying 81.21% of the total area. Of these, however, three (Mex 57-473 with 19.00%, NCo 310 with 12.13% and Z Mex 55-32 with 10.65%) were the most popular.

South Africa distillery[14]

Glendale Sugar Millers (Pty.) Ltd. has announced the establishment of a distillery at its factory at Glendale on the Natal North Coast which will initially produce 500,000 litres a year of alcohol. The distillery operation is one of a number of diversification projects which have been investigated to ensure the long-term viability of the factory and its growers, many of whom are small-scale farmers.

Higher US HFS demand[15]

Spurred by raising demand from the soft drinks industry, HFS producers are likely to increase output by 5% in 1988 to nearly 3 million short tons. Early this year the USDA predicted a 2% growth but hot weather boosted 1988 soft drink demand. Corn production has suffered from the associated drought, but large farmer-owned and CCC reserves are sufficient to meet all needs until the 1989 crop is harvested.

Australian sugar factory closures[16]

The North Eton sugar factory in Queensland will be the third Australian sugar factory to close down in three years, after the Qunaba and Goondi factories. It will close at the end of the 1988 crushing season as part of the rationalization program in the Mackay area. The Mackay Sugar Cooperative Association, which owns the six district factories have announced that the Cattle Creek factory will also close at the end of the 1990 season. Job losses will be avoided and cane supplies from the two mill areas will be transferred to the other four factories – Farleigh, Racecourse, Pleystowe and Marian – which will be upgraded to handle a total hourly crushing rate of 2050 tonnes.

Uganda sugar factory rehabilitation project[17]

The Arab Bank for Economic Development in Africa (BADEA) has offered to lend Uganda $10 million to help rehabilitate Kinyala sugar factory near the western town of Masindi. BADEA is carrying out a feasibility study on reactivating the plant which ceased operations in 1984. To restore Kinyala to its full production capacity of 37,000 tonnes/year by 1992 would cost $104 million and, once BADEA has completed its feasibility study, more Arab financial institutions are expected to offer funds. Kinyala is the third project for rehabilitation, intended to make Uganda self-sufficient in sugar once more. The first sugar complex at Lugazi, near Kampala, resumed production in June, and the second, at Kakira, near Jinja, is due to start up again early in 1989. Booker Agriculture International has been planting 400 acres of cane at Kinyala to provide seed for a further 20,000 acres of the estate.

Fiji - China long-term contract[18]

Fiji has successfully re-negotiated all its long-term sugar markets according to the Minister for Information. Under the Fiji/China long-term agreement, between 45 and 50,000 tonnes of raw sugar will be supplied to China every year for five years starting in 1988. Because of movements in the world market price it has been agreed that, for 1989, 50,000 tonnes to be supplied in the second half of the year would be priced on a basis of the New York settlement price.

Hurricane damage in Jamaica

Hurricane Gilbert, which passed through the Caribbean area in September, struck Jamaica and Mexico, causing damage to the cane crop and infrastructure in the former and loss of life in the latter. Cuba was on the fringe of its path and only received rain which will benefit next year's cane crop. Losses of $27.2 million are reported[19] to have been suffered by the Jamaican sugar industry; however, it will be able to produce its export quotas of 125,000 tonnes for the EEC and 7500 tonnes for the US, but will have to import sugar to make up for a resulting shortfall on the local market. Jamaica had expected to produce between 230,000 and 236,000 tonnes this year but industry officials foresee 30 - 40% lower production because of the poor quality of the cane that is now expected.

China sugar crop area increase[20]

China's 1988 sugar area has risen to 1,523,000 hectares from 1,300,000 in 1987 because of higher purchasing prices and subsidies paid to farmers, according to the *Economics Information* newspaper. It said there have been sugar shortages because of a drop in acreage in recent years. To encourage farmers to grow more, state departments are paying them a subsidy of 8 yuan per tonne of sugar cane and 18 yuan per tonne of beet. The greatest increase in beet area in the north is in Heilongjiang, where the 1988 planted area is 98,000 ha more than in 1987, and the biggest rise in cane area in the south is in Yunnan, where the planted area of 264,000 ha is 26.3% higher than in 1987. Sugar output in the 1988/89 season should exceed 5 million tonnes, up from 4.52 million tonnes in 1987/88, according to an official newspaper, *China Rural Management News*. The increase should improve market supplies and cut imports; China has become one of the world's biggest sugar importers.

12 *Financial Times*, August 9, 1988.
13 *ATAM*, 1988, **2**, (2), 21 - 26.
14 *S. African Sugar J.*, 1988, **72**, 258.
15 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 466.
16 *Australian Canegrower*, 1988, **10**, (8), 7.
17 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 505.
18 *Reserve Bank of Fiji News Review*, 1988, (24).
19 F. O. Licht, *Int. Sugar Rpt.*, 1988, **120**, 504.
20 *Reuter Sugar Newsletter*, July 13, 1988; July 15, 1988.

Mexico sugar technologists conference, 1988

The 14th National Congress of the Asociación de Técnicos Azucareros de México was held at the Hotel El Presidente in Cuernavaca, Morelos, during September 28 to October 1, attended by more than 500 technologists, mostly from Mexico but also from Cuba, the Dominican Republic, El Salvador, the USA and other countries. The papers presented included 5 on administration, 18 on field topics, 14 on diversification, 10 on energy, 3 on extraction, and 3 on processing, while there were a number of round-table discussions. Summaries of the papers were available to members attending and a volume of *Proceedings* is to be published shortly. A prize for the best paper was given to Eng. Maximino Méndez of Ingenio Oacalco for his work "The Melacon (Invert syrup) project – an alternative for diversification of the sugar industry in Mexico".

Pakistan sugar technologists conference, 1988

The 24th Annual Convention of the Pakistan Society of Sugar Technologists was held in the Hotel Pear-Continental in Rawalpindi, during the last week of July, with about 700 local members and 100 foreign visitors. The President, H. A. Naqvi, welcomed them and reported that sugar production in the country had reached 1.74 million tonnes. Pakistan has the sixth largest cane area, at about 900,000 ha, but cane and sugar output fluctuations have required imports which this year have amounted to 302,000 tonnes, white value. To meet estimated requirements of 2.5 million tonnes by 1995 requires further investment and Mr. Naqvi favoured expansion of existing units rather than building new ones. Another source would be sugar recovered from molasses and starch-based liquid sugar, while he stressed the need to use bagasse for newsprint manufacture and molasses for producing power alcohol.

PERSONAL NOTES

Since it became part of the Beresford Group, British Sugar plc. has expanded its horizons beyond sugar manufacture and has become involved with other activities where its collective expertise in agriculture, technology, nutrition and marketing could be applied. These activities have for a few years been under the Bristar Group name of which British Sugar is one part. Among recent management changes, **Bob Bass** will no longer be concerned with the sugar factories currently operated by British Sugar and is instead responsible for seeking other businesses which could be associated with Bristar science; such projects include paper manufacture from straw, etc. **Malcolm Branch** will as an Executive Director be responsible for the technical operations in British Sugar, while **Roger B. Begy**, Marketing Director of British Sugar, will in addition become Assistant Managing Director of the food section of British Sugar, responsible for the Eurosugars operations at Corby, Single Service at Telford., etc. Chief Engineer **Jim Hogg** will report to **Dr. Branch**, as will the three Group Production Managers and Quality Manager **Graham Wilson**, the last on a day-to-day basis. **Peter Dyke**, Agricultural Director of British Sugar, has additionally been appointed Managing Director for the agricultural operations of the Bristar Group, e.g. those concerned with alfalfa and cotton seed production in the USA, etc.

Finance Director, **Geoff Taylor**, is to retire a year early to avoid departure of two directors at the same time (**Peter Dyke** is due to retire next year), and will be succeeded by **Peter Butler** from Beresford. A management committee will be set up for British Sugar, to include the directors and some other executives including, in due course, a marketing manager and an agricultural manager.

We regret to report the death in August of **J. Cecil Ferguson**, founder of Ferguson Perforating & Wire Company, suppliers of screens and woven wire for filters and centrifugals used in the sugar industry. He had been a member of Sugar Industry Technologists and had attended many of the annual meetings, including that in Savannah this year in spite of the difficulties which arose because of a stroke he had suffered earlier.

The Beet Sugar Development Foundation, in Fort Collins, Colorado, USA, has announced the appointment of **Thomas K. Schwarz** as Manager, as from September 16. His background is pesticide and environmental management. He replaces **Stephen Reynolds**, who has joined Holly Seed Corporation; both will share duties in the management of American Society of Sugar Beet Technologists up to the biennial meeting in 1989.

Peter James who, since joining British Sugar in 1964 as a graduate trainee, held a number of positions in production and reconstruction. Between 1978 and 1988 he served in the Group's consultancy division, BSD Ltd., becoming Director and General Manager. Following the closures of BSD he became Production Administration Manager of British Sugar but has now left the Group to join SKIL (Sugar Knowledge International Ltd.) of Etchingham, East Sussex, He has been elected a Director, joining **Alistair Birrell, David Hughan, James Wilkinson** and **Allan James**.

Make a date .....

When?	Who?	Where?
November 1988	Sociedade dos Técnicos Açucareiros e Alcooleiros do Brasil, C.P. 532, Piracicaba, SP, Brazil; 13400. (Maintenance Seminar)	E.S.A. 'Luiz de Queiroz", Piracicaba, SP.
November 3/4, 1988	Jamaican Association of Sugar Technologists, c/o Sugar Industry Research Institute, Kendal Road, Mandeville P.O., Jamaica, W.I.	Jamaica
November 14/16, 1988	Hawaiian Sugar Technologists, P.O. Box 1057, Aiea, HI 96701, USA	Ala Moana Hotel, Honolulu, Hawaii.
February 26/March 2, 1989	American Society of Sugar Beet Technologists, 2301 Research Boulevard, Suite 107, Fort Collins, CO 80526, U.S.A.	Hyatt Regency Hotel, New Orleans, LA.
June 5/8, 1989	South African Sugar Technologists Association, c/o S.A.S.A. Experiment Station, Mount Edgecombe, Natal, South Africa 4300.	Elangeni Hotel, Durban
October 12/21, 1989	International Society of Sugar Cane Technologists, c/o STAB, C.P. 532, Piracicaba, SP, Brazil 13400.	São Paulo, Brazil.

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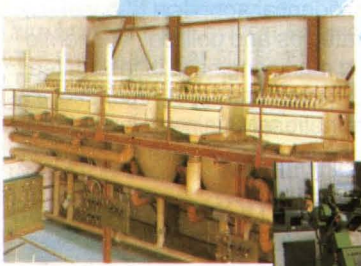

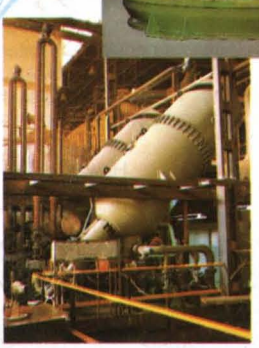

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