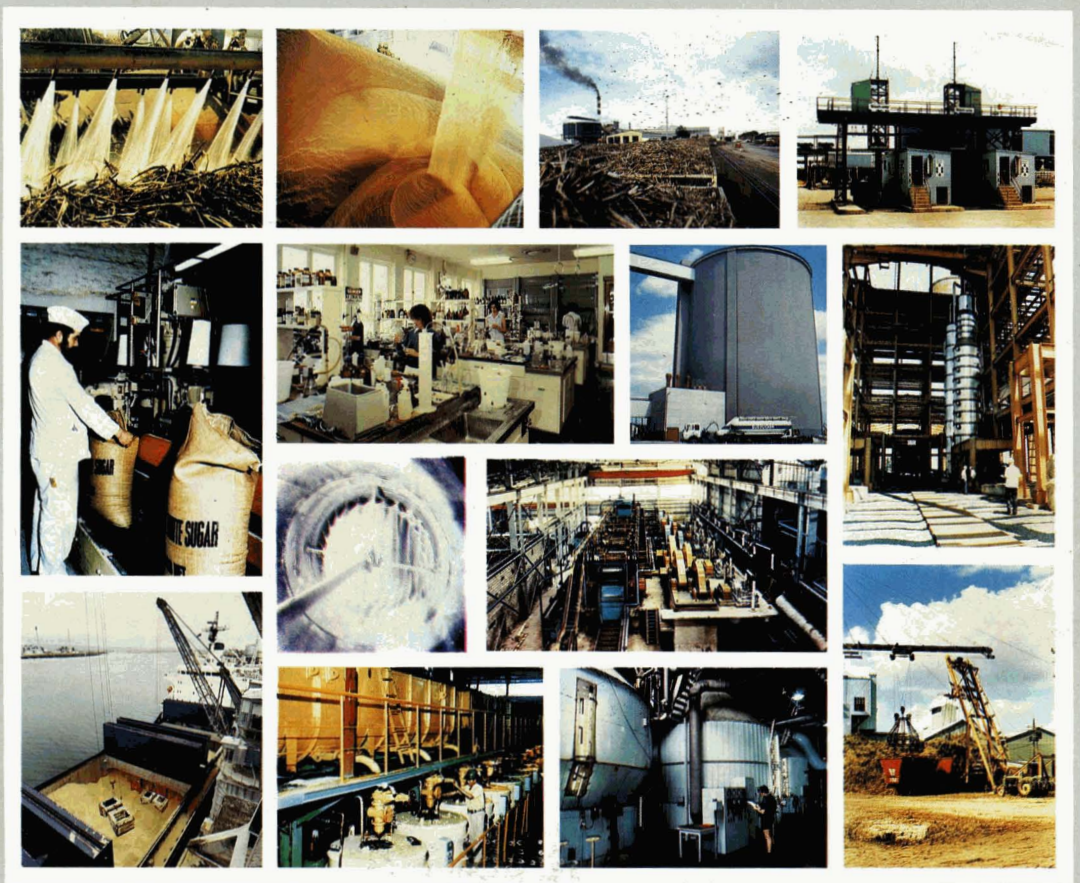
INTERNATIONAL SUGAR JOURNAL



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CONTENTS October 1985

Panel of Referees

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Consultant and former Director, Sugar Milling Research Institute, South Africa.

M. MATIC
Emeritus Professor and former Director, Sugar Milling Research Institute, South Africa.

K. J. PARKER
Consultant and former Chief Scientist, Tate & Lyle Ltd.

R. PIECK
Former Director of Sugar Technology, Raffinerie Tirlemontoise S.A.

T. RODGERS
Former Deputy Chairman, British Sugar plc.

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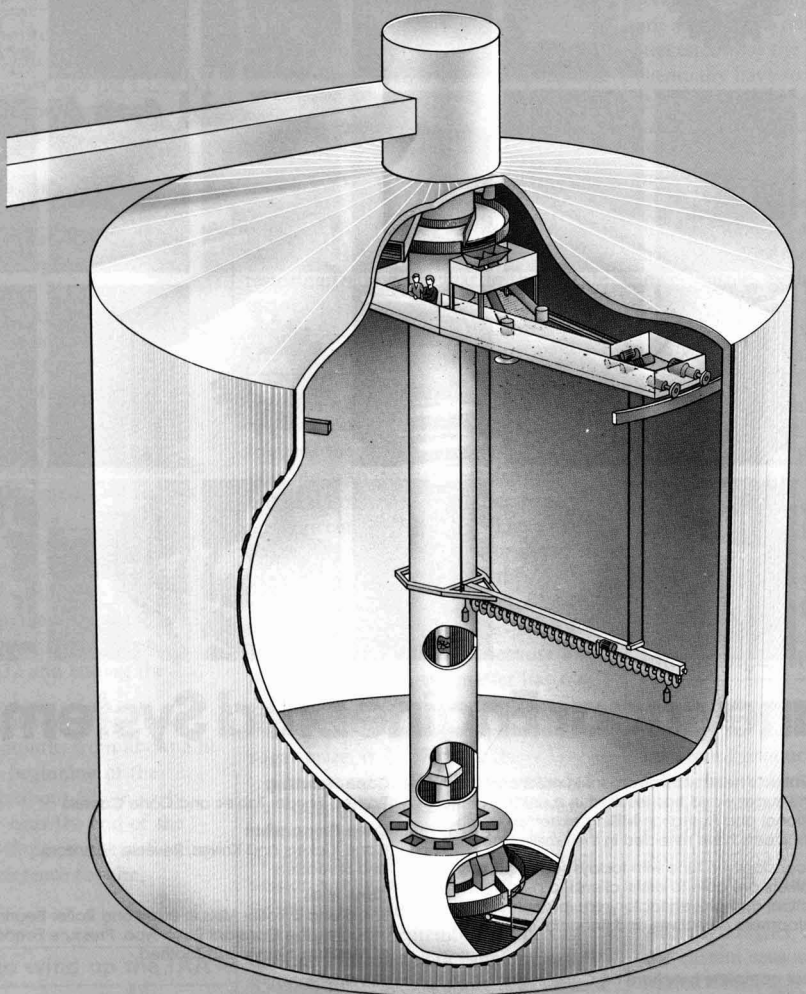

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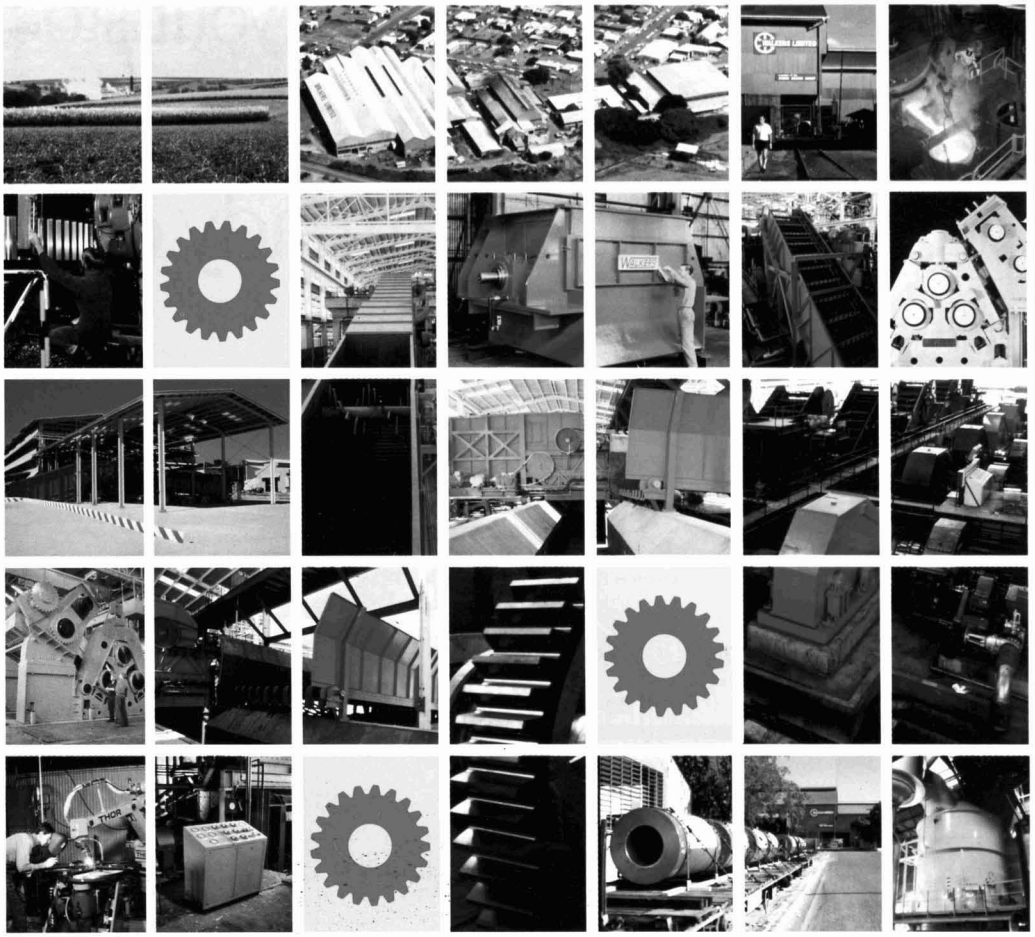

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Notes and comments

World sugar prices

The improvement of sugar prices which commenced in July was maintained in August and the LDP(W) which started the month at $152.50 per tonne rose to $157.50 on August 7, sank to $153 the next day but rebounded to $158 on August 9 and remained between $156 and $162.50 during most of the rest of the month, rising to $166 on August 29 before ending the month at $164. The improvement was largely due to a high level of buying, particularly by India, with the prospect of further requirements for that country and a number of others.

The raw sugar market has been buoyed by the white sugar business, in spite of a lack of trading, and from a level of $114.50 on July 31, the LDP rose to $121.50 on August 1, climbed to $129 on August 6 but declined to $117.50 on August 8. From then to August 28 it remained in the range $111.50-$125 before climbing on August 29 to $132 and ending the month at $127.

The premium of whites over raws rose during the month; from about $30 per tonne at the beginning of the month it went to about $25 in early August but rose near the end of the month to $35-$40 per tonne, reflecting the market's preference for the refined product.

Brazil plans to wind up the IAA

The Minister of Trade, Sr. Roberto Gusmão, has been authorized by President Sarney to start winding up the Brazilian Coffee Institute and the Sugar and Alcohol Institute (IAA) from September 1985 with the aim of completing the process within two years. The London offices of both organizations may well continue in being because of the proximity of the headquarters of the International Coffee Organization and the International Sugar Organization.

Sugar sales will be directed by a National Council of Producers and other functions of the IAA will be spread among various ministries and possibly the Foreign Trade Department of the Banco do Brasil.

Future changes are not likely to affect honouring of agreements reached with the IAA and Brazil's export policy is expected to be unchanged. The object of the changes appears to be to cut costs and reduce bureaucracy by restoring trading in sugar to the private sector.

US sugar policy meeting[1]

The US government's sugar policy review group held its first meeting towards the end of August to consider how much to cut next year's sugar import quota, but delayed an expected announcement of the US Market Stabilization Price (MSP) for next year. A USDA official said that the MSP announcement, earlier expected by September 1, would be delayed until the beginning of October because a new regulation on the matter has not yet cleared government agencies. The 1984/85 MSP, the benchmark domestic sugar price, is 21.57 cents/lb.

Government officials who attended the sugar group meeting said it was devoted to a review of the overall US supply and demand outlook. Another session would be held in early September because the quota had to be announced by September 15. Private estimates of the quota range from 850,000 to 1,250,000 short tons against last year's basic quota of 2,550,000 tons. Many analysts, however, feel that the calculations for next year are extremely difficult because of the two-months extension in the 1985 quota year.

Philippines sugar import possibility[2]

It has been widely reported in the Philippines that sugar stocks are much lower than has been officially estimated. Though an audit has recently been completed, details have not so far been released but it has been suggested that the stock figure will eventually have to be reduced by more than 250,000 tonnes. The government has called for an output from the 1984/85 season of 1.6 million tonnes to meet domestic requirements and the US quota, but it has been suggested that bad weather and the deteriorating law-and-order situation have caused a lower output, perhaps of below 1.45 million tonnes.

If the supply position eventually proves to be as bad as this, it is possible that the Philippines will need to import sugar later this year and quantities up to 200,000 tonnes have been mentioned. From information supplied from the Philippines, C. Czarnikow Ltd. estimate production in 1984/85 at 1.5 million tonnes, raw value, and in 1985/86 at 1.4 million tonnes; in 1981/82 and 1982/83 production exceeded 2.5 million tonnes.

Indian sugar situation[3]

India is on the verge of sugar scarcity; the glut situation created by the record production levels of 8.4 and 8.2 million tonnes, white value, in the 1981/82 and 1982/83 seasons evaporated as a consequence of the low production levels of 5.9 and an expected 6.0 million tonnes during the 1983/84 and 1984/85 seasons. Although higher crops were expected in the current season in Gujarat, Maharashtra and Tamil Nadu, poorer crops in other regions have limited production to the 6.0 million tonnes forecast at the start of the season.

On the other hand, an unprecedented upward trend has been observed in the consumption pattern for sugar in the past few years which, if it has continued, will place the current year's consumption figure at a record level.

1 *Public Ledger's Commodity Week*, August 31, 1985.
2 C. Czarnikow Ltd., *Sugar Review*, 1985, (1740), 97.
3 *Sugar Scene*, 1985, **3**, (5), 2-3.

Expected consumption, calculated on the basis of the government's monthly release mechanism, is 8.5 million tonnes, although this may be reduced to 8.0 million tonnes when deductions are made for sugar in the pipeline, stocks at factories and with traders, etc. Stocks at the beginning of the season were 2,375,000 tonnes against 4,700,000 tonnes a year earlier. Contracts have been placed for the import of 400,000 tonnes from international trade houses but even with this, total availabilities amount to 8,775,000 tonnes and, after deduction of the 8.0 million tonnes of expected consumption, this leaves only 775,000 tonnes to meet consumption during the first three months of the 1985/86 season when production is meagre.

Production in the next season will be dependent on the monsoon but is provisionally put at 7.24 million tonnes. Plantings are taking place under unsatisfactory weather conditions, mainly the absence of winter rainfall in the major producing states, and the cane area is estimated at 3.1 million hectares against 3.0 in 1984/85. Khandsari production is forecast at 743,000 tonnes giving a total centrifugal sugar availability of 7.98 million tonnes. Imports of 1.2 million tonnes are therefore expected in 1985/86 if high prices are to be avoided. As a consequence of the probable scarcity and likely higher prices, total 1985/86 centrifugal sugar consumption (factory-produced and khandsari) is forecast at 9.0 million tonnes against 9.26 million tonnes in the current season.

Brazil's alcohol scheme hits stumbling block[4]

Brazil's hugely successful fuel from cane program — the prototype in a field which is attracting a great deal of interest from developing world sugar producers — faces what could be its biggest test in the form of competition from falling oil prices.

A recent World Bank report said that low world oil prices threaten to make the country's alcohol fuel from sugar cane program uneconomical. The irony of this is that the high cost of oil imports was the initial catalyst for a program which has resulted in 91% of cars sold in Brazil being run on pure alcohol.

The report's main argument was that, taking into account the anticipated decline in oil prices, the major investments needed to maintain the present market share of alcohol-powered cars "are not likely to be justified in the present decade."

Brazil has asked the Bank for a loan of $325 million spread over 15 years as part of its $930 million alcohol expansion scheme for the next five years. The Bank however, estimates that $8500 million would have to be invested to maintain the present market share of alcohol cars.

It therefore proposes dampening Brazil's enthusiasm for alcohol-powered cars by raising retail prices to 75% of gasohol and reducing the tax advantages to purchasers of alcohol-driven cars which make them 18% cheaper than gasohol models.

The Bank wants to cut alcohol cars to 50% of light vehicle sales within two years and claims Brazil's intended investment in new distilleries would not yield adequate returns at a time when oil prices are coming down. Instead, it would like the money spent on boosting cane yields and cutting processing costs.

The alcohol program has helped cut oil expenditure by more than $3000 million in just five years but, if alcohol cars continue to grow in popularity, fuel demand could more than double by the end of the decade. The irony then would be that Brazil might have to export more oil to subsidise alcohol production.

Italy sugar industry rationalization[5]

The beet sugar industry in Italy has been facing difficult times over the last year or so; a rationalization program has been under way which has led to reductions in beet area and some disenchantment with the crop by growers. However, a report by *Agra Europe* indicates that new measures have now led to increased harmony between processors and farmers and, as a result of this renewal of confidence, to an expansion in the area this year.

A new organization has been set up named Finbieticola as a joint finance company by the two main umbrella groups for the growers, ANB and CNB. It is the aim of the new body to complement the activities of the state reorganization company, RIBS, and to make sugar factories more accessible to the growers. There is a target to increase direct farmer involvement in factories from the present 6% to 40%, which would be more in line with the pattern in other EEC member states.

The government's five-year development program plans to redevelop the sugar industry at a cost of some 400,000 million lire and these recent moves would seem to have set the plan on a much more positive footing. The beet area is scheduled to increase to around 271,000 hectares, sectioned into ten main production regions. Some 15 factories out of 43 are to be closed by 1988 while there will be some running down of acreage in the north linked with expansion in the south. By raising the average capacity of factories it is planned to stabilize annual production at some 1.57 million tonnes of white sugar.

C. Czarnikow Ltd. believe that there would need to be some flexibility built into any target size for the industry since by the time this is due to be realised there is a strong likelihood that the next five-year sugar régime for the Community will make provision for a greater permitted maximum in charges to producers should the finance be required to cover the cost of exporting surplus quota production.

4 *Public Ledger's Commodity Week*, July 7, 1985.
5 C. Czarnikow Ltd., *Sugar Review*, 1985, (1739), 92.

Sugar in the life of mankind—The story of sugar illustrated by philatelic material

By Heikki Hongisto

In the *Australian Stamp Monthly* a philatelist, David Plummer, wrote in 1983: "Not many industries are better represented in the stamp album than the sugar industry is, particularly so far as cane is concerned; beet is not quite so well documented. The product of the industry is in demand the world over, and whenever heat and moisture are available, a good crop can be realized. Sugar is the ideal crop for many areas, and its worth to many countries is shown by the number of sugar stamps issued."

As early as in December 1954 an article was published in this journal entitled "Sugar on Stamps, a World Tour of the Sugar Industry in the Stamp Album". Indeed, this article, published in the very year when the author of the present paper joined the sugar industry, connected with the kind of thinking presented by the Australian philatelist some 30 years later, suggested to him the idea of setting up a collection of sugar stamps. Later on, when the structure of the collection began to take shape, the author — whilst enjoying his hobby enormously — remembered the words of Harold Powers, the well-known sugar chemist and contributor to this journal, about "we who have devoted our lives to sugar for its own sweet sake". By combining his hobby with the subject of his daily work, the author of this causerie considers the expression of Harold Powers to have, to some extent, come true.

In order to make a thematic collection — at least if one wants to exhibit the collection — it is not enough to collect stamps and fix them on an album leaf in some sort of order. One has to decide what one wants to exhibit.

There are obviously two alternatives; to build a documentary collection, in which all the sugar stamps from different parts of the world are exhibited country by country describing the purpose of each issue etc. The other way is to tell a story with (and only with) philatelic documents. The question many years ago was, would it be possible to tell the story of sugar this way. The hesitant answer was yes, let's try. In 1967 a book was published in Germany, named "Zucker im Leben der Völker", and from then on the author has worked with a collection "Sugar in the Life of Mankind". It is a cultural and economic history of sugar, trying to describe the main aspects of the sugar industry from its earliest days to the present day.

The collection now includes about 180 album leaves with more than one thousand philatelic items: postage stamps, post marks, postal stationery, meter marks, prephilatelic letters (philately begins with the "penny black" issued in May 1840) etc, all related to the story. The collection has been exhibited a few times and has been awarded a vermeil-medail.

To start with, the collection has to deal with the occurence of sugar in nature, the different sugars and to present some scientific background. There is fortunately enough material for most of this. To illustrate photosynthesis is somewhat difficult, but a number of stamps have made an attempt to do so, although none concerns cane or beet directly.

Then to the history of sugar. Of course, since the peoples of antiquity sweetened their food and drink with honey, some album leaves are included to evidence man's early wish to have his food sweetened.

The route of sugar cane is then followed from the Far East to Southern Europe and from there round the tropical zones all over the world. There are a few album leaves on the origin of sugar with some interesting information. A Laos stamp showing Buddha is there to show that the God according to Indian mythology arose from a sugar cane. Some books claim that the sweet cane mentioned in the Bible by Isaiah and Jeremiah is sugar cane.

Columbus, on his second voyage, took with him seedlings of sugar cane from the Canary Islands and planted them in Hispaniola, the present Haiti and Dominican Republic. It was, in fact, the development of the West and East Indies as colonies that brought cane sugar to most countries in Europe at relatively low prices. This development is amply described with philatelic material. The famous book of Noël Deerr "The History of Sugar" has, together with some other English and German books, given most valuable information on the early plantations and cane planters, some of which are recorded on stamp, too. Such planters were e.g. Sir Thomas Warner who became governor of St. Kitts, Francis, Lord Willoughby, whose ship is shown in an Antiguan stamp, and Captain John Powell who reported to his ship owner on the prospects on cane planting in Barbados.

The story goes on: sugar refineries were built in some European countries and later on in North America in order to refine cane raw sugar. There are some stamps showing location of early sugar refineries, e.g. at the Weisenbrügge in Berlin and in the old City of Stockholm. The collection also includes an early trading house circular from Hamburg to Würzburg reporting on the London prices of sugar in 1798.

As early as in the 18th century sugar extraction from beets succeeded in Germany, but it was not until the long years of the Napoleonic wars and the British Blockade of Europe that rendered sugar such a rarity in Continental countries that the development of the cultivation of sugar beet as a competitor of sugar cane began. Although none of the great names of this development, Marggraf or Achard, have been honoured by an issue of postage stamps, there are other stamps, post- and meter marks which can be used to illustrate this important period of sugar industry. Napoleon, who must be given much credit for the development of the beet as a source of sugar is of course shown on a stamp

This article was the winner in our 1984 competition for a non-technical contribution of general interest to sugar industry people.

included in the collection. Although he did not originate the production, he certainly gave it the impetus it needed. After the fall of the Emperor, cane sugar came back, and it was only after the measures of Adolphe Thiers, "the second father of the domestic sugar industry in France", that the beet sugar industry survived.

Later on there has been a hard competition between sugar cane and sugar beet, generally led by cane. However, about 100 years ago when the abolition of slavery put an end to cheap slave labour and hundreds of new beet factories were built in Continental Europe, beet sugar production for a while surpassed that of cane sugar. All these phases of the sugar industry are described in the collection. As to slavery there are a lot of stamps describing the slave trade; the ships that brought sugar to Europe did not return empty but took with them slaves from Africa as return freight. The Spanish priest Bartolomé de las Casas (1474-1566) has been shown in many stamps. This man, who devoted his life to the benefit of the American Indians, happened to present the fateful thought that the African negroes would better stand the heavy work at the sugar plantations. There is also in the collection e.g. a prephilatelic letter from Demerara, British Guiana (dated in March 1836), reporting on many interesting aspects of the sugar industry of this important area. (Demerara, of course was famous for her bright, lustrous high quality raw sugar). Among other things are mentioned difficulties associated with labour owing to talk of slave emancipation.

Personalities connected with the sugar industry are not so commonly illustrated on stamp, although Dr. Charles Telfair, who effected considerable improvement in the method of breeding cane on Mauritius, has got a whole block of his own of 6 stamps (Figure 1). This set was issued to mark the 150th anniversary of his work. Telfair had a reputation as an enlightened and sensible slave owner. His workers were "well looked after, and allowed reasonable hours for meals, rest and sleep". Mauritius has issued also another set connected with a sugar industry personality, namely to honour Adolf von Plevitz, social reformer. He became manager of his father-in-law's estate, and became concerned by ill-treatment of Indian immigrants at the hands of white planters and decided to champion their cause.

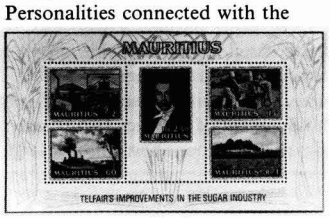

Fig. 1

Fig. 2

There are some other sugar personalities illustrated. Worthy of mentioning is certainly the well-known sugar scientist Alvaro Reinoso, illustrated in two Cuban stamps (Figure 2). The term Reynoso system has become a stereotyped phrase in Java referring to deep-trench cultivation as opposed to shallow surface planting.

The remarkable growth of the beet sugar industry at the end of last century is illustrated by several German "sugar letters' from one factory to another, as well as meter marks telling about the centenaries of some factories (Figure 3).

Our century and especially the years after the second world war have witnessed an enormous growth of the sugar industry all over the world with establishment of new factories in new sugar growing countries (Figure 4).

After the history of sugar, only a part of which has been referred to above, the collection then describes in detail the geography, cultivation, harvesting and processing of both sugar cane and sugar beet as well as,different departments of sugar factories and refineries.

A good picture of cane growing is available on stamps from Fiji, Cuba, Indonesia and Haiti (with the Sugar Queen, Figure 5), though Peru, Jamaica, Zambia, Argentina, Trinidad, Mauritius and others have each issued stamps to honour sugar, the principal industry for most of these countries. Material on soil preparation, irrigation, destroying pests, even battle against malaria have been found to depict these stages of the cultivation.

Cutting the cane, a primitive and laborious task until recently, is next in the sequence and has been shown on several issues (Figure 6). The important

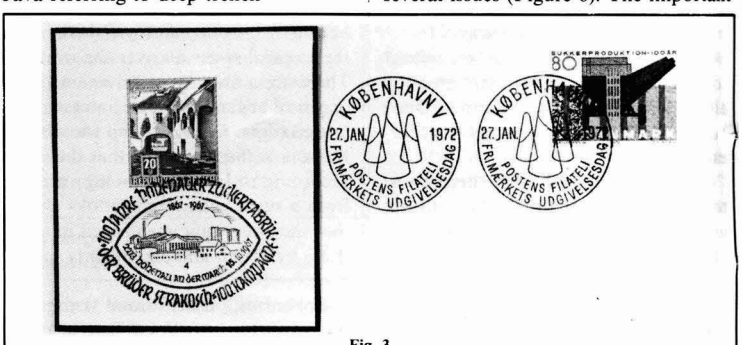

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

development of mechanical harvesting has also recently been shown on stamps (Figure 7).

Transporting sugar cane is a very well accounted chapter in sugar stamp issues, in addition to which there is some postal stationery. On the transport of cane by rail there has been enough material for a detailed article "Sugar trains — a sweet little theme" in the *Stamp & Postal History News* of April 1983. Cane is also shown being transported from the canefields in punts, by ox-carts and by trucks. The author has at least 30 different stamps on cane transport, some of which are shown in Figure 8. This chapter of the collection includes an interesting printing error. A Panama 2 centavo stamp of 1942 showing a sugar cart drawn by oxen and inscribed "Acarrero de Caña" was subsequently reissued in 1948 with the amended caption "Acarreo de Caña" and again in new colours in 1950.

Another error of design included in this philatelic sugar collection is from Fiji. The first sugar presentation was on a 5d stamp in 1938, a bicoloured with a fed frame and showing a clear stand of cane, the latter printed in blue. Following local protests the stamp was reissued two years later with the cane in the appropriate green colour.

Some stamps, especially from Cuba, give some idea of the processing stages with crushing equipment, evaporators, vacuum pans etc. All in all it is no wonder that Cuba has issued more stamps on sugar than any other sugar producing country. The author has some 70 different sugar-related stamps from Cuba, in addition to which there are numerous post marks. The slogan post mark "Compre Azúcar Cubano" (buy Cuban sugar), has been in use at least 30 years. Among the Cuban issues there is the one of the first stamps on sugar. In 1899 under U.S. military rule, the Republic issued a brown 10c stamp

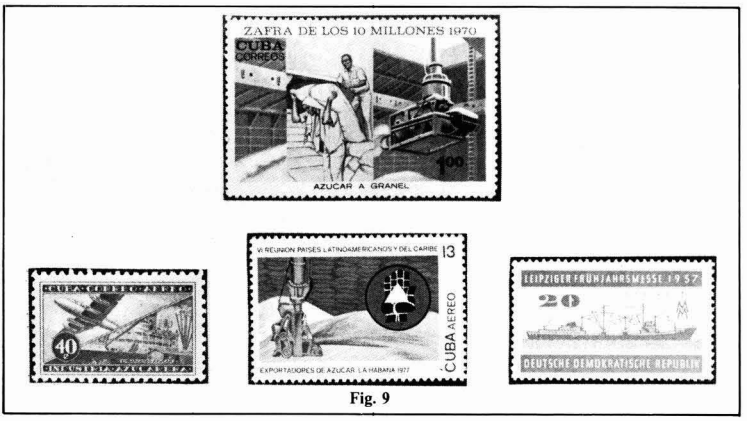

Fig. 9

showing a native farmer with his ox and plough tilling the soil in a cane field. This stamp may also be seen superimposed on a Cuban issue of 1955.

Refining, the final stage, usually follows at a place removed from the raw sugar mill, and this accounts for the number of stamps of sugar being transported and stored in silos (Figure 9). The production of lump sugar is a speciality of the refineries. This part of the collection includes a number of nice meter marks.

Realizing the important contribution of agricultural research, and particularly cane breeding, in 1950 the British Commonwealth ordered the issue of a 2c emerald stamp for use in Barbados. The stamp depicts cane in flower, and the scene includes the tall structure called a lantern, which is used as a pollination cage for crossing and breeding cane varieties (Figure 10).

Fig. 10

It can be argued which is the most distinguished sugar stamp — there are many worthy of the name — but according to the above mentioned Australian philatelist, the least distinguished is perhaps the Somalia air stamp of 1965. The sugar mill shown "apparently produces sugar in lumps; pillars of sugar two stories high are piled against walls, and one of the cane-cutters shown is working bare-handed, while the other appears to be dancing. Did the designer ever see sugar cane, or a mill?"

Although sugar beet as a whole has not received the same amount of consideration as sugar cane among the people who decide about the stamp issues and their design, there is quite a lot of interesting material. In an early article (of 1955) its author was able to present only two "beet stamps", one from Russia and one from "the often kicked-around Saar State in Europe". In fact there were already at that time more stamps, and the number has grown much since those years (Figure 11). In addition there are a number of interesting Ukrainian and Russian postal stationery of the early 1930's and a lot of older and newer meter marks. All in all it is possible to give a fairly complete illustration of sugar beet and its cultivation as well as of the beet sugar industry. A Moroccan stamp of 1963, e.g. shows a well drawn beet

Fig. 11

with a factory in the background, while a Czechoslovakian 20h stamp of 1961 shows a beet, sugar bags and a tempting steaming cup of coffee with sugar cubes in the saucer (Figure 12).

Fig. 12

The collection then describes the use of sugar. It is nowadays used in about equal amounts in households and industry in order to give energy and taste and for preserving fruits and other foodstuffs.

The pharmaceutical use of sugars is described underlining the nutritional and medical aspects.

There is a group of stamps which advertise sugar as a product of commerce or are issued to commemorate sugar exhibitions etc. This group includes slogan post marks and meter marks, too. Some old prephilatelic letters give information on the way of trade in past days, on prices etc.

One prephilatelic letter from Jamaica reports on shipment of raw sugar and harvest prospects, another from Austria about price of coke used in beet factories etc. They are all quite interesting and increase the philatelic value of the collection.

The above has been a very brief description of the collection which in addition depicts many other aspects on sugar in the life of mankind; sugar in connection with some geographical names, in literature etc.

The collection emphasizes all the way through the constantly important position of sugar as one of the most important foodstuffs of mankind. Building of the collection has been and continues to be a most rewarding hobby.

Literature

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David Plummer: "A sweet theme, Thematic collecting," *The Australian Stamp Monthly,* June 1983.

Howard Linecar: "Sugar Trains — a sweet little theme," *Stamp & Postal History News,* March 30-April 12, 1983.

Sugar Industry Technologists 44th Annual Meeting, 1985

The 1985 meeting of Sugar Industry Technologists Inc., ably organized by the Executive Director, R. Stuart Patterson, formerly of C & H Sugar Refining Co., took place in St. John, New Brunswick, Canada, in early June. Members assembled during the week-end of June 2/3, the first official function, other than Executive Committee and Directors' meetings, being a "mixer" on the Sunday evening.

The program of papers was as indicated in an earlier issue of this Journal[1] but additional papers were presented, including "Modification of a Roto-Louvre granulator" by Malcolm K. Faviell, "Construction and start-up of a coal fired boiler and turbo-generator" by Joseph C. Tillman, "The use of electric boilers in sugar refineries as an alternative source of steam" by J. Aurelio Bezerra, and "Deaerator stress corrosion cracking" by Peter Bulionis. Abstracts of all the papers will appear in this Journal in due course.

On June 5, after the technical sessions, members were able to visit the St. John refinery of Lantic Sugar Ltd. who hosted the meeting. Lantic Sugar also owns refineries in Montreal and Oshawa.

At St. John, raw sugar is unloaded at 250 tonnes/hr by grab from bulk carriers which have access to the port all year round. From two collecting bins, conveyors deliver sugar to two bucket elevators feeding a 100-tonne holding bin. From this it is conveyed via Avery scales to a system delivering 47.6 tonnes/hr to process and the balance to the 25,000-tonne raw sugar shed. When no ship is unloading, sugar is reclaimed by a drag scraper and conveyor system.

The raw sugar passes beneath an electromagnet and via scales to a mingler where it is mixed with affination syrup. The magma overflows a weir at 92.5°Bx and is raised to 112°-120°F before feeding to five Western States centrifugals. These

1 *I.S.J.*, 1985, **87**, 119.

discharge to a melter where the washed sugar is dissolved to 66.5°Bx at 158°F and pH 7.0. The affination syrup is partly recycled and partly sent to the pan house. The washed sugar liquor is screened and clarified with lime and phosphoric acid in the presence of Talofloc and Taloflote and the floc separated by aeration. Remelt liquors are clarified similarly while soft sugar liquor is clarified without Talofloc.

The liquor is treated by the Canesorb process[2], press-filtered and sent to the pan feed tanks. When invert syrup is required, part of the liquor is treated with hydrochloric acid, heated, neutralized and the Brix adjusted after cooling. A three-boiling system is used for white sugar while soft sugars are boiled on blends with affination and remelt syrups. Massecuites are spun in Western States batch centrifugals, dried and the granulated sugar screened, with the various fractions sent to appropriate silos and thence to the packing station. Three grades of remelt are boiled and remelted. The higher grades are melted, clarified and used for soft sugar production while the lowest is used as feed material for the intermediate grade.

The refined sugar warehouse is a three-storey building which holds about 5500 tonnes of products stored on pallets, including 100 lb cotton bags, 40 kg paper sacks and bundles and cases of smaller packs. The shipping floor holds five boxcars on each side for loading and despatch by rail. This can be at a rate up to 1100 tonnes/day and includes most of the refinery's output, the balance going by road truck. Liquid sugars are shipped in railcars.

2 *ibid.*, 1983, **85**, 14-18, 38-42, 72-76.

The analysis of sugars in beet Part II. Sugar extraction

By A. P. Mulcock, S. Moore and F. Barnes

(Microbiology Department, Lincoln College, Canterbury, New Zealand)

In any extraction and analysis to find the sugar content of beet, account must be taken of marc volume. The literature on this subject has been reviewed by Vukov[1]. He reported that the term "marc" has usually been defined as the undissolved part of the sugar beet, after a complete extraction of soluble sucrose and non-sugar compounds, the conditions of the extraction being similar to those used in industrial processing. The volume of beet sample not occupied by juice was generally regarded as "marc volume".

Beet tissue does not consist of dry marc plus liquid juice, however, as the marc may contain varying quantities of bound water. The concept that the sugar beet root can be considered to consist of hydrated marc is an artificial one since the cell walls which make up the marc contain a solution of sugars and other solutes, the concentration of which in this solution is lower than that in the cell sap. Thus it may be assumed that an adsorption equilibrium between marc, water and solutes is set up on extraction.

In Europe and the USA it is usual for all the beet for the manufacture of sugar in any one factory to come from

1 "Physics and chemistry of sugar beet in sugar manufacture" (Elsevier, Amsterdam) 1977.

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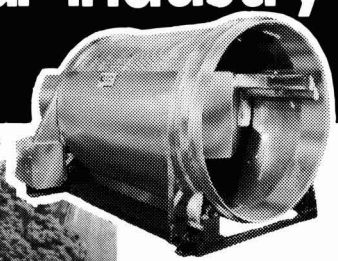

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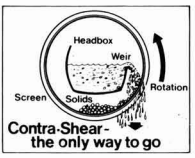

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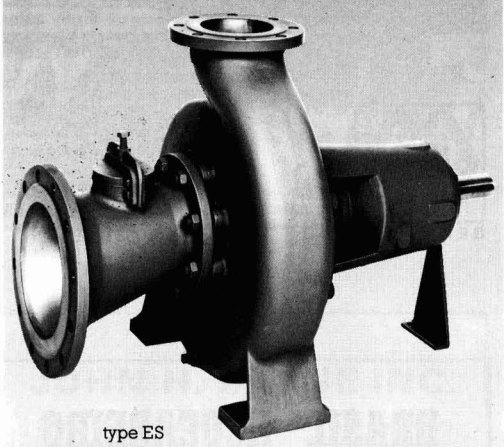

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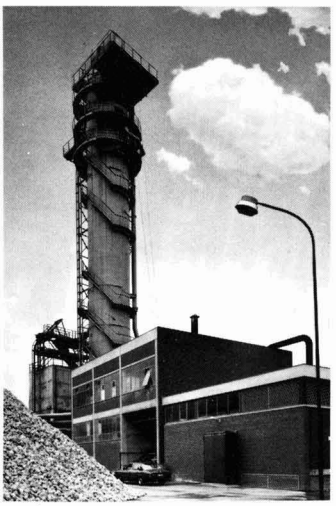

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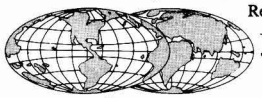

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ISJ Abstracts

Cane sugar manufacture

The which and why of flocculants for cane juice clarification in Barbados sugar factories

S. A. Brooks and J. Klonowski. *Proc. 2nd Ann. Conf. Barbados Sugar Tech. Assoc.*, 1984, 7 pp.

Comparative trials on a number of unnamed flocculants are reported.

Sugar manufacture from sugar cane

A. Vigh. *Cukoripar*, 1984, **37**, 139-144 (*Hungarian*).

Descriptions are given of cane cultivation and harvesting and of factory processes for manufacture of both raw and white sugar.

Sugar boiler combines many skills to produce quality sugar

A. G. Noble. *BSES Bull.*, 1984, (7), 6-7.

The typical 3-massecuite boiling process is outlined, and some of the factors to be taken into consideration to ensure optimum performance are explained.

Investigation of scale in juice heaters

C. G. Edilia. *Technol. Quim.*, 1984, **5**, (1), 55-70, 150; through *Ref. Zhurn. AN SSSR (Khim.)*, 1984, (24), Abs. 24 R486.

Scale formation in juice heaters was studied as a function of various parameters, including juice feed temperature, steam temperature and juice flow rate, with the aim of developing a mathematical model for use in heater designing and evaluation of heater performance in sugar factories. The investigations were conducted on an experimental unit comprising four annular heat exchangers 6 m long and having a copper inner tube of 28 mm diameter and an annular steel shell of 3.8 cm diameter. In addition to the above-mentioned parameters, the SO_4^{--}, Ca^{++}, Brix and sugar contents were also measured. All the data obtained were processed by computer. The juice flow rate (1-3 m/sec) was much greater than in the factory heaters, so that each test was of insufficient duration to give comparable data, and the tests are to be continued.

Joint probe on effects of cane properties on milling process

G. A. Brotherton. *BSES Bull.*, 1984, (8), 22-23.

A small-scale impact test was used to determine the milling properties of cane varieties in terms of the energy required for a thin hammer to fracture a sample which it struck at right angles to it; the sample was a 10 mm diameter core cut from the centre of a series of stalk internodes. Results showed that, for a No. 1 mill, the mechanical performance was governed, for practical purposes, solely by the fibre content, whereas this was not necessarily the case with subsequent mills in the train. The measurements obtained were consistent for a given cane variety under all test conditions, with the energy absorption approximately rising with increase in fibre content. The method may prove to be of value for identifying problem varieties early in the breeding program.

Centrifugal screen corrosion reduces sugar recovery

Anon. *BSES Bull.*, 1984, (8), 23.

See Greig *et al.*: *I.S.J.*, 1985, **87**, 35A.

On comparison of boiling house efficiency

F. P. Dizon. *Crystallizer*, 1984, **7**, (4/5), 14-15, 17.

A formula for reduced boiling house recovery has been developed which is based on a standard mixed juice purity of 85 (as proposed by Noel Deerr) and which is similar to Deerr's formula but with average values substituted. It takes the form: $R_{D85} = 99.7 - 0.1765\ S_{mj}R_F$, where R_{D85} = derived reduced boiling house recovery, S_{mj} = sucrose in mixed juice and R_F = retention ratio, which is defined as

$$\frac{100 - R}{N_{mj}}$$

where R = actual boiling house recovery % and N_{mj} = non-sucrose in mixed juice %. Application of the formula to results at a number of sugar factories in the Philippines shows similarity in the accuracies of the new formula and that of Noel Deerr; the new one is considered an improvement because of its relative simplicity, while being more accurate than that of Mittal.

Trash recovery project at the Oahu sugar factory

T. Tabata. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 55-58.

Dissatisfaction with the performance of Olsen rolls installed for trash separation led to modifications of the cane cleaning system at Oahu Sugar Co. Nine bumping rolls, made of steel piping with 19-inch square steel plates welded at 2-inch intervals, replace the Olsen rolls. Cane that has passed through the stool drums bounces over the rolls as water is sprayed onto it. The cane and leafy trash then bounce over a set of collar rolls (similar to the bumping rolls, but with round discs instead of square plates) while being sprayed with water. The trash, including cane pieces, passes to the prepared cane carrier; a new conveyor for disposal of stones and mud was to be installed as well as a reclamation system for short cane pieces (that would otherwise be lost with the stones and mud). On the basis of some 1983 data, it is estimated that the modified scheme, handling cane from 7000 acres, will increase sugar recovery by 0.5-1.0 short tons/acre.

Improving mill extraction using juice recycling. I

J. W. Bersch. *Rpts. 42nd Ann. Conf.*

Hawaiian Sugar Tech., 1983, 155-160.

See Onna: *I.S.J.*, 1985, **87**, 69A.

Improving mill extraction using juice recycling. II

K. Onna. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 141-143.

See *I.S.J.*, 1985, **87**, 69A.

High-grade seed pan control using the SSR-72 pan refractometer at Kekaha Sugar Company

J. Albert-Thenet. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 144-145.

At Kekaha, consistency has been used for some time for seed pan control, but it is readily affected by viscosity, crystal content and temperature. With refractometer control, the pan may be seeded at the right time consistent with optimum supersaturation provided the purity of the footing is known and the temperature is controlled. Details are given of a system centred on an SSR-72 critical-angle refractometer manufactured by the Electron Machine Corp. which was first installed as an indicating instrument but subsequently used to control the syrup and water valves so as to prevent false graining. A helical scanner in the sensing head rotates at 60 rps and sweeps a beam of light continuously through a series of angles at the interface between a sapphire prism and the massecuite. Depending on the Brix, light will be refracted at the higher angles or reflected at the lower angles; the ratio between the two forms is a function of the refractive index and is interpreted by a solar cell from the light impulses received from the prism. The signal is suitably processed and converted to a pneumatic signal for control of the valves. A selector links the refractometer system to the consistency system, so that control is possible by means of either system or a combination of them. The refractometer has permitted excellent seed strikes, while good results have been obtained with use of the system to control boiling up to a seed grain size of about 0.15 mm, followed by switching to consistency control (the refractometer overriding the consistency system to prevent excessive supersaturation).

Standardizing pan work with a recording on-line refractometer

J. H. Payne. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 146-148.

While variability in juice composition makes complete standardization and complete automation of raw sugar boiling too complex for most practical purposes, standardization and control of seed boiling is possible with the aid of a system such as that incorporating an Electron Machine Corp. on-line recording refractometer. Aspects of high-grade seeding are discussed, including fixed footing purity, fixed absolute pressure and heating vapour pressure, controlled syrup and molasses solids concentration, supersaturation, seed slurry grain size, and crystal growth after seeding. A standard procedure is then described for high-grade boiling, and some advice is given on low-grade boiling.

HC & S boiling house expansion and practices

K. Nakano. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 149-151.

Details are given of the expansion program at Puunene factory which was initiated in 1978 with the intention of increasing the crushing capacity from 290 to 380 tch. A description is also given of the new 3-massecuite boiling scheme in which *A*-massecuite is boiled from straight syrup to a sugar of 99 purity, *B*-massecuite is boiled from 87 purity remelt and 68.5 purity *A*-molasses to give a sugar of 98 purity, and *C*-massecuite of 58 purity is boiled from *A*-molasses and 56 purity *B*-molasses. Separate seeding for the *A*- and *B*-massecuites replaces the previous combined process.

Survey of low-grade massecuite reheating in Hawaii

T. T. Bennett. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 152-154.

Factors involved in massecuite reheating are discussed and the types of heater used in Hawaii and results obtained are examined. It is stated that at about half of the factories, the massecuite is reheated in the crystallizers, but this is not particularly efficient because of the relatively low heating surface area available. Aspects of dilution with water or molasses as a means of reducing viscosity are considered, and Hawaiian practices in this field indicated.

An evaluation of existing methods of controlling cane feed through the mills

G. R. Webster. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 155-160.

The benefits of good control of cane flow to and through the mill train (or diffuser) are stated, and desirable features of an integrated system indicated. A survey is presented of control systems used in eight Hawaiian sugar factories having annual sugar outputs in the range of 40-70,000 short tons, and in five factories of larger outputs (80-130,000 tons). Brief comments are made on the system at each factory, and an overall assessment is given.

Alternative energy resources in Hawaii

G. E. St. John. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 167-169.

Actual and potential sources and forms of energy in Hawaii are surveyed, including bagasse, solar energy, geothermal energy, ocean thermal energy, hydroelectricity and wind.

Role of water treatment in boiler efficiency optimization

J. Perlich. *Rpts. 42nd Ann. Conf.*

Hawaiian Sugar Tech., 1983, 170-173.

A hypothetical case study is used to show the potential savings obtainable when boiler efficiency is optimized by minimizing blowdown and scale. Blowdown may be minimized by improving its control, increasing the conductivity limits on the boiler water, reducing feedwater conductivity and raising its quality. Each measure is discussed, and the role played by minimizing tube deposits is demonstrated by comparing heat transfer coefficients for clean tubes and tubes carrying a $1/16$-inch layer of iron deposit.

Conveyor chain and sprocket interaction

R. E. Skewis. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 187-188.

Aspects of chain and sprocket systems used on conveyors are discussed and advice is offered on proper use of sprockets to extend chain life and reduce operating costs.

Update on centrifugal washing tests at Oahu Sugar Company factory

T. Moritsugu and B. J. Somera. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 189-194.

Single and double washing tests were carried out with the aim of establishing guidelines for optimizing both methods. The amount of water applied to give a required sugar pol depended mainly on the extent of molasses removal before washing. In double washing, the timing of the first wash appeared to have a more direct influence on sugar pol than did the second wash. Since the ease of molasses separation during spinning without water varied with the massecuite, a "base spin time" was established for each massecuite and served as basis for choosing the spinning time settings used during the runs. An unduly long spinning time relative to the base spin time led to a greater increase in molasses purity, although it could also result in a higher sugar pol. While the colour of the raw sugar improved with rise in pol, there was a point after which further increase in pol was accompanied by a dramatic increase in molasses purity with hardly any further improvement in sugar colour.

Hydraulic cranes at HC & S Company

D. Shanaman. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 202-203.

Details are given of the factory yard operations at Paia, where the use of three Caterpillar 245 hydraulic loaders, with an electric cable crane as standby, has permitted a target 10% increase in crushing rate without the high expenditure on a feeder table, while cane handling costs have been reduced. Other benefits of a hydraulic loader are mentioned. Tests on a Link-Belt LS-5800 hydraulic loader at Puunene factory are also reported; results were so good that it was decided to purchase the machine, and the main benefits are listed.

Hydraulic crane costs at McBryde Sugar Company

J. W. Hoxie. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 204-205.

The costs and advantages of operating a Link-Belt LS-5800 CL hydraulic cane loader in the factory yard, by comparison with a cable crane, are briefly discussed.

Application of the Tilby cane separator for sugar cane processing

H. Bourzutschky. *Zuckerind.*, 1985, **110**, 141-151 (*English, German.*)

An account is given of the development of the Tilby cane separator from the first experiments carried out, via the setting up of two companies to build the machinery and market it, the bankruptcy of Canadian Cane Equipment Ltd. (the company formed from the previous two), work carried out in Barbados, to the installation of two separators, one in Brazil and the other in Jamaica. The technology of the separation process is described, and potential uses of the three separated components (rind, pith and wax) are discussed.

Annox gas withdrawal and evaporator rating

M. Prasad and N. K. Sharma. *Indian Sugar*, 1984, **34**, 553-557.

Details are given of modifications to the incondensable gas withdrawal system in a quintuple-effect evaporator which permitted improved evaporator performance.

The Maxipol system

G. Appel. *Sugar J.*, 1985, **47**, (8), 18-20.

Details are given of the Maxipol patented system of cane milling in which an intermediate carrier having a permeable apron and a juice collecting tray carried a blanket of bagasse that was first saturated with juice from the mill following the carrier and then with imbibition juice as normally (addition of the two juices being necessarily at different locations so as to prevent mixing). The juice in the bagasse was thus displaced and flowed through the carrier. There were four distinct juices, differing in their sugar content; the richest was the residual juice in the bagasse entering the carrier, the next richest was that displaced from the blanket and flowing through the carrier, the leanest juice was the imbibition juice, while the fourth juice was that recycled from the mill following the carrier and comprising a mixture of residual and maceration juices. An account is given of trials in various sugar factories in different countries, and reasons are given for the failure of the system.

Beet sugar manufacture

Acid cleaning of sugar industry evaporators with a corrosion inhibitor

M. Tömördi and L. Németh. *Cukoripar,* 1984, **37,** 155-158, 160-161 (*Hungarian*).

Comparative tests on a number of corrosion inhibitors are reported, in which steel plate samples were immersed in dilute molasses and cleaned with HCl in the absence of inhibitor and in the presence of Armohib 28 (an Armour Hess product), KL-13 F (a Hungarian product) and Coronál 2K, Coronál 2NK and Coronál 30 (from Yugoslavia). In all cases, Armohib 28 gave by far the best results in terms of weight loss reduction, followed by KL-13 F. Armohib 28 was highly effective at temperatures in the range of 30-70°C in the presence of 2.5-15.0% HCl; at 70°C the corrosion rate resulting from 15% HCl was restricted to 9.9×10^{-3} kg/m²/hr by the inhibitor, compared with 1757.72×10^{-3} kg/m²/hr without inhibitor. Prices of the products tested are indicated.

Gauging the performance of a continuous mixing centrifugal at Hrochuv Tynec sugar factory during the 1983 campaign

P. Kadlec *et al. Listy Cukr.,* 1984, **100,** 265-269 (*Czech*).

The OKK-1400 M continuous centrifugal is designed to handle intermediate and low-grade massecuites, to mix the separated sugar with syrup to produce a magma and to produce a melt by e.g. dissolving affined sugar in water. The performance of the machine for magma and melt production was evaluated. A magma produced from *C*-massecuite at a rate in the range 1.5-11.0 tonnes/hr contained no lumps or conglomerates and had a crystal content of 52%; specific power consumption was 2.4-2.7 kWh/tonne. The mean crystal size was 10% smaller than in magma from a batch centrifugal. Throughput was limited by the inadequate diameter of the line feeding massecuite to the distribution trough and to the centrifugal and by insufficient supply of syrup for mixing. For melt production, *A*-massecuite was spun at a rate of 1.5-8.5 tonnes/hr; steam was used to heat the massecuite and reduce its viscosity, and dilution water was also fed at 22 litres/hr — the proportion of larger crystals rose in the absence of steam and water. Melt Brix was in the range 60-66°.

Sugar storage in silos. IX. Sugar stabilization line at Kojetin sugar factory

O. Mikus, L. Neuzil and M. Navratil. *Listy Cukr.,* 1984, **100,** 270-275 (*Czech*).

Details are given of the conditioning plant used at Kojetin for F 10 sugar intended for domestic sale in 1-kg packets. The moisture content is reduced to 0.05% in a fluidized-bed dryer and the sugar then conveyed to a stabilizing vessel of 380 tonnes capacity from which it is periodically removed for cooling to approx. 25°C in a fluidized-bed cooler, which also removes crystals smaller than 0.25 mm. The economic benefits of the plant are calculated.

The use of vibratory techniques in the sugar industry

J. Hluze. *Listy Cukr.,* 1984, **100,** 275-282 (*Czech*).

The basic parameters, advantages and sugar factories where they have been installed are given, together with diagrams, for three types of refined sugar vibratory screen, a beet hopper with automatically-controlled vibratory discharge to a conveyor, a vibratory beet trash separator and a water separator, and a vibratory conveyor for lumpy and granular materials.

A PO 1400 belt separator for coarse material

E. Kremplova and M. Pokorny. *Listy Cukr.,* 1984, **100,** 283-284 (*Czech*).

Mechanical impurities are removed from flume-wash water by means of an endless moving screen sloping away from the direction of flow of the water; the impurities fall from the end of the separator where the screen is about to start its return journey. The water falling through the screen at its upper level helps to clean the screen at its lower level. Since the bottom of the separator is sloping, the screened water flows out under gravity. In tests, 0.9 tonnes of impurities were removed per hour, equivalent to 1.8% on beet, and the BOD_5 was reduced by 0.1 kg O_2 per tonne of beet.

Sugar beet and frost damage in the Netherlands. A successful approach to prevent the delivery of frozen beet

L. H. de Nie, P. W. van der Pol and M. V. van de Velde. *Zuckerind.,* 1985, 110, 37-42.

See *I.S.J.,* 1985, **87,** 26A.

Sealed D.C. drives for sugar centrifugals

R. Barth. *Zuckerind.,* 1985, **110,** 42-43 (*German*).

Details are given of the AEG-Telefunken water-cooled D.C. motors developed as batch centrifugal drives in the sugar industry.

Improving the working conditions of sugar factory centrifugal operators

V. F. Evfimenko, P. N. Doroshenko and A. N. Zinenko. *Sakhar. Prom.,* 1985, (1), 16-18 (*Russian*).

The adverse effects of the emission of heat, noise and vibration from automatic centrifugals on their operators have been investigated, and some advice is given on how to reduce the nuisance level and improve the working conditions.

Steps to improve the performance of a vacuum filtration station

M. P. Spivak, V. F. Bereznii, A. P. Levitskii and Yu. V. Anikeev. *Sakhar. Prom.*, 1985, (1), 28-29 (*Russian*).

Details are given of modifications to the vacuum filters used to treat carbonatation mud at Teofipol'skii sugar factory which led to reductions in cake losses and in energy consumption. Other changes described involved CO_2 feed to the 1st and 2nd carbonatation vessels and juice pH control, as well as installation of a milk-of-lime buffer tank to provide a constant-density feed.

Experience in the operation of milk-of-lime activators

O. A. Savchenko, V. M. Leshchenko, V. I. Mikhailovskii and B. V. Voloshin. *Sakhar. Prom.*, 1985, (1), 29-30 (*Russian*).

Experience in the operation of milk-of-lime activators (provided with high-speed spray jets to disperse the lime particles in bubbles containing a gas/steam mixture and thus raise the free CaO content and reduce limestone consumption) is described, particularly the effect of siting of the activator between the CaO tank and the dosing system as used in three different systems at three factories.

Investigation of heat transfer intensification in beet sugar factory heaters

A. A. Pochechun *et al. Sakhar. Prom.*, 1985, (1), 39-42 (*Russian*).

Experiments are reported in which tubes having internal annular ribbing were used in vertical juice heaters in place of smooth-walled tubes so as to increase juice turbulence and thus reduce scaling. The benefits of the ribbed tubes were demonstrated by a 70% increase in heat transfer compared with the smooth tubes at identical juice flow velocity.

Sugar storage in silos. X. Mechanical properties of crystal sugar

V. Kavan. *Listy Cukr.*, 1985, **101**, 6-10 (*Czech*).

Mechanical properties of crystal sugar that need to be taken into account when storage plant is designed are defined and their significance indicated. Included are the angle of repose and of fall, bulk density (including the effect of the pressure imposed by the upper layers of sugar on those below), angles of internal and surface friction, granulometry and moisture content. Methods for measuring the various parameters are indicated, and results of laboratory and pilot plant investigations are presented.

Sugar storage in silos. XI. An aspirated lock for sugar bunkers and silos

O. Mikus. *Listy Cukr.*, 1985, **101**, 1-6 (*Czech*).

A description is given of an aspirated system intended for sugar discharge from bunkers or silos to a conveyor. The sugar falls under gravity into a vertical, rectangular section housing a rotary breaker designed to break up any lumps that may have formed. The stream of sugar then passes through a pivoted gate to the conveyor. As the gate opens, it actuates the aspirator, thus preventing formation of excessive dust clouds. The system, designed for an hourly sugar flow of up to 35 tonnes, was satisfactorily tested during two campaigns at Kojetín sugar factory.

High-BOD loading treatment using large-scale deep aeration tanks

N. Shimizu *et al. J. Ferment. Technol.* (Osaka), 1984, **62**, (3), 277-284; through *S.I.A.*, 1985, **47**, Abs. 85-0190.

Tests were carried out on the treatment of beet factory waste water in three deep aeration tanks (liquid height 9 m, diameter 8.7 m). To overcome the problem of low activity of activated sludge in these tanks, a pipe sparger, above which were five perforated plates, was used to increase the oxygen transfer rate to 390 mg/litre/hr. With an influent BOD of 2400-2900 mg/litre and a BOD loading of 9.7-11.6 kg/m^3/day, BOD removal was 98-99% and suspended solids removal was 66-97%. The maximum BOD loading observed was 14.7 kg/m^3/day, at which power consumption was only 0.56 kWh/kg BOD removed. The results indicate that very high BOD waste water can be efficiently treated in deep aeration tanks.

Effect of low-grade massecuite foaming on the quality of low-grade sugar

L. I. Trebin, V. V. Mank, I. A. Lyakhova and A. P. Lapin. *Sakhar. Prom.*, 1985, (2), 16-17 (*Russian*).

Experiments confirmed a fall in density and a rise in dynamic viscosity with increase in the amount of air dispersed in molasses at constant temperature, in accordance with Richardson's formula. Further investigations showed that foaming brought about by injection of air into massecuite in a partly filled distribution trough caused a fall in low-grade sugar Brix, purity and sugar content, all three parameters falling with increase in the amount of air dispersed. Measures to prevent foaming are suggested.

The difference between the calculated optimum pH_{20} of 2nd carbonatation juice and the pH_{20} of juice containing a minimum of lime salts, and ways of reducing it

T. P. Khvalkovskii. *Sakhar. Prom.*, 1985, (2), 17-19 (*Russian*).

The difference mentioned in the title has increased in Soviet sugar factories in recent years as a result of fall in beet juice quality. Among measures to reduce the difference is the addition of

sodium triphosphate or soda with the aim of maintaining a minimum pH_{20} of final molasses of 7.0-7.2 and thus minimizing sugar losses. Triphosphate is preferable to soda because it greatly increases Ca^{++} precipitation, so that, to achieve the same degree of lime salts removal, less triphosphate is required; this results in a smaller rise in molasses sugar associated with replacement of Ca^{++} with Na^{+}. A further advantage of sodium triphosphate is the greater adsorptive property of calcium triphosphate mud relative to colouring matter and soluble nitrogenous compounds. Partial replacement of soda with triphosphate is not recommended.

Factory tests on a low-temperature regime (in pan boiling)

Yu. D. Kot *et al. Sakhar. Prom.*, 1985, (2), 20-22 (*Russian*).

The conventional temperature change in pan boiling is from 79-80°C after nucleation to 75-78°C with *A*-massecuite, to 80°C with *B*-massecuite where a 2-massecuite system is used, to 75°C with *B*-massecuite in the case of a 3-massecuite system, and to 75°C with *C*-massecuite; however, a 10-15°C reduction in the temperature at dropping would bring a number of benefits, and factory tests were carried out. Results showed that a gradient falling from 74-76°C after nucleation in *A*-massecuite to 58-60°C at the end of low-grade boiling reduced the low-grade cooling time in the crystallizers by approx. 30%, increased sugar yield by at least 0.1% on beet (as a result of reduced degradation losses), and cut steam and fuel consumption by 2% and 0.2%, respectively, on beet.

Increasing the efficiency of thermal energy use in the sugar industry on the basis of single-pass evaporators

N. A. Pryadko *et al. Sakhar. Prom.*, 1985, (2), 25-28 (*Russian*).

While operation of a conventional quintuple-effect evaporator at elevated temperatures, designed to allow higher diffusion juice drafts and provide a thick juice of 70-72°Bx, was beset by a number of problems, a system in which a climbing-film evaporator was added to a quadruple-effect evaporator plus concentrator has permitted a saving in steam while allowing juice to be handled at a temperature of at least 135°C and maintaining vapour bleed at a required constant temperature for use in the pan station. A number of equations are presented for calculation of the evaporation parameters, and features and benefits of climbing-film evaporators are discussed.

A control and regulation system for beet storage in piles

B. A. Eremenko *et al. Sakhar. Prom.*, 1985, (2), 29-31 (*Russian*).

Details are given of a remote automatic control scheme which adjusts the temperature and moisture content of forced-fed air as well as the air feed rate according to the ambient temperature and R.H. of the air surrounding the pile. Tests in which the automatic control system was compared with a forced-ventilation system but with manual adjustment of the air parameters confirmed the benefits of the automatic system in terms of beet weight and sugar losses.

Radiometric density as measure for the boiling process

K. E. Austmeyer and T. Frankenfeld. *Zuckerind.*, 1985, **110**, 122-130 (*German*).

Details are given of a system for measuring massecuite density as a control parameter for white sugar boiling; it consists of a ^{137}Cs emitter located (in a suitable sealed housing) in the outer shell towards the bottom of the vacuum pan, a scintillation counter and photomultiplier. Investigations have shown that density measurement is more accurate and more sensitive to changes in the massecuite parameters in the initial boiling stages, including the graining point, than viscosity or consistency, which is, however, more accurate in the final stages of the process. A temperature correction is needed for density measurement, and the system is of no advantage over conductivity (which is more cost-effective) for low-grade boiling.

The development of electric drives for sugar centrifugals

H. Grass. *Zuckerind.*, 1985, **110**, 132-136 (*German*).

An account is given of the development of electric drives for batch centrifugals in line with the increases in basket sizes and loads, which have created considerable increase in moments of inertia and thus made heavy demands of the motors.

Plate-type filter of 100 m^2 surface area for thin and thick juice

I. Oglaza and B. Ciak. *Gaz. Cukr.*, 1984, **92**, 179 (*Polish*).

Details are given of a new filter manufactured in Poland which received its final assessment in 1983/84 and is designed to act as a polish filter for thin juice and for thick juice treatment using $CaCO_3$ as precoat.

Reconversion of two steam generators to coal at Pontelongo sugar factory

M. Pengo. *Ind. Sacc. Ital.*, 1984, **77**, 173-176 (*Italian*).

Details are given of the reconversion of two boilers to coal firing for which they were originally built in 1941 but, in the meantime, had used oil as fuel after suitable conversion. Information is given on the performancecs of the two boilers, each rated at a steam output of 35 tonnes/hr at 22 bar and 350°C, after their reconversion, and on the operation of the ancillary plant.

Sugar refining

The amount of run-off to be recycled to purification in raw sugar processing

R. Ts. Mishchuk and L. G. Belostotskii. *Sakhar. Prom.*, 1984, (10), 31-33 *(Russian).*

The practice of carbonatating *A*-massecuite run-off and recycling it to the *A*-massecuite pan is widely used in the Soviet Union, and equations are presented for calculation of the amount to be recycled as a function of its Brix and purity.

Conditioning and caking experiments on refined sugar

T. L. Excell. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 56-60.

See Anon: *I.S.J.*, 1985, **87**, 40A.

Continuous vacuum crystallization at Nantes refinery. Energy saving in crystallization

J. Cuel and C. Longue-Epée. *Sucr. Franç.*, 1984, **125**, 471-480 *(French).*

See *I.S.J.*, 1984, **86**, 109-113.

Refining cane sugar in a beet sugar factory

L. Toth. *Sugar J.*, 1984, **47**, (5), 7-12.

See *I.S.J.*, 1985, **87**, 62A.

Non-sugars removal in the syrup purification process in Cuban refineries

R. Fajardo G., J. Castellanos E., O. Navia Z. and L. D. Bobrovnik. *Sakhar. Prom.*, 1984, (12), 24-25 *(Russian).*

Studies were made of the degree of melt decolorization and colloid separation that could be achieved by phosphate-lime treatment, and the results shown to be much better than obtained by refineries in Villa Clara province. Laboratory experiments demonstrated the effects of temperature, treatment time and quantities of lime and phosphoric acid on efficiency of the treatment; gel chromatography was also used in a study of the mechanism of colloid separation.

Effect of the rhythm of work of a factory on carbon dioxide utilization and limestone consumption in raw sugar processing

R. Ts. Mishchuk, L. G. Belostotskii, L. D. Shevtsov and T. I. Zakharenko. *Sakhar. Prom.*, 1984, (12), 27-28 *(Russian).*

A method of calculating the consumption of lime and limestone in refining is described which is based on the degree of utilization of CO_2 in melt carbonatation. Comparison is made between calculated and actual values at Andrushevka factory.

Processing scheme and equipment of an ion exchange station for syrup decolorization in sugar refining

Ya. O. Kravets, V. N. Eremenko, G. V. Bizovetskaya, V. S. Pavlenko and I. P. Polyakov. *Sakhar. Prom.*, 1985, (1), 22-26 *(Russian).*

Descriptions are given of the technology and equipment as used at four Soviet refineries for syrup decolorization using AV-17-2P anion exchange resin, and advice is given on installation and use of individual pieces of equipment.

Optimization of energy usage at C and H Crockett refinery

H. K. Scholl. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 161-166.

Details are given of measures introduced at Crockett to reduce energy consumption; they include: adding an extra effect to the quadruple-effect low-purity sweet-water evaporator and making the soft liquor single-effect evaporator into a double-effect system (both new effects being rising-film units); converting heating steam users, such as syrup and melt tanks, from high-pressure steam of 65 psig to low-pressure steam (10 psig); using vapour from the triple-effect evaporator for No. 1 liquor to preheat fresh water for use as boiler make-up; installing combustion controls on the two boilers; reducing water consumption by improved process control and re-use of process water; and changing the type of fuel oil used. These and other measures have reduced the estimated energy costs for 1983 from $27.4 million to $18.4 million, equivalent to an annual saving of 7,250,000 therms.

Heat consumption during the refining of raw cane sugar

B. Mitev and D. Dimitrov. *Khranitelna Prom.*, 1984, **33**, (4), 28-29; through *S.I.A.*, 1985, **47**, Abs. 85-0104.

Energy consumption and fuel equivalent at each stage of the refining process are tabulated for Gorna Oryakhovitsa and Kameno factories (in Bulgaria). Boiling of 1st massecuite accounted for 52% and 45.8%, respectively, of the total, the difference being due to the low syrup Brix at the former factory. Unaccounted losses were about 30% at both; these were due to losses of heat, vapour and condensate, and to unnecessary water addition. At both factories, raw throughput had negligible effect on daily steam consumption; obviously, the former should be kept at the maximum possible. It is considered that about 30% of the steam could be saved by this and other simple measures: maintain the Brix of melt at 52°-55° and raise that of liquor to 65°-70°; improve thermal insulation; operate the boilers on condensate as far as possible; avoid unnecessary water addition; boil 1st, 2nd and 3rd massecuites to 91-92, 92-93 and 93-94°Bx, respectively.

Starch based sweeteners

Purification and concentration of fructose run-off

N. I. Odorod'ko and A. A. Ostrovskaya. *Sakhar. Prom.*, 1984, (7), 31-33 *(Russian).*

In a two-boiling scheme for fructose manufacture from sucrose, the 1st massecuite is treated with ethanol as movement fluid, spun in a centrifugal and the alcohol driven off the run-off in a vacuum pan. The run-off is then treated with active carbon and concentrated to a required level before use in 2nd massecuite boiling. Studies on this treatment showed that maximum decolorization efficiency (almost 80%) with 1% active carbon on dry solids was achieved within the first 15 minutes of 25 minutes of contact, after which it remained constant; temperature (20, 30 or 50°C) had little effect on decolorization. During 50 minutes' concentration to 88-90% dry solids, there was a fall in pH from 4.65 to 3.35, while colour rose almost proportionately with the change in concentration. Sugar degradation to organic acids rose with time and increase in concentration, reaching 0.055 g/100 ml at the end of the period.

Separation of a glucose-fructose mixture by anion exchange chromatography

S. K. Suri, S. Bhatt and S. Bose. *Indian Sugar*, 1984, **33**, 807-812.

Experiments are reported in which fructose and glucose were separated by passage through three columns (in series) of IRA-400 (OH) resin in bisulphite form. Recovery of both sugars was better at 40° than at 25°C.

Sugar and other sweeteners

G. Helgesson. *Betodlaren*, 1984, **47**, (1), 18-20; through *Ref. Zhurn. AN SSSR (Khim.)*, 1984, (14), Abs. 14 R432.

A short survey is presented of sucrose, glucose, fructose, glucose/fructose syrup and synthetic sweeteners and of their uses.

Isomerization of glucose to fructose in the presence of an aluminate

L. D. Bobrovnik, G. A. Lezenko, O. P. Nazarova and A. A. Erofeeva. *Pishch. Prom.*, 1983, **29**, 27-30 *(Russian).*

In tests on glucose isomerization to fructose in the presence of sodium aluminate, 11.4 g of the aluminate in powder form was added to 100 ml of 1.4M glucose solution (or to a different volume of comparable concentration but always containing 25 g of the sugar), followed by addition of NaOH to give a required pH. The solution was then heated to a pre-set temperature at which it was then held for a given time. Results showed that maximum fructose yield was obtained at approx. 80°C, pH 10.5-11.0 and a time of 0.84 hr. However, since excessively high values of these three determinant factors will cause increased degradation of the sugars and formation of greater amounts of colouring matter, determination of the optimum conditions should allow for this.

Isomerization of glucose to fructose in a fluidized bed reactor

C. B. Ching, Y. Y. Ho and M. N. Rathor. *Biotechnol. Bioeng.*, 1984, **26**, (7), 820-823; through *S.I.A.*, 1984, **46**, Abs. 84-1220.

In order to assess the practicability of carrying out this reaction in a fluidized bed, studies were undertaken on the degree of back-mixing and its effect on performance. Experimental data on % conversion of glucose at various liquid velocities agreed well with values predicted from an axial dispersion model. They showed less good agreement with those predicted from two other models (plug flow and continuous stirred-tank reactor).

Touchy corn syrups can go with flow. How to handle high-fructose, dextrose syrups

L. Hobbs. *Candy Ind.*, 1984, **149**, (2), 40, 42; through *S.I.A.*, 1984, **46**, Abs. 84-1221.

Storage conditions for HFS and the newer glucose syrups at confectionery factories must be carefully controlled. If the syrups get too cool, glucose may crystallize; if they are overheated, colour develops. Advice is given on optimum conditions. Stainless steel or epoxy-lined tanks are recommended.

Isoglucose?

G. Cnockaert. *Le Betteravier*, 1984, **18**, (190), 4-5 *(French).*

After explaining the nature of the sucrose molecule and its separation into the glucose and fructose moieties when ingested, the author briefly discusses the derivations of glucose, fructose and invert sugar, and defines the term "isoglucose" (produced from glucose or a glucose polymer and containing at least 10% fructose on dry solids); its manufacture by enzymatic isomerization and the reason (greater sweetness) for converting some of the glucose to fructose is discussed.

Immobilized enzymes

P. Thibault. *Ind. Alim. Agric.*, 1984, **101**, 885-889 *(French).*

Chief methods of enzyme immobilization and applications of the immobilized enzymes are surveyed, including invert syrup manufacture using invertase, and fructose manufacture by isomerization of glucose using isomerase.

High-volume chromatography separates the "hard to separate" organic compounds

Anon. *Food Eng.*, 1983, **55**, (5), 154; through *Food Sci. Tech. Abs.*, 1984, **16**, (7), 7L349.

The ADSEP chromatographic process, currently in operation at various corn wet milling plants, is briefly described. The process selectively adsorbs a component from a 2-component mixture in a continuous moving-bed process. In sweetener manufacture, a 90% (on dry solids) fructose syrup is obtained from a 42% fructose syrup; the two syrups are then blended to give the desired 55% fructose syrup, e.g. for use in bottling. The ADSEP system recovers 90-95% of the fructose using 3.5-5 lb water/lb fructose; conventional methods recover less than 90% of the fructose using 7-10 lb water/lb fructose. Sugar recovery from molasses using a similar process is also outlined.

Electro-flotator for corn syrup purification

N. N. Solov'ev, V. G. Karpov, V. N. Korobkov and V. P. Polishchuk. *Sakhar. Prom.*, 1984, (12), 40-41 *(Russian).*

An electro-flotation unit for removal of coagulated albumins and droplets of fat from corn syrup is described which in tests achieved 75-76% purification.

Glucose isomerase immobilized on SiO_2 carrier with high productivity

G. Weidenbach, D. Bonse and G. Richter. *Starch/Stärke,* 1984, **36,** 412-416.

A glucose isomerase obtained from *Streptomyces rubiginosus* was adsorbed on a SiO_2 carrier and then immobilized with glutaric dialdehyde for use in converting a 45% glucose feed to 42% fructose at a rate of 22 tonnes fructose per kg enzyme. (For HFS production, the glucose and fructose must be separated and the glucose fraction recycled.) The effects of degree of isomerization, temperature, pH, cofactors and inhibitors (particularly calcium) on activity and productivity are discussed. Because of the high productivity of the isomerase, only very small columns are needed.

Monosaccharides from sucrose. IV. Preparation of glucose and fructose by column chromatography

M. Tadra, J. Tuma and M. Kulhanek. *Listy Cukr.*, 1985, **101,** 10-15 *(Czech).*

Laboratory experiments on glucose and fructose separation by passage of sucrose or invert sugar solutions through a cation exchange column are reported. Optimum conditions were found to be a column height of about 2 m and an internal diameter of up to 30 cm, an initial sugar concentration of 37%, a temperature of 50-70°C, a flow rate of 0.4 ml/min/cm^2, a column load of 55 g sugar per litre resin and 80-90% saturation of the column. Ostion KS 0407 in Ca^{++} form provided more rapid throughput than the other resins tested and gave a glucose fraction of 95% and a fructose fraction of 95-97%, from which both sugars could be obtained in crystal form. There was practically no difference in the results between sucrose and invert sugar as starting materials.

Oxidized glucose syrup. Production, parameters and food applications

Y. M. Gallali and G. G. Birch. *Starch/Stärke,* 1985, **37,** 58-61.

Oxidation of a glucose syrup using bromine or electrolysis increased the ash content considerably, necessitating demineralization. Zerolit DM-F mixed-bed resin was used, with 2.5% acetic acid as eluting solvent. Electrolytic oxidation led to 22.5% decrease in M.W., about 15% increase in ash and a fall in pH from 6.0 to 5.2, while oxidation with bromine gave double the ash content caused by electrolysis, but gave better oxidation. Properties of the oxidized syrup were determined. The syrup may have considerable mineral-complexing properties. Short-term rat feeding trials showed no external abnormalities in the animals. Further investigation of the oxidized syrup as a possible food component is suggested.

A kinetic study on the isomerization of glucose in the presence of immobilized glucose isomerase

T. C. Huang and C. S. Lee. *J. Chinese Inst. Chem. Engrs.*, 1983, **14,** (1), 127-133; through *S.I.A.*, 1985, **47,** Abs. 85-0126.

The effects of Mg^{++} and Co^{++} ions at various concentrations and of pH and agitation speed are shown in graphs. A Lineweaver-Burk plot and an Arrhenius plot for the forward and reverse reactions (conversion of glucose to fructose, and of fructose to glucose) are given; hence the apparent activation energy and heat of reaction of glucose isomerization were calculated.

Flow dynamics of immobilized enzyme reactors

C. B. Ching and Y. Y. Ho. *Appl. Microbiol. Biotechnol.*, 1984, **20,** (5), 303-309; through *S.I.A.*, 1985, **47,** Abs. 85-0127.

Enzymatic conversion of glucose to fructose was carried out in a packed-bed and in a fluidized-bed reactor. The flow dynamics of these two systems, loaded with two different types of immobilized glucose isomerase particles (a commercial product, Sweetase, and one prepared by the authors) were studied. The effect of liquid velocity on the extent of liquid dispersion was examined. Theoretical data on the conversion of glucose to fructose were calculated by means of three mathematical models: plug flow, continuous stirred-tank reactor and axial dispersed plug flow. The last model gave the best prediction of the experimental performance of both the packed-bed and the fluidized-bed reactor.

Laboratory studies

Applications of immobilized enzymes in flow injection analysis

M. Masoom and A. Townshend. *Anal. Proc.*, 1985, **22**, (1), 6-8.

The advantages of immobilized over soluble enzymes in flow injection analysis are mentioned and descriptions given of methods used for glucose and sucrose determination. Glucose oxidase used for glucose determination was immobilized on controlled porosity glass (CPG) by cross-linking with glutaric dialdehyde. Sucrose was determined by incorporating an immobilized invertase-CPG column before the glucose oxidase column. However, the glucose moiety was α-D-glucose, while the substrate for glucose oxidase is β-D-glucose, so that mutarotase was needed for the conversion; various methods for mutarotase immobilization all gave unstable preparations, but immobilization of invertase and mutarotase together on CPG gave a stable product. For analysis of sucrose-glucose mixtures, a controlled bypass around the invertase column permits flow through both this and the glucose oxidase column or through the latter column only. The two sugars were determined within 35 sec using two sequential sample injections. The system can be modified so that only a single injection is needed; the sample is split so that it flows simultaneously through the invertase and glucose oxidase columns as well as just the glucose oxidase column, the portion of sample not passing through the invertase column being delayed so as to reach the glucose oxidase column after the other portion. Thus, two signals are obtained in succession from the detector, giving rapid, accurate results for sucrose + glucose and glucose alone.

Digital density meter puts Brix measurement on automatic

W. P. P. Abeydeera. *BSES Bull.*, 1984, (8), 10-11.

See *I.S.J.*, 1985, **87**, 45A.

Particle measuring technology and grain size distributions

K. E. Austmeyer. *Zuckerind.*, 1985, **110**, 19-27 *(German).*

The importance of sugar crystal size distribution for subsequent processing is stressed, and techniques and equipment available for crystal size measurement are surveyed; they are grouped under direct and indirect counting methods (the former including the Coulter counter, flow-through photometer and hologram/laser beam methods, while the latter include various means of analysing crystal photographs), separation techniques such as sieve analysis and screen analysis (the latter based on differential dispersion of crystals in an air stream on the basis of their differing weights and hence speed of fall), and sedimentation in a gravity or a centrifugal field. Mathematical approximation of grain size distribution is examined, and comparison made between the Gaussian (normal) distribution approach and the RRSB (Rosin-Rammler-Sperling-Bennett) distribution; mention is also made of logarithmic distribution and the Gaudin-Gates-Schuhmann exponential distribution methods. An example of crystal size analysis is given for a seed slurry. The crystal size distribution of product sugar is usually governed by crystal growth rate, the crystal size distribution of the seed and the residence time in a batch pan; however, in the case of continuous boiling, the crystals will be subject to a distribution of residence times rather than one uniform period. This is demonstrated by histograms for crystal size distribution in continuous boiling where the crystallization takes place in a unit of which a varying number of compartments is used. The effects of seed crystal size, number of compartments and proportion of seed crystals in the final crystal sugar, all at constant uniformity coefficient of the RRSB distribution, are clearly seen. The results show how adjustment of the determinants can provide better graining than batch boiling, with a remarkably low proportion of fines. The increased investment costs of a greater number of compartments can be offset by the savings resulting from the reduction in false grain.

The Betalyser system for sugar beet quality analysis. Its technical development from 1975 to the present day

W. Kernchen. *Zuckerind.*, 1985, **110**, 49-52 *(German).*

The Betalyser automatic system developed by the author's company is described and stages in its modernization indicated. It includes a polarimeter, a flame photometer for K and Na determination, a filter photometer for N determination, a computer terminal and a printer. Details are given of the components and of the analytical sequences.

Sucrose solubility in molasses after exchange of anions for nitrates

J. Dobrzycki and F. Daneshyar. *Gaz. Cukr.*, 1984, **92**, 149-150 *(Polish).*

In laboratory experiments, samples of molasses diluted to approx. 20% dry solids were treated either directly with Wofatit SBW anion exchange resin and the anions thus replaced with nitrates, or indirectly with the resin in OH^- form and the alkaline eluate adjusted to pH 8.5 with nitric acid. Sucrose solubility was determined at 80°C by the method of Wagnerowski. Results showed that the two methods increased the molasses purity and reduced sucrose solubility, the effect of the indirect method being most marked. Low-grade massecuite exhaustion at 50°C was improved and it is calculated that the technique could reduce molasses losses by about 30%.

By-products

Improving the two-stage method of molasses fermentation

A. M. Kuts and V. F. Sukhodol. *Pishch. Prom.*, 1984, **30**, 68-72 *(Russian)*.

Laboratory and factory-scale experiments were conducted on ethanol and baker's yeast manufacture by two-stage molasses fermentation with a 20:80 mixture of strain B yeast and hybrid 112. Increase in the pH of the wort to 5.4 and to 5.5 compared with 5.1 in the control caused no change in alcohol yield but increased biomass yield by 4.69 and 6.92%, respectively, reduced the amount of HCl needed for molasses acidification by 10 and 20%, respectively, and caused a reduction in the total volatile impurities in the alcohol. Increase in the pH of the wort to 5.8 and 6.0 caused further increase in the biomass yield but the alcohol yield fell.

Energy in sugar cane and its bioconversion

S. L. Sang. *Taiwan Sugar*, 1984, **31**, 145-151.

An analysis is presented of the energy expended in growing and processing of cane to yield alcohol, and of the available energy content in cane. An energy balance calculated for ethanol production showed a steam consumption of 4.90 kg/litre of 99.6% ethanol produced, with an ethanol yield of approx. 77 litres/tonne of cane, or 5627 litres/ha/year. A bagasse surplus of up to 126 kg/tonne (9.22 tonnes/ha/year) could be used as additional raw material for alcohol manufacture, and research on alcohol fermentation of bagasse hydrolysate at the Taiwan Sugar Research Institute is outlined.

Low-temperature pulp drying: fundamentals and economic considerations. IV

K. E. Austmeyer and W. Poersch. *Zuckerind.*, 1985, **110**, 28-34 *(German)*.

Of the approx. 20% of the moisture left in beet pulp after pressing, one-third can be removed in a drum dryer, while two-thirds can be removed by a dryer of the perforated band type[1]. The question of energy consumption is discussed, in which it is stressed that, since drying consumes much more energy than pressing, the latter technique should be used to the fullest possible extent. It is shown mathematically that raising the temperature of the air input from 50° to 95°C will allow halving of the required dryer surface area (thus reducing capital costs) and of the power consumption of the air blower, while giving the same drying efficiency. Other forms of dryer (not specifically designed for beet pulp) are briefly discussed: a low-pressure unit intended for heat-sensitive materials in which the material is heated by e.g. electricity on a number of horizontal trays one above the other in a vessel provided with a frusto-conical bottom leading into a condensate tank, and two forms of convector dryer using superheated steam as drying medium. The use of pan vapours or of discharge air from a high-temperature pulp dryer[2] as heating medium in a band dryer is discussed, and the economics of low-temperature pulp drying with or without partial compression of pan vapour are studied.

Use of pressed or dried beet pulp for beef bulls

C. V. Boucqué, L. O. Fiems, B. G. Cottyn and F. X. Buysse. *Le Betteravier*, 1985, **19**, (193), 8-10, 14 *(French)*.

The advantages of ensilaged pressed pulp over dried pulp as fodder for fattening cattle are discussed.

Continuous fermentation using the Biostil system

L. K. Garlick. *Rpts. 42nd Ann. Conf. Hawaiian Sugar Tech.*, 1983, 174-177.

See *I.S.J.*, 1984, **86**, 192.

Qualified pulp manufacture from hemicellulose-extracted bagasse

W. F. Yee, L. H. Wang, M. C. Hsie and S. L. Sang. *Rpt. Taiwan Sugar Research Inst.*, 1984, (104), 33-43.

Tests on the use of bagasse, from which 55, 65 or 74% of the hemicellulose had been extracted by acid hydrolysis, as raw material for paper pulp manufacture showed that the hemicellulose was an essential ingredient for the process, the resultant pulp having too low a burst factor. However, a 1:1 mixture of fresh bagasse and bagasse with 55-65% hemicellulose extracted yielded a product meeting standard requirements; digestion was carried out for 20 minutes at 170°C or for 30 minutes at 125°C.

Considerations on vinasse disposal by combustion

G. Iaquaniello and A. Martini. *Ind. Sacc. Ital.*, 1984, **77**, 177-180 *(Italian)*.

Factors in the operation of a waste-heat boiler used to incinerate vinasse of 60-65% dry solids are discussed. The heat is extracted from the flue gases which contain particles of various salts, including sodium sulphate, potassium sulphate, chloride, carbonate, etc. These salts have a low melting point, and the molten particles can be rapidly deposited as incrustation on the boiler tubes in the convection zone; so as to prevent this, the gases must be cooled to a temperature below the m.p. of the salts in the radiation zone between the combustion chamber and the superheater preceding the convection zone. For this reason, particular attention has had to be paid to the design of the radiation zone. A procedure for calculation of the requisite radiant surface is outlined.

1 Austmeyer & Poersch: *I.S.J.*, 1984, **86**, 192; 1985, **87**, 20A.
2 Praus & Niemann: *ibid.*, 1984, **86**, 192.

a relatively small area having similar soils and uniform climatic conditions, so the assumption of a constant marc value will probably give a reasonable result. In analyses described here less uniform material was offered for testing; the samples included fodder beet as well as sugar beet since trials involving different varieties of both were conducted. A range of fertilizer treatments was used as well as different levels of irrigation. Depending on the method of sampling the more fibrous hypercotyl may or may not have been included in the ground sample. It would appear that all or any of these variables could cause changes to the marc content.

Whatever method of extraction is used, a solution of sugars of unknown composition will be obtained for analysis. It is obviously essential to know the volume of this solution, and the weight of beet from which it was extracted. This volume can be determined in two ways, by assumption of a constant marc volume or measurement of the volume of a filtrate from an extraction process from a known weight of beet.

The second method was adopted in these investigations. However, the efficiency of extraction is still affected by variations both in the marc content and in the residual sugar held in the cell walls.

Analysis of expressed juice

The use of expressed beet juice would overcome the need for extraction, and therefore would shorten the analysis time considerably. This was investigated. A quantity of freshly ground beet brei was obtained. Some of the liquid associated with the brei which collected in the bottom of the container, was taken, diluted, analysed and the percentage total sugar in the solution calculated. The initial results were lower than those for conventional ethanol extraction. Further work would be needed to show a consistent relationship here and to cover any effect of beet varieties, growing management, or sample preservation. Furthermore, because of the large number of samples involved it was not possible to analyse all samples immediately; it was necessary to freeze subsamples after grinding.

Consequently the liquid which collects in the bottom of the container after thawing a preserved sample may not have the same composition as juice expressed from the freshly harvested plant. Nevertheless such a method of assessment, if proven and standardized, could be successfully used for routine analyses in an industrial process once equipment and parameters had been standardized.

Initial extraction procedure

In the past, polarimetry has been the usual method for determination of the sucrose content of beet. Consequently, extraction methods were designed so that there would be a minimal effect on the optical properties of the extract. When HPLC is used this is not relevant.

For polarimetry a basic lead acetate suspension (33.3%) has been recommended[2] but this was avoided here for fear of damaging the column in the HPLC. The extraction procedure evolved was based on the work of Henderson[3] of the Agricultural Engineering Institute of Lincoln College, who showed that 80% ethanol was an efficient solvent for extraction of sugar from beet.

The method originally devised for extraction of sugars was as follows:

(1) Minced samples (pieces about 0.5 cm) were held frozen at -17°C in closed plastic containers.
(2) Samples were thawed in a water bath at 30°-35°C for 20-30 min.
(3) After the contents had been mixed with a spatula in the container a sub-sample of approximately 8 g was weighed accurately into a tared 100 ml beaker.
(4) 50 ml of 80% ethanol was added and the mixture was heated for 20 min in a water bath at 55±5°C; during extraction it was stirred twice.
(5) The extract was vacuum filtered through a No. 1 Whatman paper prewetted with water on a Buchner funnel. The beaker was washed out three times with distilled water and the washings poured over the contents of the filter funnel. This amounted to about 15 ml. The filtrate was poured into a 100 ml measuring cylinder, and the volume recorded. The flask, funnel and measuring cylinder were shaken but not dried after having been washed and rinsed in distilled water between samples.
(6) An aliquot for analysis was placed in a 28 ml universal screw-top bottle.

The above procedure is referred to as the initial extraction method.

Sources of error

After using this method for some time it became clear that a number of the steps could lead to errors in the final result. Thus it was observed that minced beet left on the bench unfrozen overnight showed an increase in both fructose and glucose concentration and a lower sucrose concentration. Presumably conversion of sucrose to fructose and glucose was taking place. Therefore beet was analysed within an hour of thawing.

Thawed containers left open at room temperature lost weight, presumably owing to evaporation of water. While such evaporation did not change the amount of sugar present, it did alter the percentage sugar by weight. It is possible that similar water losses may have taken place before freezing. To minimize evaporation, the time containers were open to the atmosphere never exceeded 5 min.

It was also apparent that the beet in the containers was not a homogeneous mixture. When the beet was thawed liquid collected at the bottom of the

2 Schneider: "Sugar analysis—ICUMSA methods" (International Commission for Uniform Methods of Sugar Analysis, Peterborough) 1979.
3 Personal communication.

container leaving leached beet pieces at the top. Although the contents of the container were stirred with a spatula before sampling, the mixture might not have been homogeneous.

The time could have varied since the extraction of six samples was begun almost simultaneously, but after 20 minutes they were filtered one by one, each completely before the next.

HPLC gives the concentration of sugar in the sample injected. To convert this figure into % by weight of the sugar in the beet sample, the volume of solution must be known. The volume of filtrate was measured using a 100 ml B grade measuring cylinder with a tolerance of 1%. As there was a volume of approximately 70 ml this volume was correct to 0.7 ml. There could be a reading error of 0.5 ml, so the total volume was therefore 70 ml±1.2 ml (1.7% error).

Efficiency of extraction

Because the efficiency of the original method was unknown, second and third extractions of the same material were tried. Instead of discarding residue on the filter paper, it was put in a beaker with 50 ml of 80% ethanol and extracted as before. The results of this experiment are shown in Table I.

Table I. Sugar obtained after repeated extractions (20 min) of beet samples

Sample number	*Sucrose extracted % wet beet*			*% of total sucrose recovered in one extraction*
	First extraction	*Second extraction*	*Third extraction*	
1	13.51	1.74	0.35	87
2	13.69	1.74	0.26	87
3	13.24	1.94	0.38	84
4	12.43	1.57	0.14	88
5	12.97	1.50	0.20	88
6	14.61	1.51	0.23	89
7	14.35	1.81	0.41	87
8	15.95	2.27	0.33	86
9	13.74	1.99	0.27	85
10	13.57	1.58	0.24	88
11	12.23	2.07	0.29	84
12	12.02	2.08	0.37	83
Mean				86.3

Sucrose concentration has been given in Table I rather than total sugar because fructose and glucose concentrations were nil in 2nd and 3rd extractions. The first extraction gave between 83% and 90% of all the sugar extracted after 3 extractions. If fructose and glucose concentrations were included there was a very slight increase in efficiency (<1%).

Variability of extraction method

To ascertain how constant the results could be expected to be from replicate extractions of a single sample, three samples of frozen beet brei were thawed and six sub-samples of 8 g were taken from each. These were all extracted by the initial extraction procedure and gave the results shown in Table II.

Table II. Results of extractions of replicate sub-samples of beet, expressed as sugar (equivalent sucrose) % by weight on wet beet

Replicate number	*Sample*		
	Z	*C*	*F*
1	13.51	14.35	12.63
2	13.69	15.95	13.74
3	12.22	13.74	13.89
4	12.43	13.57	14.46
5	12.97	12.23	13.45
6	14.61	12.02	13.65
Mean	13.24	13.64	13.64
CV	6.69	10.60	4.40

The use of sub-samples eliminated variations due to the history of the sample as all the beet in one sample had been thawed and frozen for the same time. The sugar concentrations obtained from 6 sub-samples from the same original sample ranged from 10% less than the mean to 17% greater than the mean. The coefficient of variation was as high as 10.60. To reduce these errors modifications to the procedure used were made.

Modification to the initial extraction procedure

Experiments are described that were designed to assess extraction efficiency, reduce errors and simplify handling.

1. Extraction time.

A beaker containing beet and ethanol was placed in the water bath at 55°±5°C for 50 min. A 1 ml aliquot of the supernatant liquid was removed every 5 min from 15 min to 50 min. The experiment was duplicated (A and B). The results of extractions are given in Table III.

Table III. Effect of extraction time on sugar extract concentration expressed as % equivalent sucrose w/v

Extraction time (min)	*A*	*B*	*Mean*
15	1.12	1.18	1.15
20	1.20	1.20	1.15
25	1.23	1.36	1.30
30	1.19	1.38	1.29
35	1.21	1.31	1.26
40	1.30	1.43	1.37
45	1.32	1.43	1.36
50	1.40	1.52	1.46

It may be seen that extraction of sugar was not complete after 20 min, the average of the duplicate results at 50 min being greater by 27%. As a proportion of this increase could have been due to evaporation an experiment was set up to determine its extent. Four beakers containing approximately 8 g of beet were weighed. 50 ml of 80% ethanol was added to each beaker and they were again weighed. After 20 min in a water bath at 55°±5°C the beakers were taken out and weighed for a third time. The above steps were repeated with four other beakers except that these were kept in the water bath for 50 min. The results are given in Table IV.

Using the mean of the sugar concentrations in Table III and the

Table IV. Solvent loss by evaporation during extraction

Time (min)	*Mass of beaker + beet (g)*	*Mass of beaker+ beet+ 50 ml 80% ethanol (g)*	*Initial mass of ethanol (g)*	*Mass of beaker+ beet+ solvent after extraction (g)*	*Mass of ethanol lost (g)*	*% Loss*
20	57.887	99.789	41.902	97.295	2.494	5.95
	44.970	87.289	42.319	85.523	1.766	4.17
	56.566	98.720	42.154	96.589	2.131	5.06
	55.727	97.830	42.103	95.751	2.079	4.94
						Mean = 5.03
50	57.864	99.321	41.457	94.165	5.156	12.44
	44.095	86.302	42.207	79.928	6.374	15.10
	56.213	98.258	42.045	92.309	5.949	14.15
	56.309	98.577	42.268	92.973	5.604	13.26
						Mean = 13.74

mean evaporation loss (Table IV) the increase in sugar extracted can be calculated; this is given in Table V.

Table V. Mass of sugar extracted with time

Extraction time (min)	*Sugars (equivalent sucrose), % w/v*	*Volume of solvent remaining (ml)*	*Mass of sugar extracted (g)*
20	1.15	47.5	0.55
50	1.46	43.1	0.63

From Table V it may be seen that the increase in the amount of sugar extracted in 50 min compared with 20 min was 0.08 g, representing a 14.5% increase. Therefore to ensure a constant extraction period of 20 min for all samples the beakers were placed in the water bath at 5 min intervals and individually removed after 20 min to allow the next stage, filtering, to proceed immediately.

In a further experiment the length of time beakers were left in the water bath was increased to 30 min. To ascertain whether the extra extraction time increased the sugar extracted, second and third extractions were tried. Instead of discarding residue on the filter paper the residue was returned to a beaker with 50 ml of 80% ethanol and extracted for a further 30 min. The results are shown in Table VI.

When the results set out in Table VI are compared with those in Table I which shows the extraction efficiency for an extraction of 20 min, it is clear that increasing the extraction time increased the efficiency of extraction from an average of 86.3% to 89.7%.

Table VI

Sample number	*% Sucrose extracted*			*% of total sucrose recovered in one extraction*
	First extraction	*Second extraction*	*Third extraction*	
1	8.36	1.04	—	89
2	8.65	1.07	—	89
3	8.80	1.16	—	88
5	9.27	0.70	—	93
6	7.37	0.93	—	89
7	8.08	1.08	—	88
8	8.54	1.01	—	89
9	9.17	0.97	—	90
10	8.82	0.82	—	91
11	8.10	1.15	—	88
12	9.77	0.72	—	93
Mean				89.7

Reduction in size of beet particles

It was postulated that, if the beet sample were pulverized finely, the extraction of sugar would be improved. After tests with available blenders, the Sorvall Omnimixer 17220 was chosen (Ivan Sorvall Inc., Newtown, CT, USA.) which has removable metal cups which screw on to a suspended blade unit (17061 Stainless Steel Chamber Assembly, 50 ml chamber.).

A new blender extraction procedure was developed, as follows: Approximately 8 g of beet was weighed accurately and transferred to the 50 ml metal blender cup and 50 ml of 80% ethanol was added. The cup was attached to the blender and lowered into a water bath at 55° ± 5°C. The beet and ethanol were blended for five minutes at top speed (16,000 rpm) and this mixture filtered immediately. The volume of the filtrate was measured as in the initial procedure.

An assessment of the blender extraction method was made by comparing the blender method outlined above and the initial extraction method. Sub-samples of beet from the same sample were extracted by each method. Comparisons were also made between water and 80% ethanol as solvents. The results are shown in Table VII. They show that the blender method extracted 17% more sugar than the initial extraction method.

Table VII

Extraction method	*Solvent*	*Total sugar extracted % by weight of wet beet*
Initial method	80% Ethanol	10.93
	"	10.85
	Water	10.40
	"	10.59
Mean		10.69
Blender method	80% Ethanol	13.39
	"	11.65
	Water	12.86
	"	12.19
Mean		12.52

Solvent efficiency

Comparison of water and of 80% ethanol as extractants was also made, including the preheating treatment. The cup containing 8 g of beet and 50 ml of solvent was sealed and placed in the water bath for five minutes to attain 55°±5°C before blending. A single beet sample was taken and four sub-samples were extracted with 80% ethanol using the blender method, while a further four sub-samples were similarly extracted with water blending.

Table VIII

	Sugar extracted % by weight of wet beet	
	Water	*80% Ethanol*
Replicate		
1	11.98	12.27
2	13.32	12.59
3	11.89	12.48
4	12.29	12.54
Mean	12.37	12.47
CV	5.34	1.12

The results in Table VIII show that solvent efficiency differences were insignificant, and there was less variation with ethanol. Ethanol caused less frothing, and therefore gave more precise volume measurements than water. It was, therefore, decided to continue to use 80% ethanol as the solvent for extraction.

Ultrasonication

Ultrasonication was introduced to further assist in the disruption of the cells for more efficient sugar extraction. A Branson Ultrasonic Cleaner B-32 (Branson Cleaning Equipment Co., Shelton, CT, USA) was used. A Grant SU4 Thermostatic Control Unit (Grant Instruments, Cambridge, England) was fitted to give a temperature of 55°±2°C.

To test the effect of ultrasonic treatment 8 sub-samples of 8 g were taken from a single sample of beet and four of these were extracted using the blender method. The other four were extracted using the blender in conjunction with the Branson ultrasonic bath. Results are reported in Table IX.

Table IX. A comparison of sugar extracted by blending only, and blending plus ultrasonication for subsamples from the same beet sample. Results expressed as sugar (equivalent sucrose) as % by weight of wet beet

	Sugar extracted % by weight of wet beet	
Replicate	*Blender*	*Blender/ ultrasonicator*
1	12.90	13.02
2	12.26	12.44
3	13.28	13.44
4	13.02	12.73
Mean	12.87	12.91

Although sugar extraction was increased by only 0.3% as a result of the treatment, use of the ultrasonicator was continued as the ultrasonic bath was used as the water bath.

The blender extraction method, incorporating ultrasonic treatment and solvent preheating, was compared with the initial extraction method. An experiment was set up in which ten samples of freshly ground beet were immediately frozen and later thawed and analysed by both methods. Results are shown in Table X.

Table X

	Sugar extracted % by weight of wet beet	
Sample No.	*Initial extraction*	*Blender/ ultrasonicator*
B1	7.39	7.83
B2	7.41	—
B3	6.99	—
B4	6.38	7.85
B5	6.81	7.96
B6	7.24	7.62
B7	7.48	8.50
B8	6.95	7.96
B9	6.92	8.77
B10	7.03	8.12
Mean	7.06	8.08
CV	4.7%	4.7%

The results (Table X) indicate that the combined effects of the blender and ultrasonication increased the amount of sugar extracted by an average of 14.5%.

Filtration

When the blender/ultrasonicator sugar extraction method was introduced it became necessary to change from Whatman No. 1 to Whatman No. 4 filter paper, owing to clogging of the former by finer beet particles produced. However, filtrate passing through Whatman No. 4 paper was not sufficiently free from suspended matter to inject directly into the HPLC column. A subsample was centrifuged (15,000 rpm for 10 min) in a Sorvall Superspeed RC2-B (Ivan Sorvall Inc., Newtown, CT, USA) to throw down residual solids prior to injection of the preparation.

Because of this change in procedure the filtering step could be reduced to a preliminary screening operation, and alternative filter bed materials with lower retention volumes than filter paper were tested. Those investigated were: sintered glass funnels—porosity 2 and 3, glass wool, glass fibre cloth—85 and 220 g/m, and stainless steel gauzes of various mesh. Stainless steel gauze (50 μm mesh) was found to be satisfactory, as it had a low retention volume and gave rapid filtering. Efficient filters were devised by attaching circular pieces of the stainless steel gauze to Buchner funnels with silicone rubber sealer [Dow Corning (Aust.) Pty. Ltd., Blacktown, NSW, Australia].

Volume measurement

An initial study of errors associated with the blender/ultrasonicator method indicated that the volume assessment procedure accounted for a large part of the total error, as mentioned above. Until this stage, the volume had been assessed using a measuring cylinder.

Weighing the filtrate was tested to ascertain if it would be a more accurate method of determining filtrate volume. Extraction using the blender/ultrasonicator method was used to obtain 8 samples of beet extract. The densities of these solutions were calculated by weighing 50 ml aliquots

Table XI

Sample No.	Mass of filtrate (g)	Calculated volume (ml)	Measured volume (ml)	Difference (%)
1	128.90	133.46	132.0	-1.09
2	104.71	108.42	109.5	+1.00
3	102.22	105.84	108.5	+2.51
4	107.92	111.74	111.0	-0.66

measured in standard flasks. The average density of the extracts was 0.9658 g/ml.

Four samples of beet from a different source were extracted by the blender/ultrasonicator method. The filtrate was weighed in a 200 ml B-grade measuring cylinder and the volume was calculated using the average density found in the previous experiment. The volume of the filtrate was also measured in the measuring cylinder. Results are shown in Table XI.

The results using a B-grade measuring cylinder were within 1% but one calculated volume result was outside this limit; the results were therefore inconclusive.

It was considered the problem of volume measurement would be overcome if the filtrate were to be diluted to an accurately known volume, using a volumetric flask. To facilitate this type of measurement the apparatus shown in Fig. 1 was devised. This consisted of a 52 mm diameter metal funnel with a narrow outlet (2 mm diameter) which passed through a plastic stopper into a 100 ml volumetric flask. A separate metal tube of the same size as the funnel outlet also passed through the stopper and this was connected to a water vacuum pump. A 60 mm diameter Buchner funnel, with a 50 μm stainless steel gauze filter bed attached, was connected to the metal funnel through a rubber bung which fitted into the top of the metal funnel. The seal was achieved by the applied vacuum. The metal parts were made of stainless steel to prevent corrosion. This apparatus allowed vacuum filtration directly into a B-grade volumetric flask. To avoid the full effect of the vacuum on the volumetric flask the hose from the vacuum pump incorporated a vacuum release. This was achieved by passing the hose through a bung in the top of a regular vacuum flask. The bung also contained a second short rubber hose which was only partially constricted with a clamp. The hose from the filter apparatus was attached to the outlet of the vacuum flask. Since a B-grade volumetric flask had a tolerance of 0.15% compared to 1% for a B-grade measuring cylinder the method was adopted.

Temperature

The influence of temperature on extraction was investigated by comparing the blender/ultrasonicator sugar extraction method at 55°C with refluxing.

To ensure that the size of beet particles was the same for both methods approximately 8.0 g of beet was weighed accurately and was given a preliminary blending in the Omnimixer with 30 ml of 80% ethanol. The contents of the blender cup were rinsed into a 100 ml round-bottomed flask using 20 ml of 80% ethanol. The

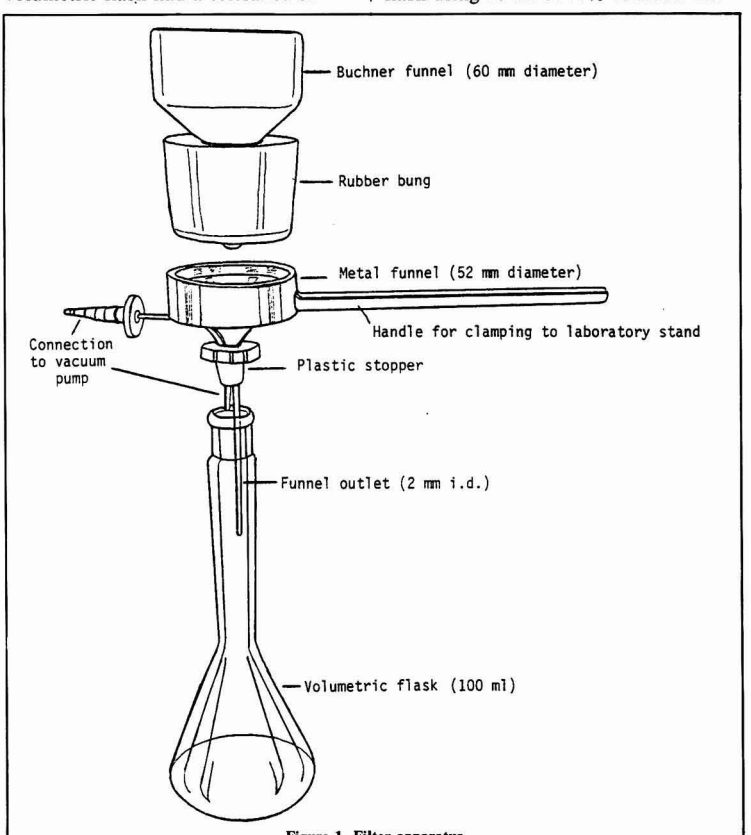


Figure 1. Filter apparatus

mixture was refluxed at 78°C for 30 min and filtered directly into a 100 ml volumetric flask. The volume was made up with three 80% ethanol rinsings and finally with distilled water. Six sugar extractions by this method and nine by the blender ultrasonicator method, were performed on subsamples of beet from the same source.

The efficiency of the two methods was further compared by re-extracting the beet by the reflux method i.e. a first extraction by either blender/ ultrasonicator or reflux and a second extraction by reflux. Results are shown in Table XII.

Table XII

Sugar extracted % by weight of wet beet			*% Sugar extracted by first extraction*
First extraction	*Second extraction*	*Total sugar*	
Blender/ultrasonicator method			
16.73	0.59	17.32	96.6
17.69	0.65	18.34	96.5
17.29	0.67	17.96	96.3
17.02	1.61	18.63	91.4
17.85	0.62	18.47	96.6
17.71	0.82	18.53	95.6
17.57	1.02	18.59	94.5
18.05	1.02	19.07	94.7
18.61	0.45	19.06	97.6
Mean 17.61	0.83	18.44	95.5
Reflux method			
15.91	0.57	16.48	96.5
17.49	0.58	18.07	96.8
17.72	0.72	18.44	96.1
17.26	0.23	17.49	98.7
17.49	0.26	17.75	98.5
17.62	0.18	17.80	99.0
Mean 17.25	0.42	17.67	97.6

The results show that the blender/ultrasonicator extraction method operated at 55°C was as efficient as the reflux method in the amount of sugar obtained after one extraction. The blender/ultrasonicator method removed approximately 95% of the sugar with one extraction and since this method required less time and involved less manipulation it was preferred.

The gravity factor in sugar cane extraction

By John H. Payne

Recent reports on experiments conducted in the weightless environment of orbiting spacecraft gives awareness to the value of giving consideration to the effect of gravity on all technological systems. Gravity, like friction, either works for you or against you. It is a factor in extracting juice from sugar cane — governing in the diffusion process, but important also in milling.

Diffusion

In simplest terms diffusion is a process in which the juice in the cane is replaced by water. In practice this is brought about by utilizing gravity for downward displacement with water of the juice from a bed of finely divided cane. The principal factors governing the efficiency of juice displacement are:

(a) *Quality of cane preparation*

The juice storage cell structure of the cane stalk should be destroyed as completely as practical, giving a mass of fibre and free juice, and leaving few intact cells from which the juice must be obtained later by true diffusion. Such rupturing should be done without mulling the fibre bundles and while retaining them at close to internode length. Mulling tends to solubilize some fibre components, decreasing the juice purity. Long fibre bundles give higher bed permeability.

(b) *Quality of the cane bed*

The mass of fibre and juice should be distributed in the diffuser as a bed uniform in height without compaction, since the liquid level should be kept close to the bed level and a hill and valley surface leads to channelling and poor flow patterns. The bed depth should also be kept at the optimum value.

(c) *Uniform distribution of water and juice on the bed*

Extraction water and recycled juice should be distributed so as to give

uniform coverage of the bed surface without impacting the bed. This is best accomplished by use of overflow type distributors.

(d) *Minimum mixing in counter-current flow pattern*

Juice draining through the bed should be returned to the proper position on the bed, ahead of its put-on point, to ensure a forward flow with minimum mixing with juice fore and aft. This requires careful coordination of the speed of the bed with the rate of flow of juice through the bed, as well as proper location of the juice distributors and collection troughs. Furthermore, the rate of juice return should be exactly that necessary to keep the bed saturated, which means that the liquid level should be even with the top of the bed. If the level is below the top of the bed, air pockets in the fibre mass will prevent plug flow through the bed. If the level is above the bed, then juice can flow forward or backward, disrupting the counter-current flow.

If these factors are maintained at optimum, then the capacity of the diffuser will depend upon the rate at which the juice flows through the bed — the percolation rate. Here the dependence is on the fixed force of gravity, the depth of the bed and the permeability of the bed.

A good quality cane has 600-650% juice on fibre. This quantity of liquid is also about the limit that the fibre will hold against the force of gravity. In the diffuser bed the interstices must be filled with liquid also in order to make possible plug-type flow. So the inventory of juice is approximately double that held by the fibre. It is this interstitial liquid which gravity pulls from the bed and produces the extraction. Thus the bagasse leaving the diffuser has about the same percentage liquid as the cane entering. Hence the description, juice displacement, is the appropriate term, rather than diffusion, and this is a gravity-dependent system.

Milling

In milling, gravity is recognized but its effect is usually referred to as drainage. The importance of the factor is generally underemphasized, both in mill operation and equipment design.

In the former standard mill, the three-roll machine, that juice, which cannot be drawn between the feed roll and the top roll by the fibre, must well up behind the nip point until it is above the low point in the feed roll grooving. Then gravity can pull it down through the advancing fibre and allow it to fall into the juice pan. Tromp[1] gives a good discussion of this in his book, an excerpt from which is reproduced here.

"In *Fig. 167* is shown the *Juice Drainage* on the front roller of a three-roller mill. It will be obvious that the bagasse or discharge roller is more easily drained than the feed roller, as the extraction point of the latter is on the centre line of the rollers, and beyond the culmination point, and the juice therefore has to mount a vertical distance x before it will flow down the front side of the roller. Radial grooving of the roller as well as Messchaert grooving is of material assistance in draining, and for heavy grinding will be an indispensable factor.

"Assuming g to be the gravity acceleration, the unobstructed falling speed of the juice will be: $V = g \times t$, where t is the time in seconds and $g = 32.162$ ft. per sec.^{2} (9.81 metres per sec.^{2}).

"On the roller surface the juice speed Vj is in proportion to the sine of the angle α with the vertical. At the culmination point 0° of the roller $\sin \alpha = 0$, and therefore a small hydrostatic head h is necesary to initiate the downward flow of the juice. At 90° the

1 "Machinery and equipment of the cane sugar factory" (Norman Rodger, London), 1936.

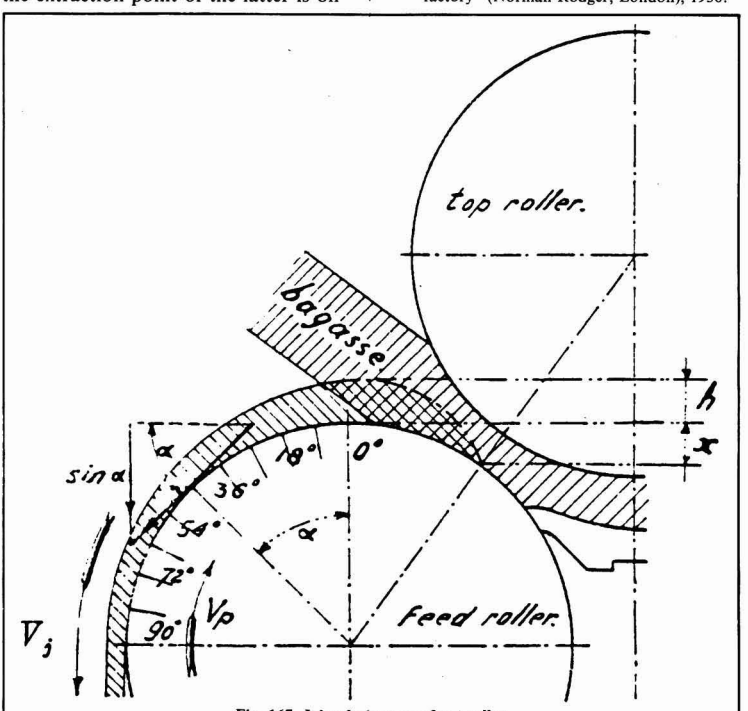


Fig. 167. Juice drainage on front roller

velocity will be equal to falling, the small adhesion between roller surface and the juice being negligible at this point."

It should be noted that the fibre as presented to the first mill has a higher juice-to-fibre ratio than the original cane. This phenomenon reduces the feedability and has led to the use of various devices such as coarse two-roll crushers, which do not permit the welling-up of juice, force feed rolls which improve feedability, and devices like the two-roll pressure feeder. From these precursors have come the five-roll mill, then the four-roll mill. But the effective use of gravity, or good drainage is an essential of good performance in all mills. If the juice can be rapidly removed from the nip of the rolls, then mill openings can be reduced, because of better feedability, and more juice recovered from the first two rolls. Total extraction of the mill will increase, making possible finally a reduction in the number of mills necessary in a tandem.

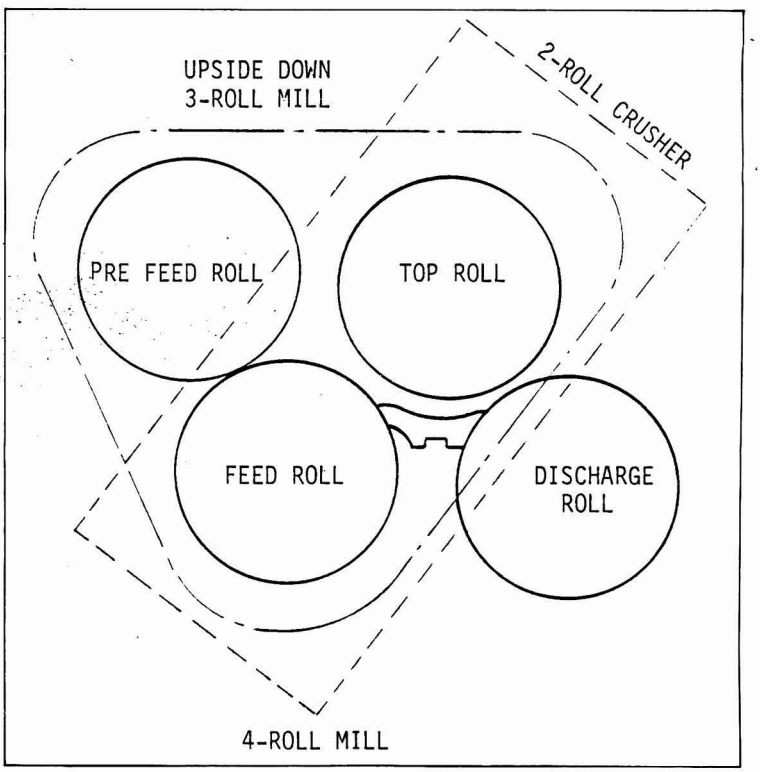
Welling up of juice in mills following the first one, where imbibition comes into play, is not entirely undesirable. It does improve the distribution of the maceration juice on the bed, as the fibre must pass through a liquid bath, giving good mixing and penetration. However, vertical mixing in the fibre is only a minor matter compared with lateral mixing.

Juice dispelled from the nip of the roll and discharge rolls of a three-roll mill is free to fall by gravity down the discharge roll. Its passage, however, is restrained by the compressed fibre on the turn-plate. Juice grooves on the discharge roll also are less useful here since they reduce the effectiveness of the pressure applied to the rolls.

The conclusion appears to be that the time trusted three-roll design is not well suited to utilizing gravity. Nor is the five-roll pressure feeder design directed to the problem. The four-roll mill does, probably unwittingly, offer an improvement. The fourth and top roll condition the feed blanket into a state of compression which causes juice to be expressed immediately by any further application of pressure at the feed roll. As there are insufficient voids at the top and fourth roll nip to permit a large quantity of juice flow upwards through that nip, the juice wells up and is forced out under pressure over the feed roll. The setting between the top roll and feed roll can be reduced, giving higher juice extraction before the discharge roll. Thus the whole principle of mill settings is different from that of a three-roll mill and the traditional rules-of-thumb are not applicable.

This concept has been described from a practical standpoint by Michael D. Sullivan in a paper concerning imbibition optimization[2]. He points out the high performance obtainable from a four-roll mill provided good cane preparation, optimum imbibition control, careful mill setting and proper maintenance prevail. He also shows that under these conditions the discharge roll does little work in expressing juice.

In fact, it is apparent that most of the work is being done by what is really an upside-down three-roll mill. Or in simpler terms it is an old fashioned two-roll crusher with a feed roll. The following sketch is illustrative.



No turn-plate is involved in the upside-down mill. It would seem prudent therefore for design engineers, inclined to want to preserve mills only for recovering sugar from cane, to look at the similarities between diffusion and milling. They are not much different. Both depend on gravity. Both

2 *I.S.J.*, 1985, **87**, 167-171.

require good cane preparation and counter-current imbibition. Of course mills are needed in both cases to dewater bagasse — at least it is cheaper to do it that way at present. And the trend toward use of imbibition water up to the boiling point in milling makes the process of dewatering the same in milling and diffusion.

The challenge then in mill design is to equal diffusion in getting 98% extraction with 150% dilution on fibre in an extraction tandem consisting of a shredder, two extraction mills and a dewatering mill. The results obtained by Sullivan show that this is entirely in the realm of reality but the work must not be encumbered by the methodology of the past.

Summary

The role of gravity in the separation of juice from cane during milling is discussed and the benefit of using a fourth roll explained as the functioning of the mill as a normal three-roll unit but upside down.

Le facteur de gravité dans l'extraction de la canne à sucre

On discute du rôle de la gravité dans la séparation du jus de la canne au cours des pressages et on montre l'avantage d'utiliser un quatrième rouleau. On l'explique comme un moulin qui fonctionne en tant qu'une unité normale à trois rouleaux, mais se trouvant à l'envers.

Der Schwerkraftsfaktor in der Zuckerrohrextraktion

Die Rolle der Schwerkraft bei der Trennung von Saft und Rohr während der Mühlenarbeit wird diskutiert und die Vorteile der Verwendung einer vierten Walze erläutert, da sie so funktioniert, als ob eine Drei-Walzen-Mühle auf den Kopf gestellt arbeiten würde.

La gravedad como factor en extracción de caña de azúcar

El papel de la gravedad en la separación del jugo de caña durante la molienda se discute y los beneficios que resultan del uso de una maza cuarta se explica como el funcionamiento del molino como una unidad ordinaria de tres mazas, pero al revés.

Brevities and statistics

Canada sugar imports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Argentina	0	15,281	0
Australia	417,517	352,571	415,345
Belize	12,488	42,198	20,363
Colombia	13,095	27,312	13,639
Cuba	256,426	195,595	199,175
Dominican Republic	22,248	10,838	0
Fiji	0	0	16,880
Guyana	5,803	30,930	26,014
Malawi	7,046	12,564	0
Mauritius	13,715	15,697	14,310
South Africa	161,431	106,462	173,645
Swaziland	60,159	155,468	29,452
USA	33,764	19,470	3,335
Zimbabwe	50,295	15,806	0
Other countries	241	467	265
	1,054,228	1,000,659	912,423

Thailand sugar production, 1984/85[2]

The 1984/85 crop in Thailand finally closed with the production of 2,468,207 tonnes of sugar, tel quel, from 25,053,000 tonnes of cane. Of the total produced, 900,103 tonnes were white sugar and the balance raws from which it is calculated that the outturn was 2,958,000 tonnes in terms of 96° raw sugar; this compares with 2,349,000 tonnes produced in 1983/84.

Mali alcohol project[3]

Molasses produced by the Dougabougou and Siribala sugar factories in Mali is to be used completely for the manufacture of alcohol by 1988. Sufficient for the national demand for pharmaceutical purposes will be provided as 95% v/v aqueous alcohol while the remainder will be upgraded to anhydrous alcohol for blending with gasoline. A series of measures are to be taken to improve the energy balance at the factories in order to minimize the extra fuel required for alcohol manufacture. Because of the low and unpredictable rainfall, adequate systems for vinasse disposal are also to be provided.

Pyrilla cane pest infestation in India[4]

A problem has arisen for the sugar industry in India which if left unchecked could cause large sugar losses. Areas of cane in western Uttar Pradesh are reported to have been seriously infested with pyrilla, an insect pest. Plants over large areas are reported to be stunted and with pale leaves. The fact that the insects are found on the underside of the leaves limits the effectiveness of spraying; some success has been reported following the introduction of a parasite to kill the pyrilla insect. The size of the problem and the seriousness with which it is viewed by the Indian authorities may be appreciated from the fact that in Uttar Pradesh more than 4000 plant protection units have been deployed to deal with it. If monsoon rains are heavy, however, damage could be limited to 5% of the crop, although lighter rains than normal would make necessary aerial spraying in August and September to avoid spread of the pest to other crops. Use of pesticides has achieved 60% control in young cane, and the cane area is larger by 10-15%.

French West Indies sugar production, 1984[5]

The four operating sugar factories in Guadeloupe crushed a total of 465,279 tonnes of cane to produce 41,244 tonnes of sugar, tel quel, against 56,504 tonnes of sugar from 613,252 tonnes of cane in 1983. In Martinique, the sole remaining factory of Le Galion crushed 90,200 tonnes of cane (82,985 tonnes in 1983) to produce 5462 tonnes (3949 tonnes) of sugar.

Sudan sugar industry rehabilitation[6]

The World Bank has agreed to fund the rehabilitation of the Sudan sugar industry whereby the four state-owned schemes will be brought up to full capacity of about 300,000 tonnes of sugar per year. Some work began in 1983 on the West German-built factories of Guneid and New Halfa, financed by a loan from West Germany. With an output of nearly 65,000 tonnes expected this season, New Halfa will be producing above design capacity. Guneid, however, is still operating at only about one-third of capacity because of problems with the irrigation system that have reduced cane production dramatically. The World Bank funds, and funds from Arab agency sources, will be channelled to the other two schemes, however, at Hajar Assalaya and Sennar. Technical assistance is to be sought overseas and one contract has gone to a Hawaiian firm. Output from the four state-owned schemes is expected to reach nearly 200,000 tonnes this year, while the Kenana Sugar Company is expected to produce roughly 305,000 tonnes, making Sudan self-sufficient for the first time and providing substantial savings in foreign exchange.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (5), 7-8.
2 C. Czarnikow Ltd., *Sugar Review*, 1985, (1738), 76.
3 *World Sugar J.*, 1985, **7**, (12), 36.
4 C. Czarnikow Ltd., *Sugar Review*, 1985, (1738), 77; F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 373.
5 *Zuckerind.*, 1985, **110**, 540.
6 *World Sugar J.*, 1985, **8**, (1), 12.

EEC sugar imports and exports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Imports			
Austria	29,179	23,316	25,015
Barbados	76,505	52,808	44,503
Belize	54,088	44,281	42,566
Congo	9,095	5,821	5,326
Cuba	26,743	173	432
Czechoslovakia	6,045	2,760	2,566
Dominican Republic	0	4,771	0
Fiji	221,576	197,709	197,263
Finland	28	52	1,170
Germany, East	27,581	27,430	27,768
Guyana	170,696	167,584	160,158
India	11,292	0	933
Ivory Coast	4,103	1,855	3,015
Jamaica	133,267	130,513	120,305
Kenya	4,337	4,403	2
Madagascar	21,080	10,465	10,446
Malawi	15,822	21,031	20,725
Mauritius	524,972	560,797	570,309
Mozambique	0	0	5,222
Poland	1,072	763	0
St. Kitts	0	0	21,945
Swaziland	118,807	136,473	126,927
Switzerland	16,244	8,522	804
Tanzania	11,002	10,167	9,793
Trinidad	46,994	62,649	51,891
Zimbabwe	28,565	29,924	19,530
Other countries	12,706	11,774	1,410
	1,571,799	1,516,041	1,470,024
Exports			
Albania	0	0	4,154
Algeria	63,550	119,583	76,757
Bangladesh	102,343	2	2,828
Benin	32,676	1,971	2,068
Bulgaria	1	28,329	5
Burundi	3,578	621	3,791
Cameroon	34,473	102	192
Cape Verde	8,445	8,870	6,001
Chad	11,920	22	276
Chile	11,256	6,107	67,264
China	0	420,336	117,478
Comoros	761	54	1,724
Congo	9,882	12,270	11,593
Cuba	1	0	19,904
Cyprus	25,376	21,533	20,124
Czechoslovakia	0	0	52,420
Djibouti	16,217	3,618	44,063
Ecuador	0	1,087	0
Egypt	289,507	70,800	150,261
Finland	12,509	307	1
French Territories	11,837	10,013	11,334
Gabon	2,179	10	11
Gambia	51,296	40,925	27,899
Germany, East	187	0	1,549
Ghana	499	8,056	5,781
Guinea	19,934	6,610	3,006
Guinea Bissau	1,033	1,137	1,154
Hong Kong	5,191	1,518	2,174
Iceland	14,534	11,443	11,781
India	34,847	504	37
Iran	105,038	262,035	195,496
Iraq	50,509	208,563	152,796
Israel	258,116	191,617	285,070
Ivory Coast	22,703	13,011	7,944
Jamaica	441	10,653	1,844
Jordan	82,618	44,020	80,841
Kenya	42,285	11,858	3,579
Kuwait	83,981	38,130	78,154
Lebanon	86,841	41,738	77,726
Liberia	10,843	13,302	6,067
Libya	34	13	40,558
Malaysia	42	12,602	4
Maldives	3,260	2,185	5,978
Mali	43,710	27,091	29,908
Malta	12,112	16,050	19,254
Mauritania	16,103	20,443	18,958
Mexico	13,993	265,509	154,858
Morocco	26,018	28,014	21,181
Niger	14,376	3,906	5,520
Nigeria	427,789	839,225	926,711
Norway	134,882	112,461	106,339
Pakistan	16,131	3,769	8,975
Papua New Guinea	320	1,720	7,147
Persian Gulf	131,348	106,933	135,015
Peru	36,531	39,859	0
Poland	956	2,183	2,689
Portugal	51,764	98,641	27,815
Rumania	37	71	4,513
Rwanda	14,029	2,554	2,558
Saudi Arabia	271,296	188,108	205,539
Senegal	2,347	9,356	8,011
Sierra Leone	9,987	4,632	10,746
Singapore	2,127	763	672
Somalia	28,457	2,395	9,951
South Africa	2,201	715	534
Spain	64,635	63,440	65,505
Sri Lanka	3,185	29,151	92,473
Sudan	39,390	628	87,096
Sweden	7,761	4,398	25,190
Switzerland	182,236	160,289	186,433
Syria	46,476	102,955	161,114
Tanzania	9,798	3,398	5,398
Togo	57,559	26,696	28,888
Tunisia	93,819	42,971	141,187
Turkey	136	3,877	420
Uganda	3,161	388	5
Upper Volta	8,612	4,857	7,174
US	19,542	44,537	1,059
USSR	644,388	868,851	1,283,791
Vietnam	8,519	14,457	0
Western Simoa	1,212	186	387
Yemen, North	194,964	66,686	100,753
Yemen, South	41,773	22,082	66,668
Yugoslavia	165,939	28,974	15,570
Zaire	16,015	5,068	6,344
Other countries	16,347	16,096	50,456
	4,392,724	4,909,960	5,614,650

Western Australia sugar project dropped[2]

The proposed Ord River scheme for cane sugar production has finally been dismissed by the Western Australia government as an economic "white elephant" which has no hope of being viable this century. When the main irrigation area with its acccompanying dam was opened in 1972, the project was seen as Australia's most far-sighted and greatest agricultural project. Since then, its remoteness and harsh tropical climate have proved an almost impossible barrier, while low world sugar prices have also worked against a plan to grow cane. Originally, the scheme was to cultivate more than 75,000 ha of irrigated land but today only 3500 ha are under cultivation with crops including mangos and peanuts.

Panama sugar output reduction[3]

Because of a reduced US quota and low prices on the world market, sugar production has been deliberately reduced in Panama so that 1985 output was only about 157,000 tonnes, raw value, against 176,499 tonnes in 1984, 206,213 tonnes in 1983 and 239,238 tonnes in 1982. Some of the factories operated at only 50% of capacity and the Felipillo factory remained closed for the second season. With a reduction in fertilizer and herbicide use, reduced replanting and irrigation, cane yields have fallen to 60 short tons/hectare against historical averages of 80-90 tons. The fall in yields is expected to continue and they could reach only 40 tons/hectare. The government is studying the possibility of converting one or more mills to alcohol manufacture but no final decisions have been reached and the necessary investment is awaited from private sources.

Philippines cane land diversification[4]

The World Bank is reported to be considering financial assistance to the Philippines sugar industry in order both to improve yields and to facilitate diversification into other crops such as corn, rice and soya beans, according to the Philippine Agriculture Minister. A team from the Bank will assess the sugar areas in the central and southern Philippines to determine how yields may best be improved and which areas would benefit from loans for crop diversification. At present there are approximately 400,000 hectares of land under cane but it is proposed that this be reduced to around 270,000 ha.

Iran sugar production fall[5]

Sugar production in Iran has declined steadily over the past few years from 703,000 tonnes, white value, in 1982/83 to 664,000 tonnes in 1983/84 and a forecast of not more than 630,000 tonnes in 1984/85. In spite of this, imports during the first quarter of the 1984/85 crop fell to a quarter of the amount in the previous crop year, when total imports reached more than 400,000 tonnes.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (7), 12-15.
2 *Australian Sugar J.*, 1985, **77**, 51.
3 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 408-409.
4 C. Czarnikow Ltd., *Sugar Review*, 1985, (1739), 83.
5. F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 430-431.

US sugar imports and exports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Imports			
Argentina	200,328	198,366	155,155
Australia	232,225	197,217	152,977
Barbados	0	13,439	24,069
Belize	26,436	28,443	43,135
Bolivia	8,450	47,416	32,366
Brazil	322,955	329,190	247,915
Canada	13,460	11,734	31,385
Colombia	59,555	66,521	32,243
Congo	7,511	0	0
Costa Rica	83,661	57,869	51,427
Dominican Republic	483,627	414,458	328,937
Ecuador	17,524	0	23,182
Fiji	29,113	0	17,466
Guatemala	137,152	136,112	54,908
Guyana	102,360	29,004	43,314
Haiti	15,682	13,749	5,957
Honduras	91,077	97,137	67,113
India	49	26,804	105
Ivory Coast	0	54,217	0
Jamaica	0	33,300	8,544
Madagascar	14,531	14,499	0
Malawi	33,156	4,935	25,532
Mauritius	31,090	27,272	17,686
Mexico	2	29,880	139
Mozambique	25,592	25,328	19,890
Nicaragua	5,469	56,030	46,653
Panama	55,288	136,141	84,079
Paraguay	0	10,074	3,450
Peru	97,717	81,933	69,149
Philippines	377,618	237,590	184,491
St. Kitts	0	16,879	8,152
El Salvador	62,010	70,453	61,924
South Africa	75,580	42,995	33,092
Surinam	87	0	2,784
Swaziland	43,801	36,303	74,310
Taiwan	32,121	30,342	56,033
Thailand	38,631	14,800	292,320
Uruguay	7,461	13,998	0
Zimbabwe	39,140	30,543	92,672
Other countries	369	31,902	154
	2,771,302	2,666,873	2,392,708
Exports			
Bahamas	10,711	2,591	3,934
Canada	31,037	20,736	5,239
Chile	19,449	0	10
Dutch Antilles	10,241	4,351	5,286
Egypt	39,218	24,290	1
EEC	1,165	45	162
Haiti	11,251	9,110	13
Israel	34	3,888	30
Jamaica	42,652	19,834	6,479
Japan	0	6,840	3,337
Jordan	0	13,375	48
Mexico	81,404	50,811	13,085
Peru	15,091	13,506	2
South Africa	0	12,663	0
Surinam	4,142	145	129
Trinidad	5,093	11,103	4,531
Venezuela	3,713	0	36
Other countries	22,897	8,055	6,942
	298,098	201,343	49,264

Spanish beet area reduction[2]

The 1985 sugar beet area has been substantially reduced to 175,000 hectares, particularly in the southern zone. The sugar beet crop for the 1985/86 campaign is expected to reach only 7.25 million tonnes, compared with 8 million tonnes for 1984/85. The Spanish government expects that this quantity will not be sufficient to fulfil the A-sugar quota set at 960,000 tonnes, white value (1,040,000 tonnes, raw value).

Yugoslavia beet area expansion[3]

The area sown to beet this year in Yugoslavia has been increased to 154,000 hectares from 143,000 hectares last year. Production of white sugar last season reached 900,000 tonnes, which exceeded domestic requirements by some 60,000 tonnes. The original plan for the new season envisages that sugar production in 1985 will amount to around 830,000 tonnes, from a beet crop of around 6.4 million tonnes, with the intention of covering domestic requirements. However, it is clear from the average performance achieved in recent seasons that another large crop may be expected, following the increase in area. Based on average yields over the past three years a white sugar output in the region of 900-910,000 tonnes is indicated.

Dominican Republic sugar exports, 1984[4]

	1984	1983	1982
	tonnes, raw value		
Algeria	0	0	11,330
Canada	21,082	0	0
Cuba	0	0	73,491
Ecuador	21,092	0	0
EEC	9,296	19,724	0
Haiti	4,877	24,337	4,922
Jamaica	22,145	10,815	0
Japan	0	14,913	0
Mexico	0	19,157	0
Morocco	26,827	53,597	15,449
Philippines	0	30,345	0
Portugal	0	0	46,098
Senegal	0	24,462	25,692
Sweden	9,296	0	0
Trinidad	30,917	2,626	0
Tunisia	0	8,652	0
USA	610,228	536,095	362,920
USSR	55,175	193,320	234,736
Venezuela	565,057	15,593	66,787
Other countries	5,184	2,538	8,753
	872,176	956,174	850,178

Brazil sugar cane area, 1985[5]

The total area planted to cane for the 1985/86 crop year is estimated at 3.80 million hectares from which a crop of 227 million tonnes of cane is expected to be harvested. Slightly less than half of this area, 1.81 million hectares, will be harvested for sugar production while the cane from the remaining 1.99 million hectares will be used for fuel alcohol production, animal feed and for alcohol for human consumption.

Fiji sugar marketing[6]

All but about 80,000 tonnes of Fiji's projected 1985 raw sugar output of 425,000-430,000 tonnes is likely to be tied up in long-term agreements. Fiji and New Zealand have agreed a new contract for the annual shipment of up to 60,000 tonnes, while China has agreed to take 40-50,000 tonnes a year for five years, starting this year, at above-market prices. Fiji also has a three-year agreement with Malaysia for an annual 60,000 tonnes, and a quota of 175,000 tonnes a year under the EEC's sugar protocol. The Fiji government has halted any increase in crop area because of the current depressed market but is calling on farmers to increase yields; it is believed possible to produce 550,000-600,000 tonnes more of sugar per year from the existing cane lands.

Japan beet area, 1985[7]

Sugar beet planting in Japan for the new season is put at 72,400 hectares which compares with 75,117 ha devoted to the crop in 1984/85. Planting commenced in mid-April and was concluded by the end of May. In Japan the crop is largely transplanted after the young beet have germinated and emerged under glass. Although this technique ensures a more even plant density, contributes to early development and helps overall yields, there can still be substantial variations from year to year caused by differing weather conditions. Over the past three seasons the amount of white sugar per hectare has fluctuated widely between 8.81 and 6.43 tonnes. Taking the new crop area this would indicate extremes of 635,000 tonnes and 463,000 tonnes, while an average yield for the past three seasons would result in some 555,000 tonnes of white sugar, against 595,000 tonnes produced in 1984/85.

Barbados sugar production, 1984/85[8]

Sugar production in Barbados in the crop year 1984/85 totalled 100,400 tonnes, virtually unchanged from the 100,500 tonnes produced in the previous crop, in spite of a 4% reduction in the area harvested to 13,739 ha.

Pakistan drought[9]

Crops on 2.7 million acres in the southern Sind Province of Pakistan, including sugar cane, have been damaged by a shortage of irrigation water in the river Indus originating from the Himalayas. Water availability at the Kotri barrage was reduced to 20% of its total capacity.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (6), 44-45.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 427.
3 C. Czarnikow Ltd., *Sugar Review*, 1985, (1739), 93.
4 *I.S.O. Stat. Bull.*, 1985, **44**, (5), 12.
5 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 429.
6 *Reuter Sugar Newsletter*, June 26, 1985.
7 C. Czarnikow Ltd., *Sugar Review*, 1985, (1739), 93.
8 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 443.
9 *Reuter Sugar Newsletter*, June 10, 1985.

Mexico sugar imports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Argentina	0	55,934	0
Brazil	31,164	70,437	165,149
Canada	0	0	10,849
Colombia	0	12,000	0
Cuba	52,845	75,617	137,475
Dominican Republic	0	11,607	0
EEC	40,217	300,085	140,794
Guatemala	0	18,080	0
Honduras	0	19,498	17,300
Korea, South	41,050	91,501	25,983
Nicaragua	27,100	282,526	28,392
Philippines	0	99,203	0
USA	81,079	50,732	12,342
	273,455	833,220	538,284

Trinidad sugar production increase[2]

Trinidad's 1985 sugar production, which reached 81,250 tonnes, exceeded slightly the target and was up 25% from the 1984 crop of 64,800 tonnes. The 1985 crop was originally forecast at 80,000 tonnes and the government is aiming to stabilize output at around 100,000 tonnes. The increased production will allow Trinidad to export 50,183 tonnes to the EEC and 15,838 tonnes to the USA.

Ivory coast sugar industry restructure[3]

The restructuring plan of the Ivory Coast's sugar industry aims to satisfy local demand for white sugar in granulated and cube form as well as penetrating other markets in West Africa. Exports are to be cut back, owing to depressed prices and technical problems, and only one factory will be producing raw sugar for export. Two factories were diverted to other crops last year and sugar production in the remaining four is expected to be around 115,000 tonnes of all forms of sugar against 126,000 tonnes produced by the six factories last year. The sugar company Sodesucre is to take over marketing of sugar from the government and will welcome private investment. The restructuring plan will reduce the labour force from 11,000 to 6000.

West Germany sugar factory closure[4]

Lehrter Zucker AG has continued its course of internal concentration after the closure of its Peine factory last year with the decision in April to stop operations at the Dinklar sugar factory. With the integration of the Munzel and Sehnde factories last year, the number of sugar factories in West Germany is now reduced to 46.

Australia bulk sugar terminal[5]

The 60,000-tonnes capacity Brisbane bulk sugar terminal has been built ready for reception of sugar. Construction of the terminal was started in June 1984 and its capacity will be raised to 120,000 tonnes by the end of 1985. The terminal has a loading capacity of 1000 tonnes per hour and could handle 200,000 tonnes a year when in full operation.

US beet sugar crop forecast[6]

On a basis of the expected state acreages of beet to be harvested for the 1985 crop, totalling 1,096,300 acres against 1,105,000 acres for the 1984 crop, and the historical average yields for 1982-1984, it is estimated that a total of 22,351,800 short tons of beet will be harvested. On a basis of 1982-1984 average sugar recoveries, sugar outturn should reach 2,906,000 tons, raw value, almost exactly the same as the 2,902,000 tons of 1984.

Colombia sugar exports, 1984[7]

	1984	1983
	tonnes, raw value	
Bulgaria	0	24,000
Canada	12,000	0
EEC	0	13,000
Finland	0	12,000
Japan	0	48,600
Korea, South	0	47,837
Mexico	0	12,000
Morocco	0	12,000
Philippines	0	12,468
Portugal	0	12,000
Tunisia	0	12,000
USA	123,730	62,028
USSR	0	34,674
Venezuela	47,250	0
	182,980	302,607

Bangladesh cane crop reduction[8]

During the past decade production of sugar in Bangladesh has gradually increased, more or less keeping pace with consumption. It was expected that production in 1983/84 would approach 300,000 tonnes, but floods devastated the growing regions and it was necessary to have recourse to substantial imports. It is reported that bad weather has again damaged the crop this season and once again substantial imports are to be required, although no figure has yet been put on the quantity.

Philippines alcohol manufacture plans[9]

The Philippines Trade and Industry Minister has said that the government plans to build 20-25 distilleries in the country to process sugar cane into ethanol; the estimated cost is US $150 million. The ethanol will permit the elimination of tetraethyl lead in gasoline, imports of which cost 90 million pesos per annum, and the surplus would be exported. A technical team from Japan, the World Bank and the Philippine Sugar Commission are studying the feasibility of the project.

Spain sugar imports, 1984[10]

	1984	1983	1982
	tonnes, raw value		
Cuba	0	0	21,588
EEC	47,103	68,520	65,505
Other countries	29	90	26
	47,132	68,610	87,119

Further Jamaica sugar factory closures[11]

Jamaica plans to close three more of the state-owned sugar factories; the remaining two state-owned and one privately-owned factories will be able to produce the 225,000 tonnes needed to cover domestic consumption and the EEC supply quota. Cane farming may continue in the areas around the closed factories if the administration's plans to use sugar cane for alcohol production are successful.

Finland sugar imports and exports, 1984[12]

	1984	1983
	tonnes, raw value	
Imports		
Argentina	0	26,655
Australia	0	26,690
Brazil	12,565	35,439
Colombia	0	12,263
Cuba	37,524	76,901
EEC	12,612	0
Philippines	12,922	0
	75,623	177,948
Exports		
Algeria	0	17,468
Norway	22,974	30,873
Trinidad	0	5,434
USSR	6,847	26,092
Other countries	1,023	2,123
	30,844	81,990

Puerto Rico distillery[13]

Peerless Oil & Chemicals is planning to refurbish its existing chemical processing plant at Puerto Rico into a distillery to make some 15 million gallons/year of fuel-grade alcohol for sale in the continental US. Molasses, initially from the Dominican Republic, will be transformed into alcohol which, since it is being produced in Puerto Rico, will be considered US-produced and thus exempt from the 60 cents/gallon import duty. The plant is expected to come on stream in 1985 and will cost around $20 million.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (5), 29.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 443-444.
3 *World Sugar J.*, 1985, **8**, (1), 29-30.
4 *Zuckerindustrie*, 1985, **110**, 626.
5 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 413.
6 *McKeaney-Flavell Sweetener News*, July 12, 1985.
7 *I.S.O. Stat. Bull.*, 1985, **44**, (6), 9.
8 C. Czarnikow Ltd., *Sugar Review*, 1985, (1739), 93.
9 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 447.
10 *I.S.O. Stat. Bull.*, 1985, **44**, (6), 37.
11 *Financial Times*, August 7, 1985.
12 *I.S.O. Stat. Bull.*, 1985, **44**, (6), 18.
13 *Amerop-Westway Newsletter*, 1985, (141), 9.

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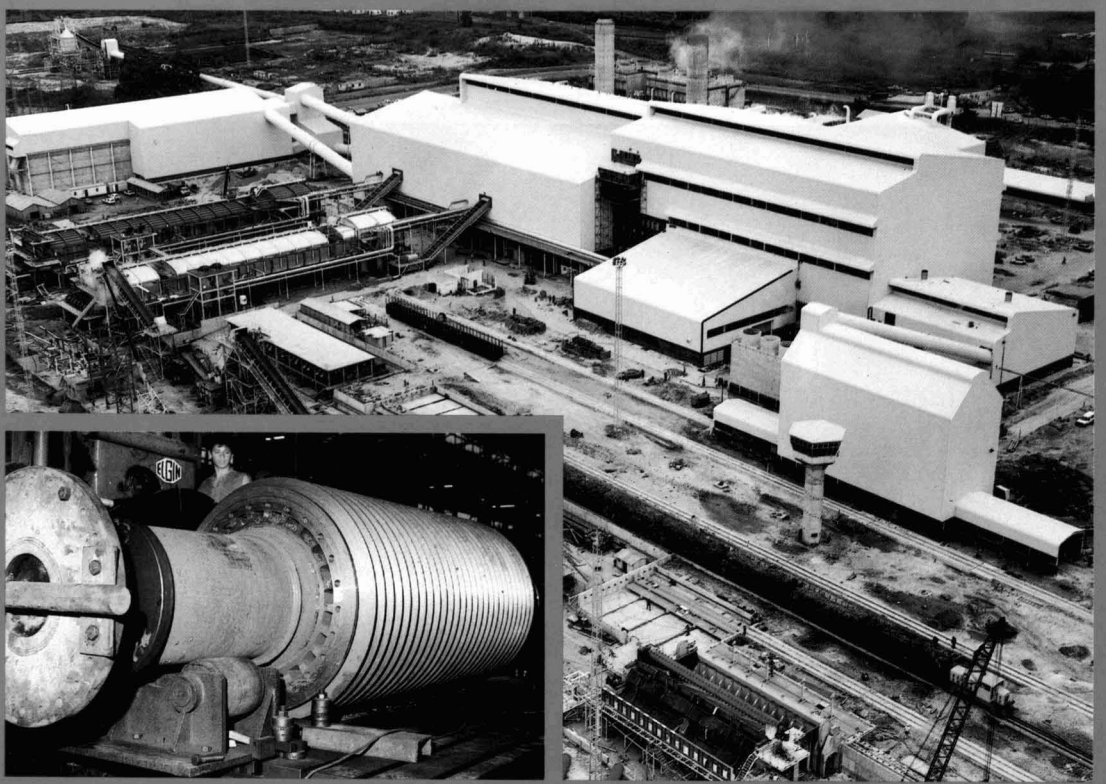

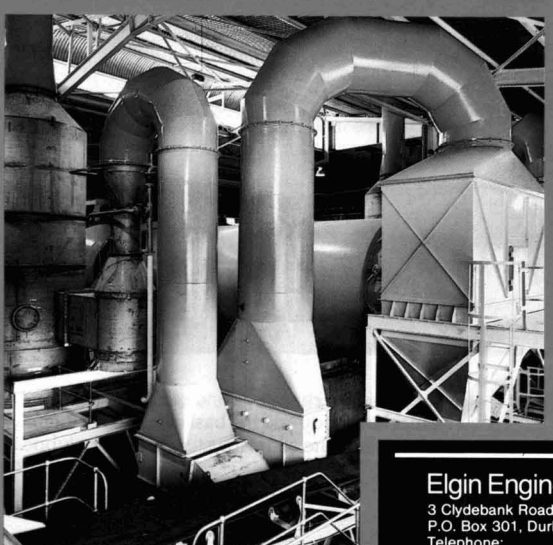

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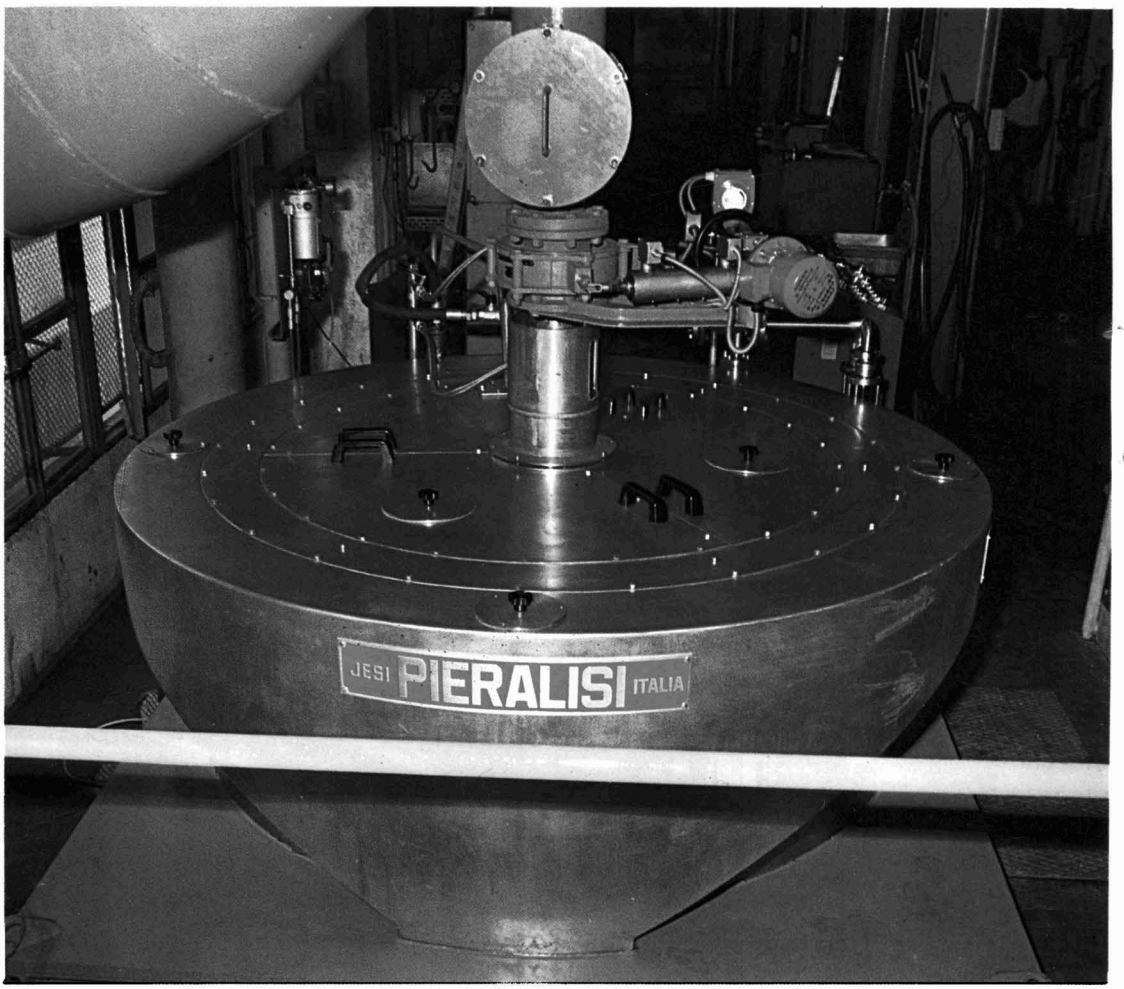

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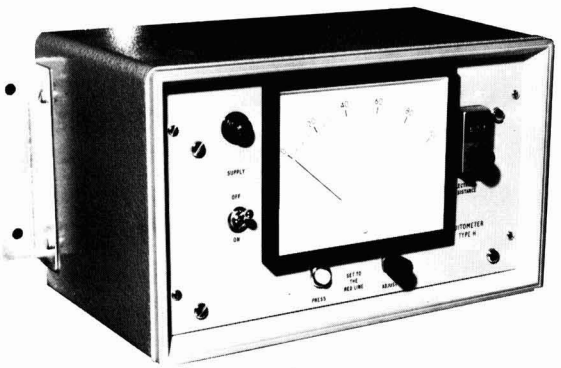

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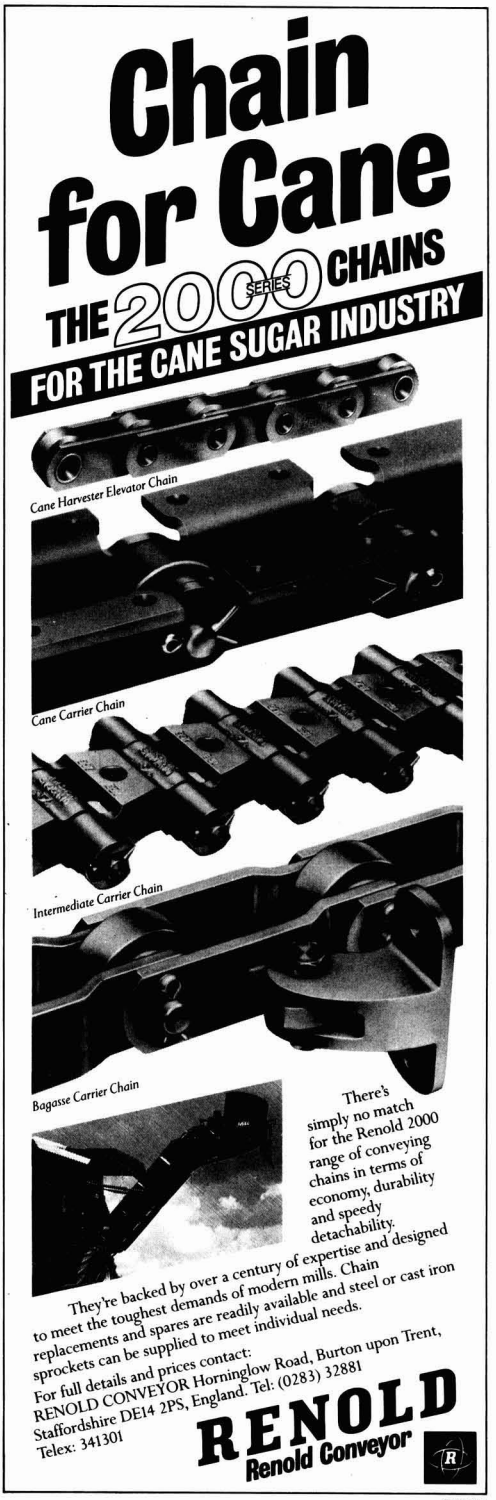

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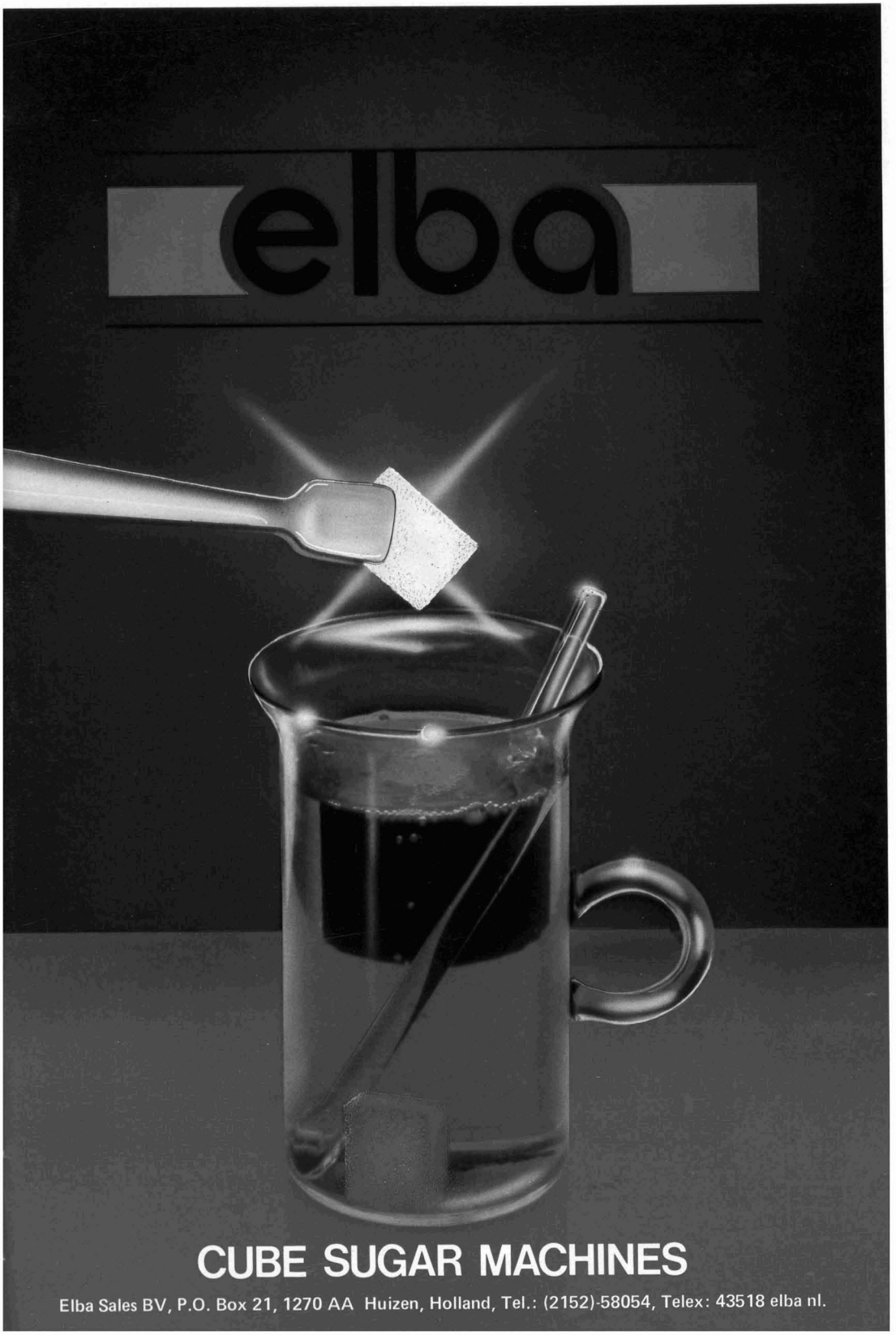
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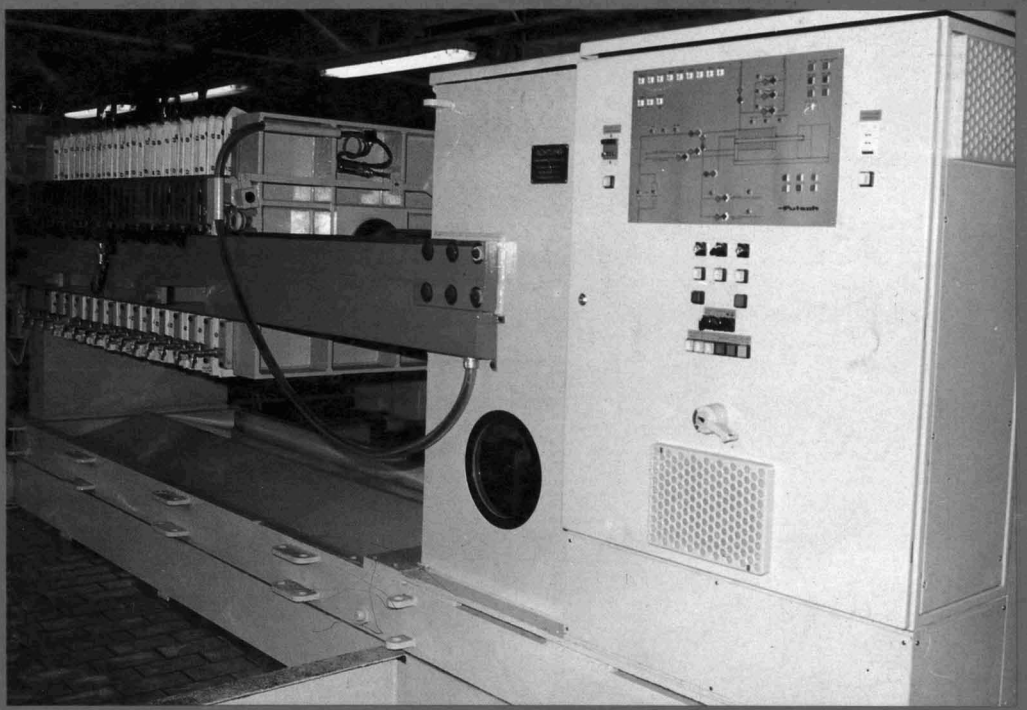

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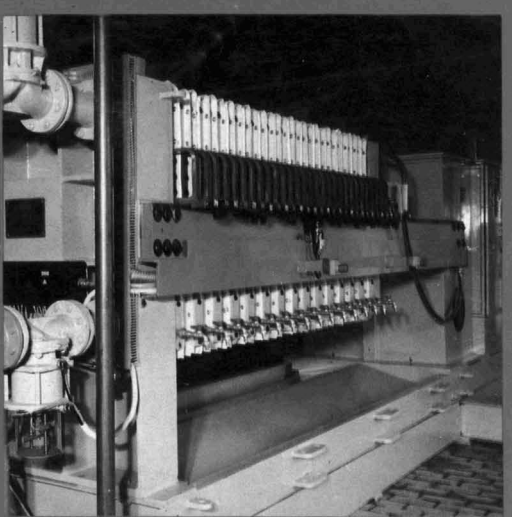

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