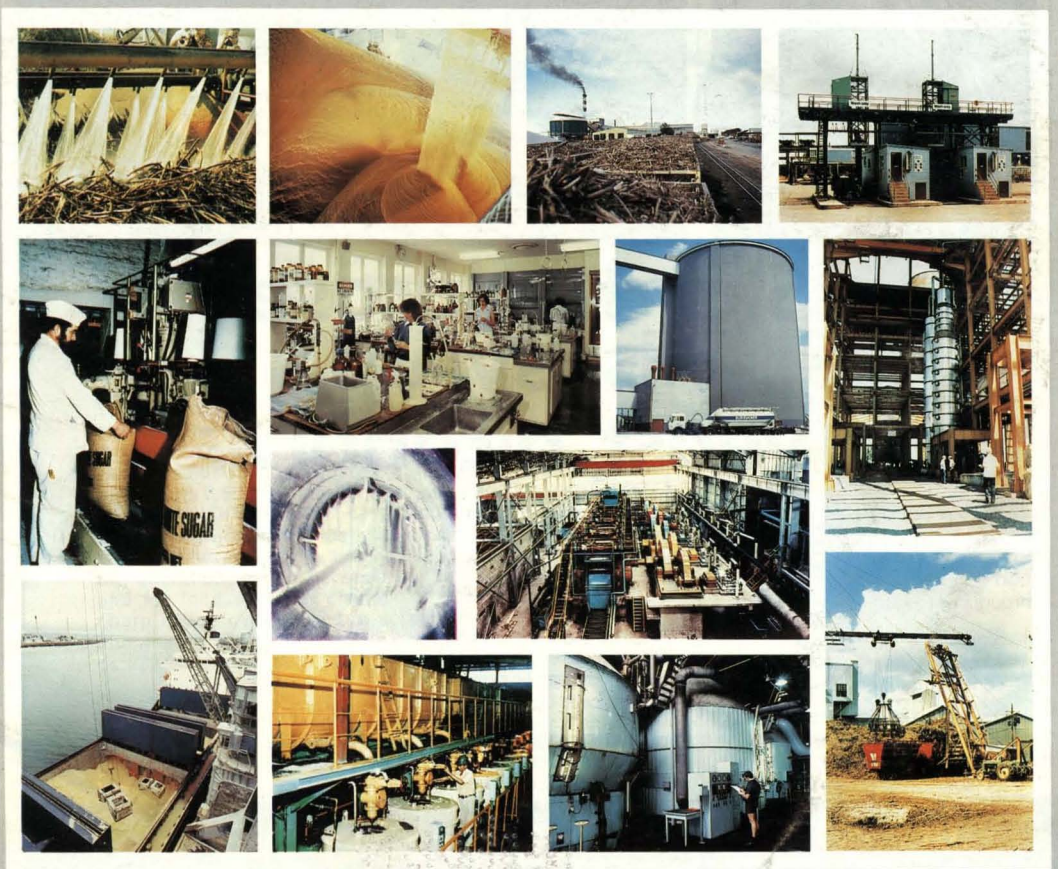
INTERNATIONAL SUGAR JOURNAL



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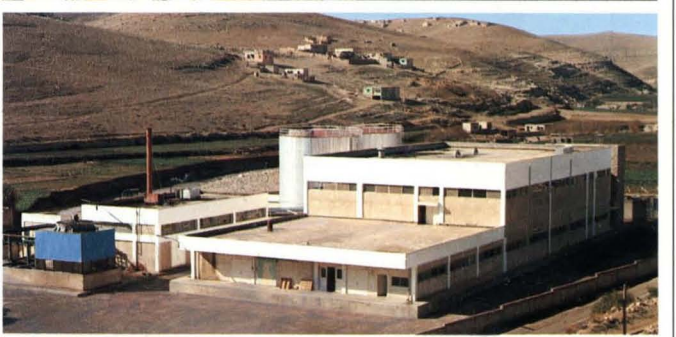

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News and views

Brazil sugar and alcohol

Around the end of February, newspapers carried headlines to the effect that Brazil was stopping alcohol production from cane, a misleading interpretation of the results of a ministerial meeting in that country following the collapse of oil prices. Almost all new vehicles built in Brazil have alcohol-fuelled engines and the demand for alcohol will continue to grow; the alcohol program remains a priority, but the government is is to cease funding the establishment of new distilleries. Alcohol production will be frozen at its present level for the next year or two, according to the Finance Minister[1], which for the 1985/86 crop year is more than 11,000 million litres.

Fears had been expressed that there would be a cutback in alcohol production and that cane would be diverted to sugar manufacture in view of the improvement in world sugar prices. Official statments have made it clear that this is not to be the case, however. The plan for the 1986/87 sugar season was expected to be anounced in late April and official forecasts of sugar production and exports are not available at the time of writing. However, C. Czarnikow Ltd. report[2] that it has been variously rumoured that exports will be limited to 1.8 or 2.2 million tonnes. Sales are already believed to be in excess of the higher of these two figures but it is known that there have been some deferrals of shipment while others are understood to be under discussion.

Prospects have also improved for alcohol exports; last year, the US International Trade Commission had made a preliminary judgement that Brazil was subsidizing exports of alcohol to the US. It imposed anti-dumping duties and bonds equal to these had to be posted on imports of Brazilian alcohol. This looked likely to put an end to plans to supply large quantities of ethanol as an octane enhancer for US gasoline.

The ITC has now ruled, by a margin of four to one, that there is no evidence that the imports have damaged the domestic industry, and the anti-dumping duties will be refunded. However, the imports still have to contend with an import duty of 60 cents per gallon, which is higher than the wholesale prices of unleaded gasoline. Brazil has maintained strong pressure at diplomatic level to have the duty reduced but so far without success.

Ownership of British Sugar plc

During the past few weeks, there has been a variety of moves by parties concerned with the ownership of the UK beet sugar company. S. & W. Berisford have been prepared to shed this part of their businesss and the Italian giant Ferruzzi, which already owns about half of Beghin-Say of France, had bought part of the Berisford company. It had been planned that it would own Berisford whose management would then buy back the non-sugar divisions. The proposal, which would have given Ferruzzi about 22.5% of EEC output, had caught the eye of the EEC Commission which was going to investigate whether such a concentration of interests could be permitted under Community Anti-Trust regulations.

Hillsdown Holdings PLC, another British food trading group, started to acquire shares in Berisford and indicated that it also was interested in taking over the whole of the company. Tate & Lyle, alarmed at the prospect of the strength of a possible Ferruzzi-British Sugar combination, also started to acquire part of Berisford in its own defence. The National Farmers Union, which includes the UK's beet growers, announced that it planned to join a British consortium to prevent foreign ownership of British Sugar.

On April 4, Hillsdown launched its expected bid for Berisford, which valued it at £486 million. Ferruzzi immediately announced that it would accept Hillsdown's offer in respect of its own 9% holding, in return for a near 4% in the proposed enlarged Hillsdown-Berisford group. Clearly, Ferruzzi's plans to acquire British Sugar had foundered on the opposition of British beet farmers and the competition watchdogs in London and Brussels.

Tate & Lyle, meanwhile, are still keen to acquire British Sugar and to produce thereby a unified British sugar industry. Unlike Hillsdown, who have offered their own shares in exchange for Berisford's, Tate & Lyle were expected at the end of April to offer a combination of shares and cash. The major factor involved is whether the UK government would allow such a merger of sugar interests since it could be said to eliminate competition. Tate & Lyle's arguments are that, first, there is no price competition at present because the EEC sugar regime provides better margins for British Sugar than for Tate & Lyle who thus have to follow British Sugar's pricing and, second, with free access to the British market for any EEC producer, competition would exist even if the two companies were to merge.

Australian sugar price support plan

On April 15 the Australian government announced its long-awaited price support plan for the sugar industry[3]. Sugar prices will be supported up to a maximum of A$230 for 1985, dropping to A$225 and A$220 a tonne for 1986 and 1987. As reported earlier[4], the Federal and Queensland government have been wrangling over responsibility for price support since late last year. Queensland has refused to support the industry outright, saying it is a Federal Government matter.

The Federal Government has chosen to interpret Queensland's recent offer of A$ 27 million in interest subsidies as its share of price support and is willing to provide another A$ 100 million over the three years if necessarily. Ironically, at present the world sugar price is above the level at which the Government would need to intervene with price support.

UK sugar imports and exports[5]

Sugar imports into the UK during 1985 amounted to 1,109,653 tonnes, tel quel, according to figures recently

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 131.
2 *Czarnikow Sugar Review*, 1986, (1747), 35.
3 *Financial Times*, April 16, 1986.
4 *I.S.J.*, 1986, **88**, 61 - 62.
5 *Czarnikow Sugar Review*, 1986, (1747), 44.

published by the UK Customs & Excise. This compares with more than 1.4 million tonnes in 1984 and 1.1 million tonnes in 1983. Of the tonnage, 1,007,203 tonnes were delivered as raw sugar and of this 954,401 tonnes were destined for refining purposes, leaving a balance of 52,802 tonnes entered as direct consumption sugar. The largest supplier to the UK last year was Mauritius with 324,242 tonnes, compared with 438,949 tonnes in 1984; the next largest were Guyana with just under 150,000 tonnes, 20,000 tonnes lower than in 1984, and Jamaica at 126,125 tonnes, almost the same as the 1984 figure. Nearly one million tonnes of last year's imports originated in ACP countries.

It is some 25 years since sugar exports from the United Kingdom were regularly in excess of half a million tonnes, while occasionally in the 1950's they exceeded 700,000 tonnes. Since then there has been a gradual decline as in-transit refining activity has dwindled. UK exports reached a low point in 1979 when only 71,509 tonnes were shipped but have since gradually increased. In 1985 354,346 tonnes were exported which is the highest level since 1964 and represents an increase of 96,201 tonnes over performance in 1984. The destinations of the largest tonnages last year were North Yemen with 50,600 tonnes, Iran at 42,094 tonnes and Egypt at 35,620 tonnes. This compares with the major shipments in 1984 of 122,792 tonnes to Israel and 23,194 tonnes to Norway. Of course, exports from the United Kingdom now include not only in-transit refined sugar but also domestically produced beet sugar.

Philippines sugar industry structure[6]

The new Philippines government is expected to introduce measures to rationalize the sugar industry and, to the extent that it eventually is encouraged to become more efficient, stabilize production some way in excess of recent indications.

A task force set up by the new president has asked members of the sugar industry to submit suggestions on ways in which structural improvement might be effected. It is proposed to set up a sugar council composed of 21 representatives from the various milling districts. At present there are 41 factories in the country but it has been suggested that as many as 24 of these may be closed. However, it is intended that the proposed alcohol industry should be implemented with an initial target for the current year of 37 million litres, which is the equivalent of 60,000 tonnes of sugar. It is hoped to double the amount next year.

Estimates of sugar output from the current crop now range from 1.1 to 1.3 million tonnes while stocks brought forward from the previous crop were of the order of 160,000 - 200,000 tonnes. Of this, only a few thousand tonnes, which have already been shipped, will be consigned to the world market; the balance will be reserved for domestic needs and the US quota. It is possible that further exports to the world market could be made during the later months of 1986 from the 1986/87 crop.

Looking to the future, a request is to be made to the USA for a quota increase; meantime, it has been suggested that, owing to a lack of pre-finance, output in 1986/87 might fall even below the current season's figure.

The changing pattern of world sugar trade

The changes which have occurred in world sugar trade between 1980 and 1985 were the subject of recent review by F. O. Licht GmbH[7]. Tonnages traded rose from 29.27 million tonnes in 1980 to 30.63 million in 1982 but have since declined to 27.77 million tonnes, raw value. The fall since 1982 can be traced to a relatively few countries in Eastern Europe and North, Central and South America. In the early 1980's production declined in the USSR owing to adverse weather but then started to recover so that imports declined. In Mexico and Venezuela, populist government policies of low domestic sugar prices drove many producers into financial trouble; thus production declined while consumption rose. The government concerned have counted the cost of the necessary imports and have taken measures to improve domestic output so that imports have declined. Similar government intervention in Chile resulted in closure of two sugar factories but their more recent re-opening has led to lower demand for imported sugar.

The greatest blow to the world sugar economy was struck by the United States, however, whose sweetener policy has fostered HFS manufacture at the expense of sugar imports so that nearly the entire burden of the decrease in US sugar consumption has been borne by developing sugar exporters of Latin America. The policy is a classic example of for how little development policy counts if it is in conflict with domestic agricultural interests.

By far the most important structural change, in its implications for the future development of the market, is the shift from developed to developing countries. The latter accounted for only about 28% of sugar imports in the 1960's but for 48% by 1985. Demand is more income- and price-elastic than in the developed world, so that the market has become more sensitive to the economic health of these countries.

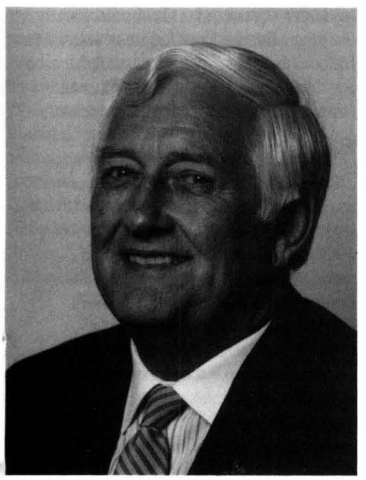
Closely related to this is the change in the form in which sugar is traded. By contrast with the decrease in raw sugar imports, white sugar trading on the world market has risen from some 4 million tonnes in 1976 to more than 10.6 million tonnes in 1985, 38% of the total sugar traded. This switch has been facilitated by the availability of white sugar from the EEC, while over the past five years there has been stagnation owing to low income per head and heavy debts in those developing countries which have been substantial buyers.

However, in the long term the white sugar market will be an expanding one as population growth raises import requirements. Raw sugar exporters, on the other hand, are fighting against a shrinking market due to structural changes in the developed countries which have traditionally been the largest importers of raw sugar.

6 *Czarnikow Sugar Review*, 1986, (1747), 37.
7 *Int. Sugar Rpt.*, 1986, **118**, 173 - 176.

Indonesia and the XIX Congress of the ISSCT

A collection of commentaries



By Owen W. Sturgess.
(Chairman, ISSCT Board of Trustees)

Indonesia, straddling the equator as a vast land bridge between south-east Asia and Australia, is a seemingly never-ending chain of islands separating the Pacific and Indian Oceans. Later this year, Indonesia will become the destination of many hundreds of sugar technologists. They will come together as members of one body for the opening ceremony of the XIX Congress of the International Society of Sugar Cane Technologists (ISSCT). The congress will be opened by His Excellency Soeharto, the President of the Republic of Indonesia, in the auditorium of grand architectural design at the Gedung Manggala Wanabakti (Forestry Centre) in Jakarta.

Technologists who elect to participate in the pre-Congress tour of the Indonesian sugar industry may find to their surprise few countries as colourful or as diverse as Indonesia with its rich blend of races, cultures, languages and religions. Indonesia is a large archipelago comprising over thirteen thousand islands and is the fifth most populous nation in the world after China, India, U.S.S.R. and U.S.A. The population of 147 million people is unevenly distributed throughout the archipelago. More than half is under 20 years of age and, importantly, 83% are rural peasants.

Indonesians fall into three hundred and more ethnic groups, each with their own cultural identity and linked by a national language based on Roman script and alphabet, referred to as "Bahasa Indonesia". They, like members of the ISSCT, are proud of their great range of heritages, which is symbolized by the motto "unity in diversity".

A long chain of mountains and a volcanic belt form the backbone of the large Indonesian islands of Sumatra, at the west, through Java and Bali, to the east. Volcanic activity has created fertile soils throughout the archipelago and it may be of interest to note from a cane-growing viewpoint that Indonesia lies outside the typhoon/cyclone belt. The most infamous of the active volcanoes is Krakatoa - an island volcano in the Sunda Straits between Java and Sumatra. Participants in the Pre-Congress tour may view from their seats in chartered aircraft the awesome majesty of a latent, smouldering Krakatoa as they fly to Gunung Madu plantation and its factory at Lampung in South Sumatra.

Vistors will be exposed to the various art forms, notably the dance dramas of Java and, possibly, Bali. The dances which are derived from Hindu mythology, feature episodes of the "Ramayana" or "Mahabharata" epics; they are stylized in movement, exquisite in costumes and are accompanied by "gamelan" music with drums, gongs, xylophones and, occasionally, stringed instruments. Performances with leather puppets will probably be a feature of tours where the puppeteer, using shadow, depicts one of the legendary wars. On the whole, Indonesians are innately artistic and express their art on canvas, wood, silver and stone.

Indonesian Sugar Industry

Turning back the pages of the sugar archives to the first third of this century, history records that the Javanese sugar industry under Dutch colonial rule was a world leader in production and advanced technology. For instance, directional breeding through the crossing and nobilization of wild cane and the commercial release of their inter-specific hybrids, viz. the POJ cultivars, were significant breakthroughs for improved production not only in Java but for the world at large. In 1935, Javanese sugar yield reached 17.5 tonnes per hectare and a yield of 25 tonnes at harvest appeared to be optimal for many crops.

When the sugar industry was being established 120 years ago in Java, suitable fertile lands were then growing rice. To avoid any social upheaval, the "Reynoso system" of growing sugar cane was introduced from Cuba. This system was and is unique by modern standards for it involves strict control of every phase of cane culture.

The Pre-Congress tour takes in the "Reynoso system" and a visit to the Gondang Baru factory in Central Java which was built in 1860, when its small mills were driven by water turbine. The last of these turbines were replaced in 1912 by twin-cylinder steam engines with slide-valves which are still operating today. Two-roller mills with Krajewski grooves are standard equipment at Gondang Baru. The de Haan process of juice clarification was initiated in this factory and is still in use. Filtration is carried out by plate and frame presses; several coil pans are operating; and the centrifugals are small batch units, driven by belts. In this factory, the juice scales are about 60 to 70 years old and installed when few, if any, factories throughout the world weighed their juices. They are still in use and appear to be accurate.

A visit to the oldest sugar experiment station in the world, viz. the Sugar Research Institute at Pasuran, will be a memorable experience for visiting technologists; next year, the Institute will celebrate its centennial year. Under Dutch rule, Indonesia became the birthplace of modern sugar technology, and by a quirk of history, much of the evidence is still in place. Significant technical advances were created at that time and disseminated around the sugar world, largely by technical articles presented and discussed at Congresses of the ISSCT.

Today, the number of old factories has gradually declined from 86 to 58, to which new factories, or others under construction, have been added. Two-thirds

of the first stage of an Indonesian rehabilitation program, covering 28 old factories, is close to completion. Many of the old factories continue to operate in the densely populated areas of Java for about 18 weeks each year; this short crushing period is consistent with a shrinking cane supply.

XIX Congress

Undoubtedly, the XIX congress is in capable hands; and plans and programs are in place. As mentioned previously, the Pre-Congress tour will not only be an intriguing mix of old and new technology but an introduction to local art forms, dances, gamelan music and the traditional textile, batik.

During October 1984, the Trustees were invited by the Congress Organizing Commitee to visit Indonesia for consultation and an overview of its plans and facilities for the tour, convention, exhibits, functions and accommodation. Trustee, Robert Antoine from Mauritius summed the feelings of all when he said "We have seen that, at all levels, from the powerful backing of the Minister, through your organizational skills down to the humblest worker, there is a will to make a success of the forthcoming international Congress."

General Vice-Chairman and Trustee Carlos Bell Raymond from the Philippines added that "the acceptance by .....Trustees of the proposed program for the 1986 congress for the Agricultural and Factory groups and the Ladies' program, consisting of visits and tours over a span of four days to places of interest, has given credence to the meticulous planning and preparation previously worked out and tested by the congress Organizing Committee."

All of the facilities necessary for a successful Congress are housed within four interlocking buildings - Gedung Manggala Wanabakti. The massive structure is elaborately finished internally in marble and teak and other timbers. The main auditorium seats up to 1400 people and has a gallery and facilities for simultaneous translation of English into Spanish and French. Additional meeting rooms, seating up to 200 persons, are available for concurrent technical sessions. The offices of the Organizing Committee are well-equipped and occupy floor space above the convention facilities, along with a post office, bank, travel agency and restaurant.

Extensive and colourful publicity in recent ISSCT Newsletters has directed attention to the range of options and associated costs, available to members who register for the XIX Congress. These options have generated a great deal of interest and enthusiasm within the ranks of technologists around the world.

Options range from a study tour of the Thai sugar industry, a pre-Congress tour of the Indonesian sugar producers on the islands of Sumatra and Java, a choice of accommodation, a ladies program, indoor and outdoor space for corporate exhibits, proceedings of Congress, an ISSCT golf tournament and finally a tourist view of the island of Bali. All offer great value with genuine appeal for sugar technologists operating within limited budgets.

A legitimate departure from council's approvals in Havana has been the switch of the Thai study tour from Post- to Pre-Congress. This switch was requested by the Thai tour committee when the proposed dates for the Congress were moved by the Organizing Committee from early to mid 1986.

The tour committee, set up by the Thailand Society of Sugar Cane Technologists under guidance of its President and ISSCT Councillor, Dr. Kasem Sooksathan, comprises representatives of the T.S.S.C.T., Thai Government and the sugar industry. Meetings with this committee in Bangkok, following a detailed overview of facilities and programs, convinced representatives of the Congress Organzing Committee, headed by Moeljono Hadipoero (General Secretary-Treasurer), that the planned Study Tour of Thailand by members of the Society registering for the XIX Congress, would be of tremendous interest and technical value. The tour program ranges from planting of cane through harvesting to processing and concludes with a seminar on Thai regulatory procedures. It should ideally set the stage for the Pre-Congress tour of the Indonesian sugar industry and form a basis for comparison between the Thai and Indonesian methods of sugar production.

Future direction of the Society

The process of reformation or renaissance of any Society, at an international level, is indeed slow. In 1977, a small group of concerned technologists were empowered in São Paulo by the XVI Administrative Committee (now Council) of the I.S.S.C.T. to reform the Society primarily because the logistics of organizing delegates and publishing accepted papers for the current and future Congresses had reached massive proportions.

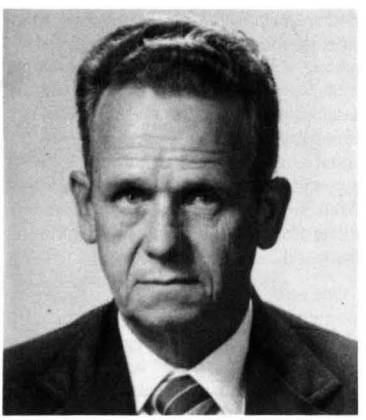
The major revision of the Society's Constitution which was adopted by the XVII Congress in Manila, restructured the central framework to which were appended individual and collective responsibilities for the key positions of Officer, Trustee, Councillor and Commissioner. Of equal importance, an amendment to the Society's objects provided a basis for the affiliation of national societies of sugar technologists, i.e. a constitutional link between national societies and their international body. These national societies, through their appointment of active technologists to the I.S.S.C.T. Council, were expected to be the "grass-roots" of the parent body. But, six years later, the revised constitution and philosophy underlying it are still not fully understood by many. Some lack of comprehension may be attributable in part, to the delay in publishing the *Proceedings* of the Havana Congress, where new policies arising from the revised articles were adopted by Council.

In recent years a rapport and a common purpose have developed between Officers and Trustees. Unfortunately, the Technical Committee has not met, preventing a similar rapport developing between the Organizing and Technical Committees and Board of Trustees. In practice, the Congress Organizing committee should consult with the Technical Committee, before determining the balance, direction

and technical content of programs for the next Congress.

In a wider context, the Technical Committee should meet to review the relevance and the number of sections within Commissions, the number of Commissions (concurrent sessions), the scope and composition of Sectional Committees, the value of Sectional Newsletters, the subsidy level for the Society's funding of research projects and subsidized financing of meetings of Sectional Committees between Congresses. Importantly, it should consult with the Trustees on all of these matters and, where necessary, request through the Board of Trustees, amendments relative to any desired technical change. Consideration should be given to expenditure of the Society's funds so that the travelling expenses may be subsidized for at least one meeting of the Technical Committee i.e. between Congress and in the country where the next Congress is being held. The Board of Trustees has accepted, by default, some of these technical responsibilities but, in the long term, the technical direction of the Society should reside in the competent hands of either the Commissioners or the Technical Committee. Some constitutional streamlining is essential to meet each or all of these worthy objectives.

"Sampai jumpa" (until then)



By James E. Irvine
(Chairman, Physiology Section, ISSCT)

New visitors to South East Asia and Indonesian Archipelago will find strange cultures and exotic ecologies there. The people of the area will be varied and fascinating to study. Dignified and reserved with strangers, they are basically a kind and friendly people. The ecology, more varied even than the people, contains some of the most ancient plants and animals still leaving, as well as some of the most exotic and bizarre. These are the lands that give rise to *Saccharum robustum* and *S. officinarum*, two ancestral forms of our modern sugar cane hybrids.

The island of Java is where these hybrids were first conceived (1888), and where the Java breeders began the first interspecific hybridization and the breeding program that climaxed with the worlds first super variety, POJ 2878, the harbinger of sugar cane's green revolution. Java was the site of many advances in both agricultural and mill technology, and those ISSCT visitors that are sated with people and environment cannot help but be facinated by the history of sugar technology that abounds.

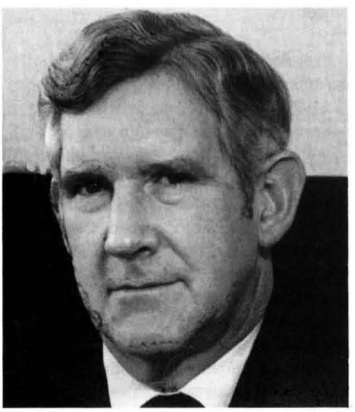
Participants in the Pre-Congress study tour in Thailand will see a fast-growing sugar industry with Thai technologists eager to show their work and learn from the visitors. Non-technical sights will include the exotic Thai temples, the little spirit houses for each country house, and the well-kept but throat-catching British cemetery near the bridge over the Kwai.

The formal program in Jakarta includes major presentations of selected topics by selected speakers, as well as the contributed papers sent by authors planning to attend. Poster presentations, first begun in the last Congress in Havana, are sure to be more popular in the future. Also planned is at least one informal workshop (tissue culture and genetic engineering). As in the last congress, the number of manuscripts permitted each section is limited. When manuscripts were slow to arrive, there was concern that good program might be difficult to put together. However, most sections in the Agriculture Division finally received several times more manuscripts than expected, with the result that the best prepared were generally those accepted.

In addition to tourism and technology, there will be substantial business conducted during the Congress. While the Board of Trustees meets periodically, the Congress is the official forum where councillors present business for discussion. The Trustees will probably hear both old and new problems requiring action. Among these may be a just appeal for Portuguese (the world's 7th language) to be given the same status as Spanish and French; or an equally just appeal to avoid Babel and limit all communication to English. Also possible for consideration might be the abolition of the very expensive *Proceedings*, to be replaced by a booklet of abstracts such as used by many other technical societies. In addition to reducing costs this would eliminate the need for a polished manuscript, thus minimizing the chance of missing an important advance because the authors' mother tongue was one other than English. Those papers worthy of full publication, could be accommodated by the technical journals in sugar technology, and in other disciplines as in other professional societies.

Sure to be considered by the Trustees will be the venue for the XX Congress. This is due to return to the Western Hemisphere, and rumours are already circulating about possibilities; one hears mention of Miami and Rio de Janeiro most often. A question certain to arise will be how the Society can avoid the prohibitions of governments against those expecting to attend future congresses. The government of the United States prohibited the entry of Cubans wishing to

attend the XIV Congress in New Orleans, and prevented its citizens from attending the XVIII Congress in Havana. Apparently, those members using South African passports will not be allowed to enter Indonesia to attend the XIX Congress. The Board of Trustees will surely ask for assurances of free entry and attendance from prospective host countries, but the Society cannot expect its interests to supersede those of individual nations, and these interests will certainly change as the world changes, making today's promise tomorrow's uncertainty.



Dr. Michael C. Bennett
(Councillor - UK, ISSCT)

As preparations for the 19th Congress enter the final stage, and sugar technologists around the world decide whether or not to attend, it is important to recognise the objectives of the ISSCT, and to assess the extent to which the Society is achieving them.

The present Constitution states that the objects of the Society shall be:
(a) to bring together sugar technologists to promote the technical discussion of field and factory problems of the cane sugar industry by means of Congresses held, as far as practicable, every three years;
(b) to provide facilities for the observation of sugar production methods and related activities in the host country during the period of congress and, under certain circumstances, in neighbouring countries;
(c) to foster the free and frank interchange of technical information;
(d) to form technical commissions and working groups to deal with the common problems of sugar cane technology;
(e) to promote cooperative research and development between the regions on topics to be specified by the membership or commissions, and to report regularly on these topics at Congresses or through appropriate media.
(f) to support worthy research projects, designed for the benefit of all; and
(g) to provide a basis for the affiliation of national or local societies of sugar cane technologists with the Society.

The success rate is mixed. Objects (a), (b), (d) and (g) are unquestionably achieved in full, and the hospitality of host countries in providing the access to their sugar industry is unsurpassed in relation to other international (non-sugar) industries' technical meetings.

The free and frank exchange of technical information [object (c)] is probably not achieved and never will be in the light of the commercial interests of both competitor sugar producers and competitor suppliers to sugar producers. Of course, the Technical Sessions do include papers which announce new products, processes and plant, and quite rightly so since the introduction of new technology should be subject to open scrutiny and the authors should be prepared to debate the validity of their claims. The Society does well to keep commercialism at a low level and it is only very occasionally that presenters overstep the boundaries of acceptibility.

The promotion of co-operative research and support of research projects [objects (e) and (f)] are severely handicapped by lack of adequate funds and by the difficulty of selecting appropriate projects.

The commercial interests of rival sugar producing and exporting countries can inhibit collaborative international research and development, thereby delaying the very progress upon which the industry as a whole depends for its survival and prosperity.

Another problem, well recognised by the Society and its Members, concerns the lack of continuity from one Congress to the next. Apart from the few Technical Commissions and Working Groups, the ISSCT, in effect, breaks up after each Congress and reforms in the next host country to commence preparations for the next meeting. Many Members feel that a greater degree of permanence, for example by the establishment of a small permanent headquarters, would be advantageous, especially in relation to the field of collaborative research and development projects. The headquarters would remain fixed, while the Congress continues to rotate around sugar producing countries of the world, as before.

One other aspect of the ISSCT Congress warrants some comment - its growth in size. Over the past five congresses, attendance has fluctuated between 700 and 1600, with alternating peaks and troughs. But the size of the published Proceedings has trebled, from the single volume of New Orleans in 1971 to three large volumes of the most recent Congresses. This is a direct reflection of the number of papers presented and poses the eternal question to any Conference organizer, what is the correct balance between quantity and quality?

On the one hand one needs a spectrum of topics to provide interest to all and stimulate discussion. On the other hand, with too many papers, the program can become dull and crowded, with insufficient time for questions and discussions. This is the Sectional and Sessional Chairmen's nightmare and there are no simple solutions to the problem. More stringent vetting of papers submitted can cause offence but is in the long- term interests of the Professional standing of the Society. The stimulation of discussion by

"planted" questions in the audience is time-tried and invariably successsful, but requires even more effort by the Chairman.

As with all conferences, success depends on many factors coming together favourably at the same time. With good papers, good presenters, good Chairmen and good audiences, success is assured in the lecture theatre. But, as we all know, the most important part of any Congress is not necessarily located in the lecture theatre. Instead it is the private discussion, the reunion of old colleagues and the informal exchange of individual problems and experience. The ISSCT has always provided the perfect forum for such meetings and long may it continue to do so.

From the point of view of the British Society of Sugar Cane Technologists, over a 10-year period, British industry has supplied more than billion pounds worth of goods and services to the world sugar industry. The ISSCT, to which it is affiliated, provides an opportunity to meet clients and exchange technical information but, above all, learn the current thinking in an industry depressed by overproduction and threatened by non-sucrose sweeteners.

By Fernando Cordovez Z.
(member of the Board of Trustees of ISSCT)

I believe that the coming ISSCT Congress to be held in Jakarta at the end of August of this year should be a very successful one. There are several reasons for this expectation:

- Java is a beautiful tropical island with a rich cultural heritage and a long tradition in cane agriculture and sugar manufacture; Indonesians are friendly by nature and unusually hospitable.
- The Organizing Committee is an efficient hard-working team that has been very active for the past three years with complete support from the Indonesian Government.
- About two hundred manuscripts have been submitted on a wide variety of subjects out of which 130 will be selected for presentation and most of the others will appear as posters.
- There will be a great number of delegates with whom it will be very worthwhile to exchange views and experiences. Nevertheless, I am afraid that the Latin-American delegation will be rather small, owing to the geographical location of Indonesia and the current economics of the world sugar industry.
- The Pre-Congress in Thailand should be of much interest because its sugar industry has been expanded and modernized in recent years.

Papers to be presented at the XIX Congress of ISSCT, Indonesia, August 1986

Processing Section (*Chairman*: Dr. Jorge T. Lodos; *Section Vice Chairman* Prof. Dr. Oey Ban Liang)

Studies on the decolorization of sugar by the use of ion exchangers in sugar cane refineries in Egypt (Aida Abd Elkader, Egypt)

Studies on the chemical composition of the ash of bagasse used as a fuel in the cane sugar industry in Egypt (Aida Abd Elkader, Egypt)

A new approach to produce liquid invert (Huang Wei-Gan, Taiwan)

Studies on the absorption of sugar colorants (S. C. Sharma and P. C. Johary, India)

Quantification of the increase in recovery due to higher imbibition % fibre (S. Kaliyamurthy, A. Abdul Haleem and P. S. Krishna Murtham, India)

C.C.S. and cane payment systems (Robert F. Sutherland and Ron B. Brooks, Australia)

Infrared studies on polymer of glucose ammonia colorant (S. C. Sharma and P. C. Johary, India)

Egyptian bagasse diffuser versus mill in Egypt (Saif El-Nasr, A. Aty Hemaida and M. El Sawah, Egypt)

Optimum imibition rate for burnt cane (Gad El-Kareem Sayed, Saif El-Nasr and A. Aty Hemaida, Egypt)

Determination of factors relating to automation of boiling of low-grade massecuites in the plantation white sugar industry (N. A. Ramaiah, G. N. Acharya and P. Kapoor, India)

Exhaustion of final molasses an achievement (T. K. A. Dewan Mohamed

and A. P. Chinnaswamy, India)

Ash balance for a pan boiling system (C. H. Chen, Taiwan)

Sucrose habit changes due to polysaccharides of different natures (M. Mochtar, Indonesia)

Automatic pH control in the liming-sulphitation juice purification system in Indonesian sugar factories (Ruwiyanai and Edi Purnomo, Indonesia)

The rheological behaviour and precentrifugalling of low-grade massecuite in cane sugar factories (Timbul Ananta and Edi Purnomo, Indonesia)

Objective colour measurements of Indonesian plantation white sugars (Simongan Gibar Gandana and Timbul Ananta, Indonesia)

Surfactants in sugar crystallization (Andrew VanHook, U.S.A.)

The technical and economic significance of the first cane diffusion plant in Indonesia (S. Singh, West Germany)

Low purity massecuite system for reducing waste molasses purity (B. S. Gurumurthy and S. Srinivasan, India)

A simplified system of sugar control in Indonesia (J. Sartono, Indonesia)

A virtual molasses factor (Susanta and J. Sartono, Indonesia)

Treatment of the waste stream from a sugar mill by Azotobacter (Y. T. Chuang, Taiwan)

Methods for analysis of dextran in sugar, molasses and juice (D. F. Day and D. Sarkar, U.S.A.)

Kinetics of sucrose crystallization from impure solutions (Michael Saska and Jean-Paul Garandet, U.S.A.)

Colouring matter inclusions in sucrose crystals (G. Mantovani, G. Vaccari, G. Sgualdino, D. Aquilano and M. Rubbo, Italy)

Effect of massecuite granulometry on efficiency of the low-purity end (Michael Saska, U.S.A.)

The continuous low-grade pan at Tully Mill (R. Broadfoot, Australia)

The use of the conductivity transducer for vacuum pan control (P. G. Wright, Australia)

Dextran measurement in cane products (J. H. Curtin and R. J. McCowage, Australia)

A study on improvement of filtrability of carbonated juice with various degrees of deterioration in the white sugar factory (S. L. Sang, C. H. Chen, C. S. Yeh and F. Y. Liu, Taiwan)

The effect of various packing materials on the keeping quality of stored plantation white sugars (Simongan Gibar Gandana, Indonesia)

Prevention of incrustation, sublimation and corrosion in the sulphur dioxide generating plant of a sulphitation sugar factory through a dehumidifier (Simongan Gibar Gandana, Indonesia)

Factors affecting mill extraction (H. S. Birkett, U.S.A.)

Study on electrodialysis desalination of Indonesian cane molasses (H. Masaki and T. Kokubu, Japan)

Preparation Index and analytical data of cane by the tumbler and wet disintegrator (Simongan Gibar Gandana, Indonesia)

Sugar loss from cane deterioration based on factory scale test (C. C. Wang, L. C. Lee, W. H. Shih and W. H. Pan, Taiwan)

Influence of cane fibre content upon processing and product options, especially electric power generation (Stephen J. Clarke, U.S.A.)

Application of water treatment technology to cane juice clarification (Stephen J. Clarke, U.S.A.)

Use of C 18 reverse phase HPLC in Australian raw sugar industry (P. C. Ivin, J. C. Baird and P. Collins, Australia)

Continuous crystallization under vacuum in raw cane sugar factories (P. Gorge, Vo Ngoc Truoc and L. Lincoln, Réunion)

Deep bed filtration in the sugar industry (N. Coote, C. Carroll and N. P. Leavins, U. K.)

Factory Engineering Section
(*Chairman*: Lindsay Lincoln; *Vice Chairman*: Karmanta Halim)

A new continuous evapo-crystallization tower for white sugar and low products (E. D. Bosse, West Germany)

Self-setting mill: a simple effective innovation (Mydur Anand, B. S. Gurumurthy and Gunasekaran, India)

An effective method of applying imbition water and juice for achieving higher mill extraction (T. K. A. Dewan Mohamed, A. P. Chinnaswamy and and A. Ramamoorthy, India)

Some aspects of contemporary bagasse fired boiler design (Paul Stark, Australia)

Experiences of using five mill performance control methods at once (Subhanuel Bahri and Soewarno Partowinoto, Indonesia)

An effort on the optimization of sucrose extraction by milling in Indonesian sugar factories (Soewarno Partowinoto and Subhanuel Bahri, Indonesia)

Fibre length ratio as an index of cane preparation (G. S. C. Rao, K. V. Rao, V. M. Murugkar and R. Narasimhan, India)

Microcrystalline sugar drying with a spouted bed (H. C. Tso, C. H. Chen and R. Y. Chang, Taiwan)

The cane sugar factory of the future (J. Maurice Paturau, Mauritius)

Investigation on combustion and combustion control in a sulphur furnace (Christian Moller and Henrik Jansdorf, Denmark)

Lotus roll performance at Bawany Sugar Mills, Pakistan (Mohammed Azam Butt, Pakistan)

An indicator for bulk density (P. F. Jain, S. P. Pandit and others, India)

Alternative synthesis for steam usage in raw sugar factories (Ana Gouveia, Ernesto Dominguez and Hector Pérez de Alejo, Mozambique)

Concept and design of multijet condenser with reference to conservation of energy

(Biraja B. Paul, India)

The influence of shredder design on cane preparation (R. N. Cullen, Australia)

Pelleting of bagasse using a rolling machine (R. N. Cullen and V. Mason, Australia)

Boiler tube wear (V. Mason, N. C. Farmer and M. K. Moir, Australia)

Mist cooling: a new method of cooling condenser water effectively (Mydur Anand and Arvind Chitale, India)

Hydraulics direct drive system (Rune Edlund, Sweden)

* * *

By-products section (*Chairman*: Dr. Yao Tung Liu; *Vice Chairman*: Dr. M. Mochtar)

Evaluation and use of bagasse ash as a ceramic constituent (M. Z. Mostafa, M. B. El-Kholi and Aida Abd Elkader, Egypt)

Use of sugar cane by-products for industrial, medicinal and nutritional purposes in Egypt (Mohamed Jassein Mohamed, Egypt)

An improvement of a L-lysine producing strain by mutation of the regulatory gene (Yao Tung Liu, Taiwan)

Successful tie-up between sugar and paper factories in India (P. J. Manohar Rao, India)

Use of molasses in the manufacture of a drug – ephedrine (P. J. Manohar Rao, India)

Enzymatic conversion of glucose to fructose (Gading F. Hutasoit, Indonesia)

Application of different membranes treatment for desalting molasses (Yahya Kurniawan and Mohammad Mochtar, Indonesia)

Physical rheology properties of a new microbial gum from sucrose (S. L. Cheng and L. H. Wang, Taiwan)

Improvement of ethanol productivity from cane molasses by continuous fermentation using immobilized yeast (Untung Murdiyatmo and Sudijanto Tedjowahjono, Indonesia)

Optimization of culture conditions for L-lysine fermentation of cane molasses (Yao-Tung Liu, Taiwan)

Review of worldwide progress in the use of bagasse as a raw material for reconstituted panelboard (J. E. Atchison, U.S.A.)

Future of the molasses-based alcohol distillation industries in the developing countries (Biraja B. Paul, India)

Distillery effluent a valuable feed stock for the by-product industry (Biraja B. Paul, India)

Direct contact heating and flash cooling of cane juice for alcohol production (Waldemar Pizaia, Danilo Tostes Oliveira and Carlos Eduardo Vaz Rossell, Brazil)

Total utilization of sugar cane as lignocellulosic resource: hydrogen peroxide alkaline pulping process (PA process) (Akio Mita, Japan)

* * *

Energy Section (*Chairman*: Prof. J. P. Stupiello; *Vice Chairman*: Dr. L. M. Panggabean)

Energy from biomass like sugar cane trash (P. J. Manohar Rao, India)

Study on energy generation through distillery effluent treatment (N. A. Ramaiah and V. G. Chikhalikar, India)

High performance of evaporator by vapour injection (Pada Carebet, Indonesia)

Re-evaluation of the calorific value formula of bagasse (Soewarno Partowinoto, Indonesia)

Seven years experience with bagasse dryers (Luiz Ernesto Correia Maranhao, Brazil)

The possibility to improve the individual bagasse drying system (Mohammad Saechu and Soewarno Partowinoto, Indonesia)

The application of ethanol in diesel fuel (H. P. Kreulen and H. C. A. van Beek, Holland)

An economic analysis of cane energy production (W. Keenliside, U.S.A.)

Computer analysis of material and energy balance strategies for raw sugar factories (W. Keenliside and S. J. Clarke, U.S.A.)

The distillation of high grade potable alcohol from molasses (Olavi Leppanen, Raimo Laakso and John Denslow, Finland)

Alcohol in Brazil as an alternative energy (D. A. Ometto, Brazil)

* * *

A list of the agricultural papers to be presented will be published in the May/June 1986 issue of *Sugar Cane*.

Facts and figures

USSR sugar imports, 1985[1]

	1985	1984
	tonnes, raw value	
Australia	0	327,626
Brazil	278,447	909,150
Colombia	0	21,400
Cuba	3,684,826	3,507,791
Czechoslovakia	0	51,965
Dominican Republic	231,255	53,568
EEC	0	735,431
Germany, East	0	7,870
Guatemala	11,499	10,745
Honduras	28,498	0
Hungary	39,775	0
Mexico	8,179	0
Philippines	0	57,200
Rumania	132,630	3,24
Elsalvador	25,447	0
Thailand	36,413	4,000
Total	4,476,969	5,704,193

New distillery for Pakistan[2]

The Punjab Industrial Development Board is to manufacture industrial alcohol from molasses in a distillery to be erected at the Kasur sugar factory. Capacity will be 40,000 litres/day and the plant and installation will cost 30 million rupees ($1,900,000).

Greece sugar production, 1985[3]

Greek sugar production in 1985 amounted to 317,122 tonnes, white value, more than enough to meet local demand of some 300,000 tonnes. The beet area in 1986 is to be 44,000 hectares, slightly more than the 43,200 ha of 1985 and sugar output is estimated at 320,000 - 330,000 tonnes, white value.

1 *I.S.O. Stat. Bull.*, 1986, **45**, (2), 50.
2 *Amerop-Westway Newsletter*, 1986, (148), 13.
3 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 165.

Hydraulic drives for a Mauritian cane mill

By Raymond Raffray
(Société Union St.-Aubin, Rivière des Anguilles, Mauritius)

Union Saint-Aubin is a medium-sized sugar factory by Mauritian standards. It is located on the south coast and has a crushing capacity of 2600 tonnes of cane per day. During a normal crop, the factory can be expected to crush some 280,000 tonnes of cane and produce around 30,000 tonnes of raw sugar. For the past ten years, Union Saint-Aubin has invested in modernization and rehabilitation. A 70 tonnes/hr 3000 kPa boiler has been installed, the evaporator capacity has been increased, a sugar dryer and additional sugar bins added, a 30 tonnes/hr *A*-massecuite Langreney continuous vacuum pan was commissioned last year and electrical power generation capacity has been increased. For the 1985 crop, two of the five 1980 × 935 mm mills were driven by Flender hydraulic motors, and in 1986 all mills will be hydraulically driven. This last addition to our factory is the subject of this article.

Although hydraulic drives are not new – we see them driving cane carriers, crystallizers, etc. – it is, we believe, the first time in the world that sugar cane mills have been powered by hydraulic drives[1] and this innovation is bound to affect the future design and modernization of sugar cane milling, in the same way as the steam turbine did after the last world war. This new investment was needed because the reduction gears of the five mills were completely worn out and major replacements had become a top priority.

We must here give a brief description of the drives as they existed previously. We had one single-stage 800 h.p. turbine driving No. 1 and No. 2 mills through a double-reduction gear box followed by two pinions and spur gear wheel. Nos. 3, 4 and 5 mills were similarly driven by one 1250 h.p. single-stage turbine also followed by a double-reduction gear box and two pinions and wheel gears.

It was decided from the beginning that, instead of going into expensive repair to the existing set-up, new individual mill drives would be given priority and were investigated as a first choice. Such drives could therefore have been either electric motors, steam turbines with appropriate reductions, or electric motors driving the final shaft through hydraulic pumps and motors, thus eliminating expensive reductions.

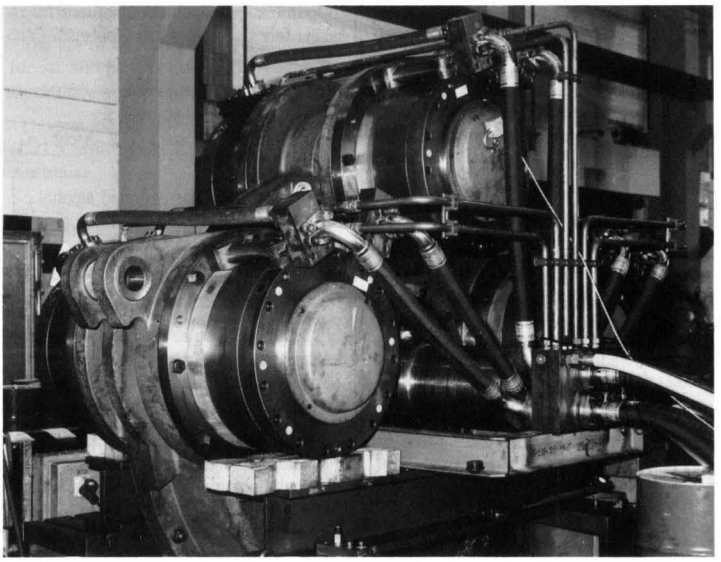


Fig. 1 Gear box assembly in the workshop; the six Hydrex motors are flange-mounted on the gear box casing

1 Wright: *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 381 - 388.

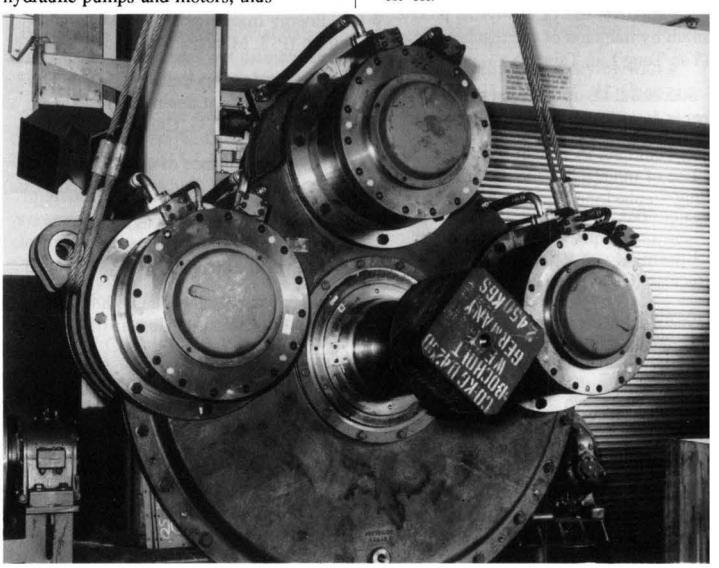


Fig. 2. Gear box assembly in the workshop; the motors are flange mounted on the gear box casing, and the square end driving shaft may be seen

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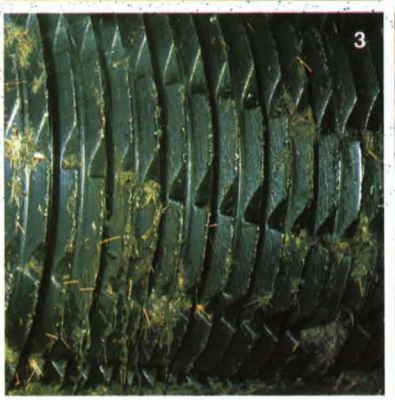

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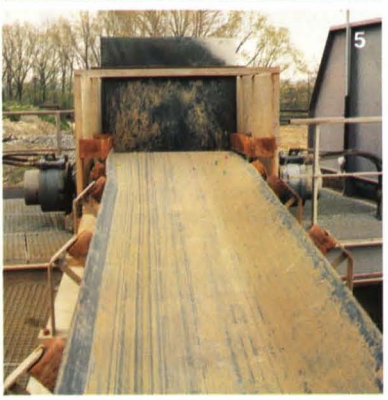

4 FLENDER special design gear with three pinions, six LSHT-motors and square tail

5 FLENDER LSHT-motors on main shaft of conveyor

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ISJ Abstracts

Cane sugar manufacture

Cane research in South Africa

Anon. *Ann. Rpt. Sugar Milling Research Inst.*, 1984/85, 4 - 14.

Extraction of impurities from sugar cane: A set of stirred vessels has been used in laboratory investigations on the effect of cane preparation, temperature and pH on the extraction of Brix and a number of selected impurities (mainly colorants and colour precursors) from cane. The results are evaluated according to Rein's model using an approach developed for studies on the extraction of soluble constituents from tea and coffee; replicated factorial designs are used with two levels of pH and temperature. Graphs are presented that clearly show how fine preparation using a Jeffco cutter-grinder gives a greater Brix extraction than coarse preparation using a shredder, and how colour absorbance was lower for juice extracted at 60°C and pH 5.8 than at 80°C and pH 7.2 for the same cane.

Purity changes and sucrose losses across clarification: In studies on the effect of mud retention time on purity drop in clarification, a clarifier was operated to give relatively thick muds over a period, and then used to give thin muds. Determination of purity and lactic acid in samples of clear and limed juice as well as the muds plus determination of mud retention using a LiCl tracer confirmed earlier findings that filtration is optimum with thin muds (of 3 - 4% solids content).

Crystal size distribution in C-massecuites: In an assessment of the effect of low-grade crystal size on molasses purity rise across continuous centrifugals, it was found that the passage of small crystals (up to 120 µm wide) through the screen perforations accounted for most of the purity rise, and that a good inverse relationship existed between the crystal population and purity rise. As a result of these findings, the South African sugar industry made a concerted effort to increase the crystal size of *C*-sugar, and the average size rose to 129 µm in November 1984 as against 100 µm in the 1983/84 season. The improvement was reflected in a fall in the target purity difference, i.e. the difference between the actual purity and expected purity, which fell from 4.4 to 2.7 with increase in the mean crystal width from 105 to 132 µm at four Tongaat-Hulett factories.

Effect of mixed juice purity on boiling house recovery: Since boiling house recovery (BHR) is affected by mixed juice purity, comparison of BHR values from different factories is less meaningful where mixed juice purities differ. A solution to the problem is based on predicted molasses purity as calculated from the mixed juice analysis. A target value BHR_t is calculated from $BHR_t = 100\ S\ (J - M_t)/J\ (S - M_t)$, where S = sugar purity, J = true purity of mixed juice (based on refractometric Brix and sucrose as determined by GC) and M_t = final molasses purity based on mixed juice analysis and given by $M_t = 33.9 - 13.4 \log_{10} [(f + g)/sa]$, where f, g and sa are, respectively, fructose, glucose and sulphated ash % mixed juice.

Investigations of undetermined losses at Pongola: High losses towards the end of the previous two seasons appeared to occur after the syrup stage and to coincide with periods of low mixed juice purity (<81). Attempts to decrease the loss by improving the filter station and clarifier (so as to reduce mud retention) seemed to have been successful, since the losses were lower than before and the ratio of reducing sugars in syrup to those in mixed juice was also lower and reasonably stable.

Water-resistant bolted shredder hammer heads: Trials on Dua Block shredder hammer heads of Australian manufacture[1] are reported. Rectangular blocks had rounded edges after about two weeks of use on each edge, but handled 134,500 tonnes of cane of 14.3% fibre content. Two channel-section heads maintained a better edge profile and completed seven weeks, during which they handled 235,600 tonnes of cane of 14.54% fibre content, and it is thought that they could have lasted eight weeks (four weeks per face). Although a full-scale test using the blocks on all hammers would have been far more significant, it was concluded that the heads performed well under reasonable operating conditions.

Perforated top mill rollers: While a perforated top roller fitted to a conventional 3-roller cane mill (at a factory where bagasse moisture contents are generally good) failed to give any improvement in the bagasse moisture level, which was in the range 48.77 - 50.76% (on a weekly basis) during a period of 10 weeks, at another factory known for its relatively poor bagasse moisture contents, a perforated top roller installed in a 5-roller mill gave a 3.36 unit reduction in the average bagasse moisture content to 49.89% despite very dirty cane.

Adhesive bonding of mill roll shells to shafts: Since shrink fitting of roller shells to cane mill shafts can sometimes lead to premature failure of the material, the possibility of bonding the shells and shafts by adhesives is of interest. The maximum transverse shear stress existing in a bonded shell/shaft interface plane has been calculated to be only 5 MPa. Two important factors affecting the strength of an adhesive bond are: the preparation of the metal surface and the thickness of the adhesive bond line. These factors were investigated using mild steel double lap shear test specimens. No significant difference was found between the bond strength of specimens with surfaces prepared by sandpapering or shotblasting. The shear strength fell rapidly from 37 MPa at a bond line thickness of 0.25 mm to 12 MPa at 2.5 mm thickness; failure with the thicker bonds occurred at the metal/adhesive interface (adhesion failure) whereas the thinner bonds failed within the adhesive layer itself (cohesion failure). In the case of other specimens more representative of mill roller geometry and materials, the bonded surface of which were given a rough grooving having a surface roughness averaging 0.25 mm, the shear strength fell linearly with increasing bond thickness from 35 MPa for 0.25 mm bonds to 30 MPa for 2 mm bonds, which was six times greater than the calculated requirement. Full-scale testing of an adhesive bonded shell and shaft was planned for the 1985 season.

Vacuum pan design data: Investigations of factors affecting the evaporation rate of *A*-

1 Dolman: *I.S.J.*, 1983, **85**, 373.

and *B*-massecuites, using an experimental vacuum pan consisting of four steam-jacketed tubes of the same diameter but of differing lengths, showed that the significant variables affecting the evaporation rate were: purity, pressure, vacuum, Brix and hydrostatic head in decreasing order of importance. Each of the jackets was provided with an individual steam inlet, incondensable gas vent and condensate drain, allowing the evaporation rate in each tube to be measured individually.

Assessment of a continuous pan on C-*massecuite*: Trials are reported on a 90 m^3 SRI continuous low-grade pan having seven compartments of progressively increasing volume and three separate calandrias, each with its own steam supply. The vertical tubes varied in length from 1.267 to 1.955 m. During the tests, 1st effect vapour was supplied at 30 kPa, and the vacuum ranged from -90 to -95 kPa. Injection steam was fed into compartments 5, 6 and 7, and circulation water into compartment 7. The evaporation rate averaged 2.7 kg/m^2/hr (a maximum of 3.0 kg/m^2/hr) and, during preliminary trials, 3.5 and 2.6 kg/m^2/hr in the 1st and 3rd calandrias, respectively. The low average evaporation rate was probably a result of high massecuite Brix (the average was 97.1°) and a low quantity of circulation water, but no explanation could be found for the low rates in the 1st section of the pan. The seed:massecuite ratio (5.4:8.4 m^3/hr) was high by comparison with the value in batch pans. The *B*-molasses feed of 66.2°Bx and 44.9 purity and *C*-seed of 90.2°Bx and 58.3 purity yielded a massecuite of 52.4 purity.

Assessment of a stirrer fitted to a C-*pan*: Comparison of the performances throughout the season of two identical low-grade pans, one fitted with an Ekato stirrer designed to operate at 48 and 32 rpm (the drop to the lower speed occurring automatically when maximum load is reached at the higher speed), showed that the stirrer gave a much higher average evaporation rate (17.9 compared with 11.9 kg/m^2/hr), a shorter boiling time (4.7 -4.9 as against 5.8 - 7.9 hr) and hence an approximate 30% increase in effective pan capacity. There was no significant difference in final molasses purity or crystal size distribution. Addition of injection steam in the stirred pan gave only marginal improvement in the evaporation rate.

Evaluation of vertical C-*crystallizers at Sezela and Illovo*: Modification of the vertical crystallizers at the two factories by replacing the rotary cooling elements with fixed banks of tubes gave an average heat transfer coefficient of 21 W/m^2/°C that was about double the value given by other types of elements tested, while flow (as defined by the tank-in-series model) was 26 against 6 - 18 tanks before the alteration.

Optimization of a continuous A-*centrifugal*: Comparison of the performances of a BMA K1500 continuous machine and batch centifugals, used for single curing of *A*-sugar to VHP sugar pol standard, showed that molasses purity rises in the batch machines (at two sugar factories) were 1.2 and 2.3, and 2.0 and 3.2 with sugar purities of 99.4 and 99.6, respectively, while those in the continuous centrifugal were 2.5 and 4.0, respectively. However, the 2.5 purity rise for 99.4 sugar purity (obtained at a wash water addition rate of 5% on massecuite) was not considered excessive; about 1 unit of the rise was due to the passage of small crystals through the screen perforations. The performance of the continuous machine could probably be improved, it is thought, by removing the vertical screen from the distribution pot (since it prevents proper massecuite distribution on the basket screen) and reducing the basket speed from 1080 to 900 rpm and thereby preventing sugar flying off the screen before it has reached the top of the basket. Hourly throughput of the centrifugal was 35 tonnes of massecuite.

Sugar traces in condensates by specific conductance measurements: While trace quantities of sugar cannot always be detected in condensates by conductivity measurements, particularly in the case of high-purity liquors, it can be shown that, if a solution is heated under pressure in a coil, the sugar breaks down into organic acids which have a measurable conductivity. When standard sucrose solutions were prepared with deionized water and treated in this way, a linear relationship was obtained between the conductivity and the concentrations of sugars present. However, analysis of factory condensates by the phenol-sulphuric acid and conductivity methods showed poor correlations between the results because of the presence in the condensates of other ionizable material that reacts in the same way as sugar; further comparisons were to be made using factory and refinery condensates, with the aim of establishing a continuous on-line methods of detection for process control.

Test kit for factory checking of the activity of amylase enzymes: A simple test was developed for on-site checking of the activity of amylase enzymes used to remove starch from syrup. The test involves measuring the time taken to hydrolyse starch in a starch-sucrose syrup, and the chemicals required for the test are available in kit form.

Supervisory control and data acquisition for process (control at Imperial Sugar Company)

B. Harrison and J. Ruzicka. *Sugar J.*, 1985, **48**, (1), 5 - 9.

See *I.S.J.*, 1985, **87**, 29A.

Which to produce - 96 pol or 97.5 pol raw sugar?

C. S. Abrigo. *Crystallizer*, 1985, **8**, (2), 12 -13.

It is shown, by calculations, how increase in raw sugar purity reduces the weight of sugar produced; on this basis, 96 pol sugar is theoretically more profitable to produce than 97.5 pol sugar (not allowing for any penalty imposed by refiners), particularly in view of the associated reduction in processing time, increased equipment capacity and decreased energy consumption. However, it is equally demonstrated that a smaller weight of refined sugar is produced from the lower pol sugar, while the refiner is also faced with problems of reduced filtrability, higher consumption of decolorizing agents, a longer processing time and higher energy consumption.

Beet sugar manufacture

Disinfectants in beet sugar extraction

R. Nystrand. *Zuckerind.*, 1985, **110,** 693 - 698.

The inhibiting effects on the activity of 220 aerobic and facultative anaerobic thermophiles isolated from beet diffusers of seven disinfectants considered as possible alternatives to formalin (which has health hazards) were determined in laboratory studies. The effects on two dominant Gram-positive bacteria, *Saccharococcus thermophilus* and *Lactobacillus* sp., were also investigated. Five of the disinfectants were also tested under factory conditions. Results indicated that shock dosing of Ekarox B 10 (containing hydrogen peroxide and ethane peroxoic acid) at 200 - 500 ppm, alone or combined with Busan 881 added periodically at 7 ppm, was comparable to formalin provided the temperature was at least 70°C. The other disinfectants tested were hydrogen peroxide, Ekarox B 1, Ekarox B 5, Antifomin DMT and Nalco 247.

Simulation models of sugar factory manufacturing schemes. II. Model of a raw sugar factory

B. Kpriva, J. Gebler and R. Stengl. *Listy Cukr.*, 1985, **101,** 180 - 188 (*Czech*).

A mathematical model is presented of the processing scheme in a raw sugar factory. An approximate boiling diagram is presented based on the calculations, covering two- and three-massecuite systems with possible affination of *A*-raw sugar, with or without mingling and/or melting of *C*-sugar.

Factors affecting sugar beet storage and fundamentals of effective protection

J. Zahradnicek. *Listy Cukr.*, 1985, **101,** 172 - 180 (*Czech*).

Detailed examination of the metabolism, processing quality and storage of beet confirmed the effects of morphology, ripeness, chemical composition and distribution, variety, temperature, injury, fertilization, irrigation, topping height, disease, extraneous matter and storage method. Advice is given on storage and on the use of protective chemicals; tests with four preparations showed that all reduced the daily weight and sugar losses by comparison with untreated controls, the best being Novozir MN 80 and MH-30.

Effect of the yellow sugar melting method on the massecuite boiling process

V. V. Spichak, A. S. Pakhomova, M. I. Egorova, G. M. Chizh and R. F. Makeeva. *Sakhar. Prom.*, 1985, (8), 20 - 22 (*Russian*).

Thick juice of 50, 55, 60 or 65°Bx was mingled with yellow sugar to give a 65 - 70°Bx melt which was then sulphitated and filtered. Use of the thick juice instead of water reduced steam consumption in boiling by 2.5% and in evaporation by 1.03% on beet (assuming a final Brix of only 58° instead of 65° and a melt of 65°Bx). The method had no adverse effect on the colour of white sugar while reducing the boiling cycle by 15 - 20% and thus raising pan capacity.

Qualitative change in beet sugar solutions during heating

T. P. Matvienko, V. A. Shestakovskii and L. I. Pankin. *Sakhar. Prom.*, 1985, (8), 22 - 24 (*Russian*).

Heating run-off at 90°C for 20 and 65 hours caused considerable sucrose degradation and colouring matter formation, with an appreciable fall in purity and noticeable rise in optical density; spectrophotometric analysis revealed a shift in the absorbancy maximum from 260 to 275 nm, indicating a change in the nature of the colouring matter. Saturation studies with artificial massecuites demonstrated that the same degree of heating reduced the saturation coefficient to well below that of molasses similarly treated, and confirmed the contribution of sucrose degradation products to a reduction in sucrose solubility and hence decrease in the saturation coefficient, Brix and viscosity. For this reason, the best criterion of factory, particularly boiling house, performance is considered to be the the molasses colour content rather than the purity difference between actual and standard molasses - the amount of sucrose degradation products in molasses increases with the colour content, and fall in molasses purity is indicative of increased sugar degradation losses. Sugar obtained from an artificial massecuite prepared from saturated run-off and sugar needed only one affination with saturated refined sugar solution to give a colour that was close to that of the original sugar, whereas three affinations were required for similar results when the run-off used for the massecuite was preheated for 65 hours. After one affination, the sugar in this case had a higher colour content than sugar obtained from massecuite boiled on molasses despite a run-off viscosity that was much lower than that of the molasses; this demonstrated that non-sugars removal from sugar crystal surfaces by spinning was governed by surface interactions of non-sugars as well as by mother-liquor viscosity.

The introduction of a corrosion-resistant air heater (for boilers)

I. G. Korateev and E. G. Stepanova. *Sakhar. Prom.*, 1985, (8), 36 - 38 (*Russian*).

The advantages of tubular air heaters in which the air flows inside horizontal tubes are discussed, including their reduced corrosion.

An automatic doser for feeding of anti-foam agent in a diffuser

B. N. Valovoi *et al. Sakhar. Prom.*, 1985, (8), 42 - 45 (*Russian*).

A pneumatic dosing device is described which is based on flow through a small orifice under constant pressure. Experiments with a test model at a sugar factory showed an accuracy of ± 1.5% over a flow range of between 7×10^{-4} and 3×10^{-3} kg/sec. The system can be assembled from standard Soviet mass-produced components.

Sugar refining

Deaerator stress corrosion cracking

P. Bulionis. *Paper presented at 44th Ann. Meeting Sugar Ind. Technol.*, 1985, 11 pp.

Reference is made to cases of deaerator explosions in industries other than the sugar industry, and to occurrences of stress corrosion cracking and corrosion fatigue as the main cracking mechanisms. It is pointed out that, with both types of cracking, a long time elapses before the cracks become visible, at which point they can spread very rapidly; however, a pressure vessel such as a deaerator becomes highly susceptible to catastrophic failure before the cracks reach this level. The specific case of the deaerator used for boiler water treatment at Redpath refinery is described, and photographs illustrate the cracks found in the vessel, which was replaced with a new one. Guidelines for deaerator replacement are set out, and the need for strict monitoring to check for possible cracks is such vessel is stressed.

Experiments on Canesorb

S. Hayama, K. Abe, I. Kawami and T. Maezono. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1985, **34**, 12 - 20 (*Japanese*)

Tests are reported in which a 20:80 w/w Canesorb:bone char mixture[1] was used to decolorize process liquor. Results showed that the decolorizing cycle could be extended to double that with bone char alone without any sacrifice of decolorizing efficiency; prolonging the cycle had only slight effect on pH, while no increase in reducing sugars was observed in the treated liquor. Although 20% less ash was removed than by bone char alone, it was possible to reduce the amount of ash recycled in sweet-water, so that the overall effect was a 10 - 15% reduction in ash removal. Because Canesorb has smaller micropores than bone char, more wash water is needed for the mixture than for bone char; moreover, Canesorb is more fragile than bone char, so that a greater amount of make-up is needed after regeneration than with char. Overall, a considerable saving in decolorizing costs can be expected by using Canesorb:bone char mixtures by comparison with bone char alone.

Refining research in South Africa

Anon. *Ann. Rpt. Sugar Milling Research Inst.*, 1984/85, 5, 8, 11.

Crystallization and crystal deformation: Laboratory procedures have been standardized so as to allow evaluation of the effects of impurities in refinery products on crystal habit and crystal growth rates under closely controlled conditions approximating to those in a refinery. By selectively removing impurity fractions from refinery molasses and adding them to pure sucrose solutions, it has been confirmed that polysaccharides (including dextrans) make only a small contribution to c-axis elongation, while the main crystal habit modifiers in refining are of low molecular weight (probably <1000).

Caking of refined sugar in 25-kg bags: For many years the South African sugar industry has experienced problems caused by refined sugar caking in 25-kg paper bags, and a detailed study was initiated of the conditions under which sugar is packed and stored; initially, two types of packaging were compared under controlled humidity and temperature. The sugar in the bags was stored at 85% R.H. and 26°C for one week and then at 40% R.H. and 30°C for another week, after which the amount of moisture absorbed by sugar in 3-ply paper bags (as normally used for local sugar) was found to be much greater than by sugar in 3-ply multi-coated bags as used only for export sugar; this sugar remained free-flowing, while the other generally caked after exposure to the lower R.H. in the second week. In order to verify these results, a long-term test program has been set up in which sugar stored in three types of paper bag (a 3- and a 4-ply type and a 3-ply bag with a polyethylene film between the two inner layers) at nine refineries was to be sampled and analysed at 3-month intervals throughout one year.

Noodsberg pan controller: A field programmable batch-type controller installed on the *B*-pan consists of two sections, each with its own micro-processor; the first comprises three 3-term controllers, each with operator panel and display. Inputs are massecuite conductivity, absolute pressure and massecuite level (as measured by differential pressure cell with remote seals), and the controllers provide outputs to control valves according to a specified control algorithm. The second section is programmable in Basic language; the microprocessor communicates with the multiloop controller via a serial port and can monitor and alter control variables. Individual controller modes may also be altered. The controller has worked very well and has found good acceptance with the pan operators; a second such system was to be installed for the following season.

Heat recovery from second carbonatation vapour at Notre-Dame refinery at Oreye

Anon. *Sucr. Belge*, 1985, **103**, 5 - 11 (*French*).

After a study of ways in which energy consumption could be reduced at the refinery had shown that heat recovery from 2nd carbonatation juice was the most suitable means in terms of the initial costs and the level of energy made available, a system was introduced in 1984/85. The article presents a technical analysis of heat loss in 2nd carbonatation vapour, examines various methods of recovering and utilizing the heat, and describes the system installed. A perforated-plate, direct-contact tubular heat exchanger was inserted in a newly installed flue above the defoamer and seepage tank. Water at 50°C in a closed circuit is heated to 80°C with vapour at 92°C and then used to preheat the air used for combustion in two boilers and for sugar drying. Results from 81 days of operation showed a fuel saving of 232 tonnes. The payback period is calculated at 157 days, or less than two campaigns.

1 See Barton & Knebel: *I.S.J.*, 1983, **85**, 14 - 18, 38 - 42, 72 - 76.

Starch based sweeteners

Studies on the conditions of enzymatic isomerization of D - glucose from *Streptomyces thermovulgaris* strain 127

M. S. Popov, G. M. Djedjeva and Y. S. Grigorova. *Dokl. Bolgarsk. Akad. Nauk*, 1984, **37**, (7), 895 - 898; through *S.I.A.*, 1985, **47**, Abs. 85-688.

This enzyme had a maximum activity at pH 8 in phosphate buffer, which would be favourable for its use for the continuous isomerization of glucose syrup. Its optimum temperature for 10 or 60 minutes' exposure was 80°C; thus it could be used at high temperatures, which would decrease the risk of microbial contamination. Enzyme activity was stimulated by Mg^{++} or Co^{++} ions, and especially by a combination of the two. Cu^{++}, Zn^{++} or Ni^{++} ions had an inhibitory effect.

The separation of synthetic mixtures of glucose and fructose and also invert sucrose feedstocks using counter-current chromatographic techniques

P. E. Barker and E. K. E. Abusabah. *Chromatographie*, 1985, **20**, (1), 9 - 12; through *S.I.A.*, 1985, **47**, Abs. 85-694.

Tests were carried out in a SCCR4 unit containing a cation exchange resin, Zerolit 225, in the Ca^{++} form. A 50% w/v feed mixture, comprising sucrose solution hydrolysed by H^+-form cationic resin, was passed to the column at 45°C. In other tests a synthetic mixture of glucose and fructose was used. The fructose purity of the fructose-rich product from the synthetic mixture was 89, but that from the inverted sucrose solution was only 73. Possible reasons for this difference (which did not occur when an anion exchange resin was used) are discussed.

Glucose isomerase and its behaviour under hydrogenation conditions

M. Makkee, A. P. G. Kieboom and H. van Bekkum. *Starch/Stärke*, 1985, **37**, 232 - 241.

A survey is presented of the literature on glucose isomerase, covering research on its use to convert glucose to fructose, the mechanism of isomerization, and commercially available immobilized glucose isomerases and their properties. Experiments are reported in which immobilized glucose isomerase was found to be suitable under hydrogenation conditions, whether in its entrapped cell environment or in its purified form. The D-glucose/D-fructose equilibrium constant was independent of the total sugar concentration, but small quantities of calcium carbonate and magnesium sulphate should be present so as to maintain sufficient enzyme activity. While addition of stoichiometric amounts of borate has been found to increase the glucose conversion substantially, the fact that the effect is due to selective complexing of D-fructose with the borate anion makes the technique unsuitable for combined hydrogenation/isomerization. The influence of sugar alcohols such as D-mannitol and D-glucitol on the activity of Optisweet 22, one of three immobilized glucose isomerases mentioned, is also discussed, and brief mention is made of the influence of the immobilized enzyme on hydrogenation catalysts.

Separation of fructose from glucose using adsorption column chromatography with an inorganic adsorbent

S. L. Cheng. *Rpt. Taiwan Sugar Research Inst.*, 1984, (106), 31 - 42 (*Chinese*).

Experiments with eight different inorganic adsorbents for fructose separation from glucose showed that basic alumina (70 - 230 mesh) was the best; further improvement in its performance was achieved by treatment with 4 - 6% $CaCl_2$ at pH 7 - 9. Results are tabulated and given in graph form, including adsorption efficiency comparison between basic alumina and a number of ion exchange resins.

Activation of the enzyme, invertase, in bottom-fermenting beer yeasts used for sugar syrup inversion

A. V. Filippovskaya, I. V. Gladysheva, T. G. Nazintseva and N. I. Derkanosov. *Izv. Vuzov, Pishch. Tekh.*, 1985, (2), 113 (*Russian*).

A method of activating invertase in beer yeasts for syrup inversion was studied, including the use of non-metabolizable sorbitol as non-specific substrate, the activation period and the possible degree of syrup inversion. The yeasts were first washed to remove traces of beer and the taste of hops, followed by activation trials with and without aeration. Without aeration, an activation period of 60 minutes at 37°C was sufficient, in the presence of 1% sorbitol, to increase the activity of the enzyme from 312 to 990 units. Syrup inversion rose from 30 to 40% as a consquence of using the activated yeasts, and invertase consumption was estimated at 300 - 350 units per kg of sugar.

The thermophysical properties of aqueous glucose solutions

M. A. Gromov. *Sakhar. Prom.*, 1985, (7), 45 - 48 (*Russian*).

A number of formulae are presented for calculation of glucose solution density, specific heat, heat conduction and heat diffusivity as functions of temperature and dry solids content.

Continuous isomerization of glucose on anion exchange columns in tetraborate form

L. D. Bobrovnik, G. A. Lezenko and O. P. Nazarova. *Sakhar.Prom.*, 1985, (8), 52 - 54 (*Russian*).

Results are presented of laboratory-scale investigations on continuous isomerization of glucose to fructose using AV-17-8 anion exchange resin in $B_4O_7^{--}$ form in a column of 2.2 cm diameter and a bed height of 40 cm. Optimum conditions to yield 29 - 31% fructose (the maximum achieved) at a sugar loss of 4.8% were: 2M glucose concentration, 65°C, pH 11 and a flow rate of 1.5 ml/min. The isomerizate was devoid of unpleasant odour but was slightly coloured.

Laboratory studies

Determination of tin in sugars by atomic absorption spectrophotometry

S. Saito, T. Miki, H. Ito and M. Kamoda. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1985, **34**, 32 - 36 (*Japanese*).

Atomic absorption spectrophotometry was applied to tin determination in granulated, soft white and raw sugar. The procedure followed included wet digestion of the 10 - 20 g sample with conc. sulphuric and nitric acids, neutralization with NaOH and making up to 50 ml with water. The solution was then adjusted to pH 1 with 10 ml of 1N HCl-KCl buffer solution, conc. HCl and NH_4OH followed by addition of 5 ml 1% APDC solution to form a complex with the tin. The solution was stood for 1 hour, 10 ml of MIBK then added and the contents shaken for 5 minutes. The MIBK containing the Sn-APDC complex was separated and a further 5 ml of 1N NH_4OH added. After shaking for 5 minutes, the NH_4OH was separated and the solution then analysed by atomic absorption spectrophotometry at 2246 Å. Recovery was 95.5 - 104.5% and the detection limit was 0.25 μg/g.

Quantitative determination of organic acids in sugars. Butyl esterification of organic acids using cation exchange resin

S. Saito, T. Miki, H. Ito and M. Kamoda. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1985, **34**, 101 - 109 (*Japanese*).

The effect of cation exchange resin on butyl esterification for determination of organic acids in sugars was investigated[1]. Results showed that: esterification efficiency of a strongly acidic cation exchanger was greater than that of a weakly acidic cation exchanger, the optimum grain size of a strongly acidic cation exchange resin was 100 - 200 mesh, the optimum cross-linkage was ×4, and there was no difference in esterification efficiency between commercial brands of a strongly acidic cation exchange resin.

Application of dextranase to the sugar manufacturing industry

A. Hattori and S. Minato. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1985, **34**, 111 - 118.

The properties of dextranase, DL-2, obtained from *Chaetomium gracile* were investigated in connexion with its possible use to reduce the dextran content in sugar factory products. Viscometric monitoring of enzymatic hydrolysis of dextran in a 1% solution containing 50% w/v sucrose showed that 12 ppm of the dextranase degraded 10,000 ppm of the dextran within 30 minutes, reducing the molecular weight from 2×10^6 to $<4 \times 10^4$ (which would solve processing problems). The enzyme had greatest activity at 55 - 65°C and pH 5 - 6, and was unaffected by 60 minutes' incubation at 80°C in 65°Bx sucrose solution; the rate of dextran hydrolysis was higher at 75 80°C than at 65°C in this solution in which 200 ppm dextranase almost completely eliminated 10,000 ppm dextran within 90 min. Comparison between gel filtration and the haze method for dextran determination showed that the former method gave accurate measurements at molecular weights above 4×10^4, while the latter gave considerable under-measurement at $<10^5$ since the turbidity was lower than that of highly polymerized dextran. Values are given of the dextran contents found by gel filtration in cane and beet sugar factory products, as well as in raw sugar samples. Recommended dosage rates of dextranase for juice and syrup treatment are tabulated for dextran levels up to 15,000 ppm and treatment times up to 60 min for juice and up to 120 min for syrup.

Methods for testing decolorizing anion exchangers

M. V. Rozhkova, G. A. Chikin, V. M. Rogozina, V. I. Tyagunova and V. A. Kashirskii. *Sakhar. Prom.*, 1985, (7), 31 - 34 (*Russian*).

While a method developed by the authors for determining resin decolorizing efficiency was valid for the start of a cycle, considerable differences (up to 40%) were found in the results obtained for the same resin some way through a cycle. In a modification of the method, 10 ml of a resin is brought into contact with 200 ml of colorant solution for 4 hours at room temperature; a model solution based on beet molasses is preferable to one of invert sugar alkaline degradation products (A) since it contains caramels and melanoidins as well as (A), and gives results close to true values as opposed to inflated results with (A) alone. Where (A) was used, storage for up to 90 days showed a fall in decolorizing efficiency which was within experimental error, so that the same model solution could be used for tests on a number of different resins. Details are also given of procedures for determining resin osmotic stability (an indicator of the degree of attrition) and anion and cation exchange capacities. Results are tabulated for various Soviet resins.

Determination of individual simple sugars in aqueous solution by near-infrared spectrophotometry

G. G. Dull and R. Giangiacomo. *J. Food Sci.*, 1984, **49**, (6), 1601 - 1603; through *Anal. Abs.*, 1985, **47**, Abs. 8F10.

Glucose, fructose and sucrose were determined in the concentration range 3 - 5.2% with use of a modified SpectroComputer (Neotec Co.), made up of a Cary monochromator, a lead sulphide detector and a Data General computer[2]. Absorption spectra of a 35% solution of the sugars were recorded in the wavelength range 1550 - 1850 nm. The 95% confidence limits for glucose, fructose and sucrose were ± 1.3%, ± 1.0% and ± 0.9%, respectively. Therefore a combination of instrument noise and sampling error results in a minimum detectable difference in sugar concentration of ± 2%.

1 See also Saito *et al.*: *I.S.J.*, 1985, **87**, 18A.

2 Rosenthal *et al.* : In "Quality detection in food" (A.S.A.E., St Joseph, MI, USA) 1976, p. 16.

By-products

Manufacture of fodder yeasts from beet molasses

N. I. Isaikina, G. I. Surovetskaya and L. V. Zhukova. *Sb. Tr. VNIIgidroliza Rastit. Materialov*, 1982, (32), 56 - 62; through *Ref. Zhurn. AN SSSR (Khim.)*, 1985, (13), Abs. 13 R408.

The technology of fodder yeast manufacture from beet molasses is examined. Sterilization of molasses takes place during its acid and heat treatment with subsequent settling. Process parameters are established for yeast growth on sterilized molasses as well as the nutrient salts consumption per kg active dry yeast. A trial was conducted under industrial conditions on yeast growth on molasses with recycling of 80% of the unfermented culture medium to the fermenter instead of water.

Use of molasses vinasse as diluent for cement slurry

I. A. Fridman *et al. Ferment. i Spirt. Prom.*, 1985, (1), 15 - 17; through *Ref. Zhurn. AN SSSR (Khim.)*, 1985, (13), Abs. 13 R424.

Comparison was made between the dilution efficiencies of (1) evaporated vinasse, (2) sulphite yeast wort, and (3) their combinations with regard to cement slurry. Results from a number of cement plants showed that up to 0.5% of (1), (2) and (3) reduced the slurry moisture content by 1.5 - 1.8, 2 - 2.2% and 2.2 - 2.5%, respectively, with corresponding reduction in fuel consumption in burning to a clinker. (1) and (3), in contrast to high-viscosity (2), did not cause any foaming of the slurry.

Studies on preparation of bagasse dissolving pulp

H. V. Huang. *Rpt. Taiwan Sugar Research Inst.*, 1984, (106), 23 - 29 (*Chinese*).

Laboratory simulation of the process used at Pingtung bagasse pulp factory was used in investigations of dissolving pulp manufacture for rayon. The pulp from the factory contained too little cellulose and too much pentosans for rayon manufacture, while further treatment by hot and cold alkaline extraction to remove non-cellulosic impurities gave a poor yield. Acid prehydrolysis of bagasse to remove pentosans prior to sulphate cooking which was followed by a CEHDA refining process gave a yield of up to 27.6%, up to approx. 96% α-cellulose, 3.5 - 5.0% pentosans, 0.25 - 0.34% ash and 90 - 91.5% whiteness. While this would be a suitable process for dissolving pulp manufacture, it would require extra equipment.

Beef cattle fattening integrated in sugar cane culture

T. C. Mendoza. *Crystallizer*, 1984/85, **7/8,** (6/1), 10 - 11.

The economics of raising beef cattle on cane farms are discussed, including the value of cane tops and molasses used as fodder. To overcome the problem of seasonality in regard to fodder availability, the author advocates ensiling cane tops, growing cane specifically for use as forage, or growing other forage crops such as Napier grass.

Feeding value of pressed beet pulp compared with other fodders

J. Haaksma. *Seker*, 1985, **31,** (117), 1 - 7 (*Turkish*).

The energy, protein and digestibility values of pressed pulp are compared with those of other fodders, and cattle feeding trials reported that have demonstrated the value of beet pulp. Results are given in table and graph form.

Coupled products in sugar manufacture

K. Herold and H. Pehslies. *Lebensmittelind.*, 1985, **32,** 161 - 163 (*German*).

By coupled products is meant waste materials that unavoidably accompany the main products in various process stages since the two types of product are from the same initial source. Examples cited are beet tails and pieces, pressed pulp and molasses. The economic effect of these waste products on the running costs of a sugar factory and hence on the manufacturing costs of sugar under East German conditions are discussed, and their economic value as useful by-products indicated.

Composition of molasses vinasse evaporated by boiler flue gases

Yu. M. Rabiner, V. P. Troino, A. A. Dudnik and T. N. Pukhovaya. *Ferment. i Spirt. Prom.*, 1985, (2), 6 - 7; through *Ref. Zhurn. AN SSSR (Khim.)*, 1985, (16), Abs. 16 R369.

Results are given of investigations on the composition of vinasses evaporated using boiler waste gases at distilleries. It was found that vinasse evaporated by direct contact with flue gas having a temperature of ≤ 300°C was comparable to normal vinasse in all parameters. The organic component in the vinasse did not decompose, so that no constituents precipitated out that, together with the discharged vapour-gas mixture, could harm the environment. The possibility is demonstrated of concentrating vinasse to a high degree with simultaneous fuel saving as a result of utilizing the waste heat.

Qualified pulp manufacturing from hemicellulose-extracted bagasse

W. F. Yee, L. H. Wang, M. C. Hsie and S. L. Sang. *Taiwan Sugar*, 1985, **32,** (3), 19 - 24.

See *I.S.J.*, 1985, **87,** 110A.

The structure of beet leaf silage clamps

Anon. *Die Zuckerrübe*, 1985, **34,** 208 - 209 (*German*).

Advice is given on construction of suitable clamps for beet leaf silage, with particular stress on the need to prevent contmination of water courses by the effluent.

Patents

US PATENTS

Thermal treatment of a carbonate suspension (filter cake)

V. L. Bildjukevich, B. K. Demidovich, D. T. Yakimovich *et al.*, of Minsk, USSR. **4,321,239**. September 4, 1980; March 23, 1982.

The suspension is divided into two portions and each is independently and simultaneously spray-dried (at 100 - 200°C). The dried material is calcined (at 550 - 1200°C) to yield lime and carbon dioxide; the lime is cooled, while the gas is supplied to the spray-drying zone for the first portion of fresh suspension. The second portion is spray-dried using heat from a separate gaseous source. The CO_2 content of the gas from the spray-dryer for the first portion is controlled by varying the relative amounts of the two portions.

Rare earth cation exchanged adsorbents for carbohydrate separation

B. J. Arena, of Des Plaines, IL, USA, *assr.* UOP Inc. **4,325,742**. February 5, 1981; April 20, 1982.

Fructose is separated from glucose and sucrose by selective adsorption on a crystalline aluminosilicate (type X or Y zeolite) which has undergone cation exchange with a lanthanide to provide a salt of a sulphonated or carboxylated polystyrene containing a cross-linking agent such as divinyl benzene in an amount comprising approx. 4% by weight of adsorbent. The aqueous sugars mixture is passed through the column at 20 - 200°C and a pressure in the range between atmospheric and 500 psig.

Production of ethanol from sugar cane

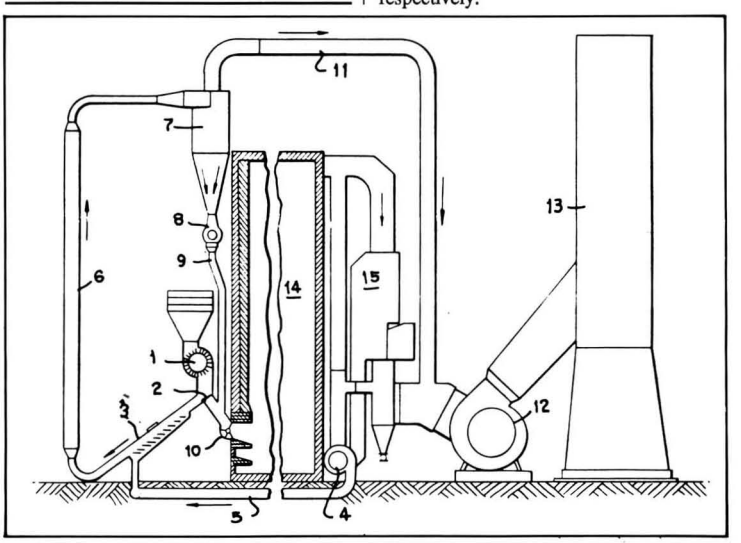
F. W. Hayes, of London, England. **4,326,036**. October 16, 1980; April 20, 1982.

In an integrated process, harvested cane is chopped and shredded and the fibre-juice mixture continuously hydrolysed in a first digester with a hemicellulose enzyme at ambient temperature, followed by separation of the fibrous residue by centrifuge and transfer of hydrolysate to a second digester for treatment with a mixed culture of a cellulase enzyme and ethanol-producing organism at a relatively high temperature (60 - 70°C). The hemicellulase and cellulase enzymes may be *Trichoderma viridi*, *Aspergillus wentii*, *Thielaviopsis paradoxa* or *Thielatia terrestris*, while suitable ethanol-producing organisms include *Saccharomyces cerevisiae*, *S. uvarum*, *Thermoactinomyces* sp., *Zymomonas stearothermophilus* and *Bacillus stearothermophilus*. The liquid fraction from the second digester is mixed with that from the first digester (after separation of any further fibrous matter) and the mixture then subjected to three-stage continuous fermentation, in which Stage 1 takes place under mildly aerobic conditions, Stage 2 is anaerobic, and optimum alcohol production takes place in Stage 3. The ethanol may be recovered by membrane separation and the fermentation residue recycled for further fermentation. The fibrous matter may be pressed to about 50% moisture content and used as fuel for the process.

Bagasse dryer

L. E. C. Maranhao, of Maceió, Alagoas, Brazil. **4,326,470**. July 18, 1980; April 27, 1982.

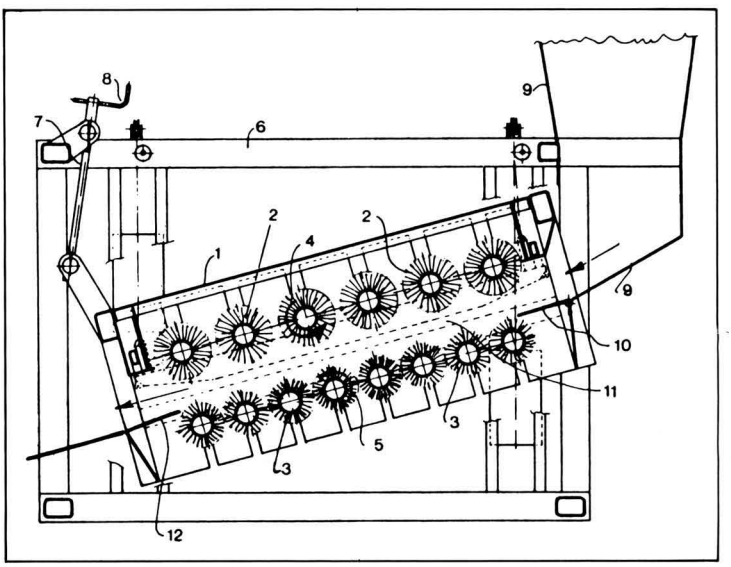
A unit that uses boiler flue gas as bagasse drying medium comprises a bagasse feeder 1 and a baffle plate 2 which causes the bagasse to pass through a channel 3 where it is mixed with the hot gases; fan 4 sucks the gases from the furnace exhaust in advance of pre-heater 15 of the boiler, after which they flow along tube 5 into channel 3. The bagasse-gas mixture is pushed to the base of column 6 whence it is transferred to separator 7; the bagasse then passes via rotary feeder 8 to tube 9 down which it flows to spreader-stokers 10 and is thrown by them into the furnace. Tube 11 connects the gas outlet of separator 7 to the impeller 12 of the boiler, so that while it pushes the gases to chimney 13 it also helps to draw the bagasse to separator 7 by the draught created in tube 6. Tests at an average bagasse throughput of 45 tonnes/hr with flue gas at 220°C have shown a 10-unit reduction in bagasse moisture, e.g. from 50 to 40%, but a 15-unit reduction was obtained where the gases, at 300°C, were obtained before the air heater; a fall in moisture content to 40% and 35% increased steam production per kg of bagasse by 15.35% and 20%, respectively.



Beet dry cleaner

R. F. Madsen and W. K. Nielsen, of Nakskov, Denmark, *assrs.* A/S De Danske Sukkerfabrikker. **4,326,892**. December 11, 1979; April 27, 1982.

The dryer, which precedes the beet slicer, comprises an inclined housing 1 containing an upper and a lower row of rotary cylindrical brushes 2 and 3 mounted so that the tips of the brushes are in contact. (Arrows 4 and 5 indicate the direction of rotation.) The slope of housing 1 is adjustable by raising or lowering its lower end by handwheel 8 and mechanism 7. Washed beets are introduced into feed funnel 9 and are guided by plate 10 into space 11 between the rows of brushes which move them towards the lower end of housing 1 and simultaneously brush them to remove all or some of their surface layers. The separated material is carried out of space 11 by brushes 3 and is deposited on the floor of the unit.



Sugar fatty acid ester purification

T. Masuda, M. Honjo, T. Takase and Y. Watanabe, of Nagoya, Japan, *assrs.* Mitsui Toatsu Chemicals Inc. **4,327,183**. April 3, 1979; April 27, 1982.

A 1 - 90% (5 - 70%) (10 - 50%) aqueous solution of a crude fatty acid ester of a sugar, particularly sucrose, is purified by decomposing the fatty acid glycerides in it during 1 - 100 hours (3 - 70 hr) (5 - 50 hr) with 0.0001 - 20% (0.0005 - 10%) (0.001 - 5%) by weight of a lipase (lipid-splitting enzyme) or during 1/2 - 50 hours (1 - 40 hr) (3 - 30 hr) with a combination of a lipase and 0.00001 - 0.005% (0.000005 - 0.1%) (0.000001 - 0.2%) of a reducing agent such as sodium dithionite, vitamin-C, glutathione, 2-mercapto-ethanol, sodium sulphite, sodium thiosulphite, hydroquinone, etc.

Increasing sugar extraction efficiency

A. H. Freytag and R. D. Cooke, of Colorado, USA, *assrs.* Great Western Sugar Co. **4,328,043**. October 14, 1980; May 4, 1982.

Carbon dioxide at 0.5 (1) (1.25) lb/short ton of beet cossettes, cane or sorghum is added to diffusion water at pH 5.0 - 6.5 (5.2 - 6.0) near the juice end (or as gas is bubbled through the water), whereby the juice purity is raised and moisture content of the exhausted cossettes reduced (thus benefiting pulp pressing).

Decationization of aqueous sugar solutions

G. Rousseau and C. Lamotte, of France, *assrs.* Rohm and Haas Company. **4,329,183**. May 30, 1980; May 11, 1982.

Conventional deionization of sugar solutions using cation exchange resin in H^+ form involves cooling the solution to approx. 10°C so as to minimize inversion at low pH with the result that the viscosity increases significantly unless the solution is diluted. However, in the process described, a solution of up to 88°Bx is treated with a strongly acidic cation exchange resin in H^+ form at 20 - 40°C (25 - 30°C) for approx. 20 minutes or with a mixture of a weakly acidic cation exchange resin in H^+ form and a weakly basic anion exchange resin in OH^- form at 20 - 90°C (40 - 90°C) (50 - 65°C) for 60 - 90 minutes; the volumetric ratio of cation exchange resin to anion exchange resin is 1:1 - 1:5. Air passed through the resin bed causes agitation between the solution and the particles.

Continuous centrifugal

H. Schaper, of Brunswick, Germany, *assr.* Braunschweigische Maschinenbauanstalt. **4,331,482**. August 27, 1980; May 25, 1982.

Massecuite enters the basket 2 of continuous centrifugal 1 via a feeding device 13 which is provided with at least an accelerating cup as well as an accelerating and distributing bell 15 in the form of a truncated cone extending, with bottom edge 16, inside the lower basket zone 10. Bell 15 or its bottom edge 16 (or an equivalent structural component) moves in the direction of double arrow 17 so that it can adopt various positions at different vertical levels. When it is in a lower position relative to the accelerating cup and to basket zone 10, the massecuite must travel over a relatively great distance on screen 12 of the lower basket zone

before reaching the upper basket zone 11. The level of the bell is so adjusted that the green syrup, which must be retained by the massecuite so as to maintain flowability into the upper basket zone, may flow through the lower row of holes 5 in zone 11 into collecting compartment 7. By suitable adjustment of bell 15 it is possible to ensure that very large quantities of green syrup are separated in lower zone 10 to such an extent that only remainders flow through the lower discharge openings 5 in zone 11. Thus, regardless of the feed massecuite liquid content, a massecuite of constant solid:liquid ratio is supplied to upper zone 11, ensuring optimum throughput and separating efficiency.

Ion exchange purification of sugar beet juice

B. Mirabel and C. Rollin, of France, *assrs.* Rhone-Poulenc Industries. **4,331,483.** November 18, 1980; May 25, 1982.

Organic nitrogenous impurities are removed from (prelimed and) filtered beet juice by treatment, at a temperature no greater than 85°C, with at least two ion exchangers in series having an exchange capacity less than 2 meq/g. No more than 800 g/litre of each resin is used, and one of the resins contains quaternary ammonium salt groups while at least one of the others contains sulphonic groups.

Continuous centrifugal

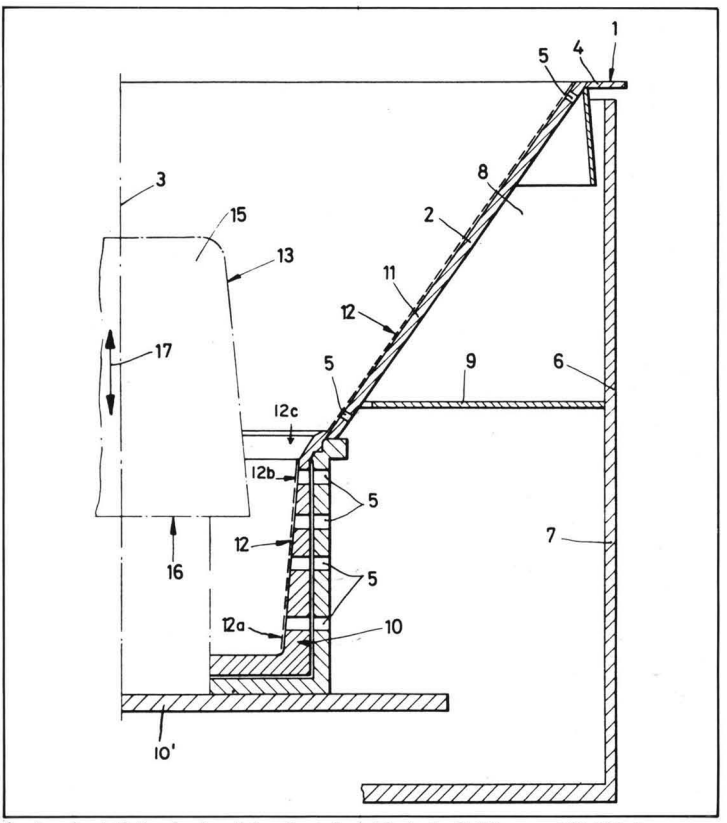
H. Kurland, H. Schaper and J. Schueller, *assrs.* Braunschweigische Maschinenbauanstalt. **4,332,621.** November 13, 1980; June 1, 1982.

See UK Patent Application 2,104,793[1].

Cane juice purification

O. G. Hohnerlein, W. E. Smith and N. T. Rimedio, *assrs.* Savannah Foods & Industries Inc. of Savannah, GA, USA. **4,332,622.** August 25, 1980; June 1, 1982.

Raw cane juice is adjusted, with e.g. phosphoric or sulphuric acid, to a pH lower than its naturally occuring pH (e.g. 2 - 5 or less) (2.5 or less) and then heated at 40 - 95°C (60 - 80°C) for a period of time (1 - 20 hr) (2 - 4 hr) sufficient to convert a desired amount (at least 95%) of sucrose to glucose and fructose. The pH is then brought to about 5.2 (4.5 - 5.4) (4.8 - 5.2) with e.g. lime, NH_4OH or NaOH or mixtures of these to form a floc, which is separated (by settling or centrifuging) and the juice then passed through a filter aid (kieselghur) to give a clear solution; this is demineralized and decolorized with cation exchange resin followed by bone char treatment, the effluent from which is treated with cation and anion exchange resin. The juice is then concentrated to at least 65°Bx (70°Bx) to give a clear, colourless and odourless syrup.



Sugars separation

M. Ando, T. Hirota and K. Shioda, *assrs.* Mitsubishi Chemical Industries Ltd. **4,332,623.** November 1, 1979; June 1, 1982.

For sucrose recovery from molasses or fructose separation from glucose by batch-wise treatment with a packed bed of cation exchange resin, the bed has fluid passes at the front and rear so as to allow circulation of the liquid while a fluid rich in fructose, glucose or sucrose is withdrawn. Feeding and withdrawal of the fluids are then stopped, and the mixture already in the column is moved down the bed, after a desorbent (water) is fed into the column simultaneously with withdrawal of a component-rich liquid from at least two points in the bed. The

1 *I.S.J.*, 1986, **88**, 22A.

adsorption unit may be in the form of three packed sections in series, the front end of the first section commencing with the rear end of the third section and an inlet port being provided for feed mixture between the rear end of the second section and the front end of the third section and for desorbent between the rear end of the third section and the front end of the second section. Similarly, withdrawal ports are provided at suitable points.

Sugars separation

(A) S. Kulprathipanja and H. S. Bloch, *assrs.* UOP Inc. **4,333,768**. December 18, 1980; June 8, 1982. (B) S. Kulprathipanja and R. W. Neuzil, *assrs.* UOP Inc. **4,333,769**. December 18, 1980; June 8, 1982.

(A) Sugars may be separated by passage through a column containing a crystalline aluminosilicate and a cellulose ether binder. As an example, a feed containing 5% by weight each of glucose, fructose and sucrose was treated in this manner to give results comparable to those given by other organically or inorganically bound adsorbents. The binder prevents the silicon in the adsorbent being dissolved in the water used for desorption.
(B) Silicon dissolution is prevented by coating the adsorbent with ethyl cellulose.

Sucrose recovery from molasses

R. W. Neuzil and R. L. Fergin, *assrs.* UOP Inc. **4,333,770**. September 8, 1980; June 8, 1982.

Sugar is recovered from beet or cane molasses (containing approx. 50% sucrose plus other sugars) by bringing the molasses into contact at 20 - 200°C and a pressure in the range from atmospheric to 500 psig with an adsorbent comprising a carbonaceous pyropolymer containing at least carbon and hydrogen atoms; the adsorbent may be in the form of a compact fixed bed, although a continuously moving countercurrent system has a much greater separation efficiency. The sugar is desorbed with aqueous 10 - 50% methanol solution at the same temperature and pressure as used for adsorption. Use of the system to separate fructose, glucose and sucrose in a mixture has also been demonstrated.

Ethanol and HFS manufacture

R. E. Heady, of Park Forest, IL, USA, *assr.* CPC International Inc. **4,335,207**. June 3, 1980; June 15, 1982.

In a two-stage process, a sucrose-containing substitute is brought into contact with fructose transferase (prepared from *Pullularia pullulans*) or a mixture of this enzyme and a glucose isomerase to produce a secondary substrate which is then fermented at 24 - 32°C and pH 5 - 5.5 with a yeast preparation such as *Saccharomyces bailii* or *S. cerevisiae* (that does not hydrolyse sucrose or fructose polymers or ferment fructose polymers) so as to convert the glucose to ethanol. The fructose polymers, which need not be separated from the glucose that is formed simultaneously, may be hydrolysed to yield HFS containing more than 80% fructose.

Saccharification of starch hydrolysates

B. E. Norman, of Farum, Denmark, *assr.* Novo Industri A/S. **4,335,208**. March 11, 1980; June 15, 1982.

Starch hydrolysates [of 8 - 12 DE and 20 - 50% (greater than 30%) dry solids by weight] are saccharified with a glucoamylase-isoamylase combination at pH below 5 (3 - 5) and at 50 - 60°C for 24 - 96 hours to yield a glucose syrup of high DE.

Alcohol manufacture without vinasse

A de Sá and J. M. Luksenberg, of Rio de Janeiro, Brazil, *assrs.* Versa Consultoria Técnica Ltda. **4,337,123**. August 29, 1980; June 29, 1982.

After fermentation of cane juice or molasses, the mash is treated by a number of processes: addition of chemical nutrients and oxygen in an amount sufficient to cause biological digestion of impurities; addition of flocculant; treatment with alkaline material in an amount sufficient for reaction with soluble impurities not eliminated by the the first two processes; decanting of solids with removal and filtration of mud and return of the liquid to process; precipitation of substances by addition of alcohol, with subsquent separation of salts; and addition of acid to precipitate insoluble salts. There is no vinasse as a result of these steps, and the alcohol is recovered as normally by distillation.

Crystal glucose manufacture

M. J. Daniels, of Reading, England, *assr.* Tate & Lyle Ltd. **4,342,603**. February 24, 1981; August 3, 1982.

A product comprising a mixture of α- and β- forms of glucose as microcrystals [at least 70% (at least 85%) of it in the form of the β-isomer], which readily dissolves in water to give solutions of approx. 60% solids content at ambient temperature, is obtained by evaporating syrup at a pressure below 400 mm Hg (100 - 150 mm Hg) (125 mm Hg). The concentrated solution is at least 60% (75 - 90%) supersaturated and contains more than 95% (98 - 99%) solids at 95 - 140°C. The solution is subjected almost instantaneously to a shear force (for less than 0.5 sec) to cause immediate nucleation of the syrup without cooling. The nucleated but essentially uncrystallized syrup is formed into a quiescent layer which is allowed to crystallize under isothermal conditions.

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The following considerations had to be taken into account and, in a sense, dictated our choice:

(1) *Steam consumption*

Steam turbines driving mills are usually single-stage, high water-rate machines. It is much more economical, as far as steam is concerned, to generate power from an efficient multi-stage turbo-alternator, rather than from individual low-power mill turbines. This consideration was of prime importance to us as we contemplated using in the future our single existing 70 tonnes/hr boiler at the maximum cane throughput. A recently published Master Plan for the Mauritian Sugar Industry also emphasizes the necessity of economizing on bagasse in order to provide an excess to be used for power generation. This imperative also dictated the use of steam-efficient drives and greatly influenced our choice.

(2) *Mechanical efficiency*

We have not worked out the overall mechanical efficiency from steam to tail-bar for our hydraulic drives; however, the efficiency from the pump motors to the tail-bar is 82.7% since two 260 kW motors deliver 430 kW to the mill.

We do not want to compare this figure with that of electric or steam turbine drives, as these can vary widely according to the equipment used, but the big advantage in favour of hydraulic drives is the absence of reduction gears which adversely affect efficiency. Absence of such gears also implies reduced overall equipment cost, as gears for other types of drive make up a high proportion of total cost (60% in the case of steam turbines).

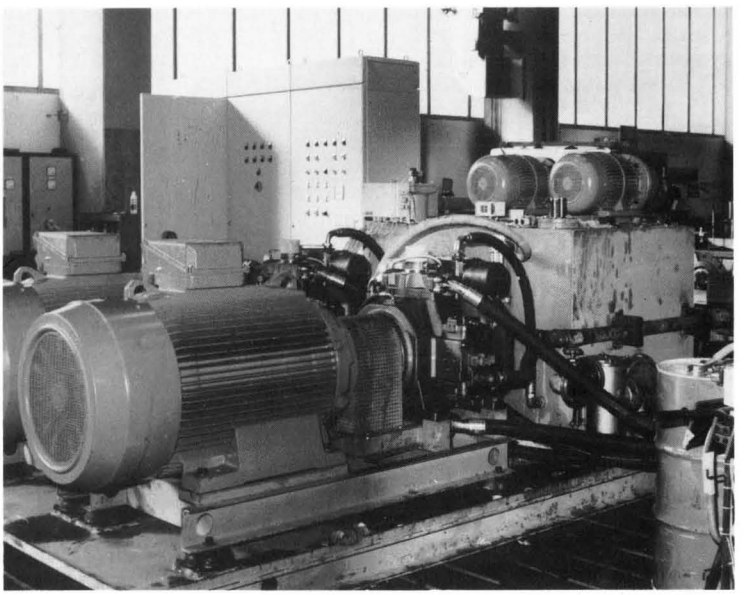


Fig. 3. Power pack on its base plate showing the two 260 kW electric motors, the two hydraulic pumps, the oil tank and, on top, two auxiliary oil pumps, one of which is used for inching around the mill in the off-season

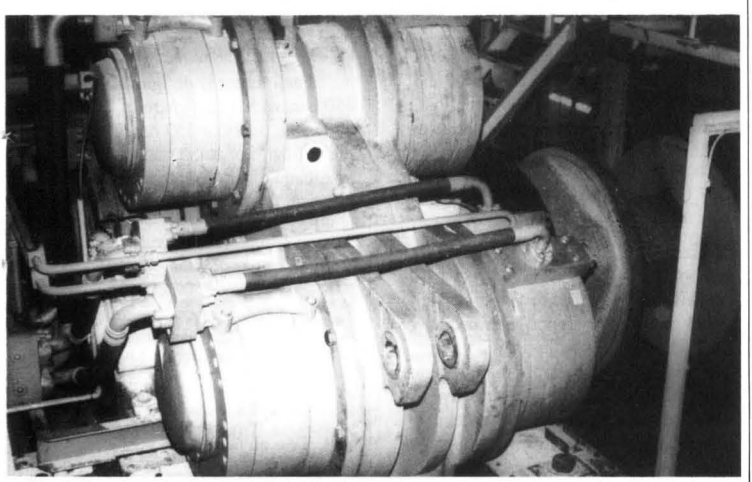


Fig. 4. Gear box showing four of the six Hydrex motors mounted on the casing. To the right may be seen the coupling boxes and tail bar

(3) *Flexibility*

The third consideration that was taken into account was the great flexibility of hydraulic drives, the speed and direction of which can be changed at will over the entire range of possible speeds. This is not possible with either steam turbines or electric motors which have a limited range of speed control and, for electric motors at least, are quite expensive. This feature was most important in our case where we would probably have to increase the capacity of the factory in several stages.

(4) *Possibility of increasing capacity*

We have just mentioned up-rating the mill capacity. Of course, any kind of drive can be designed and sized with this possibility in mind – but with

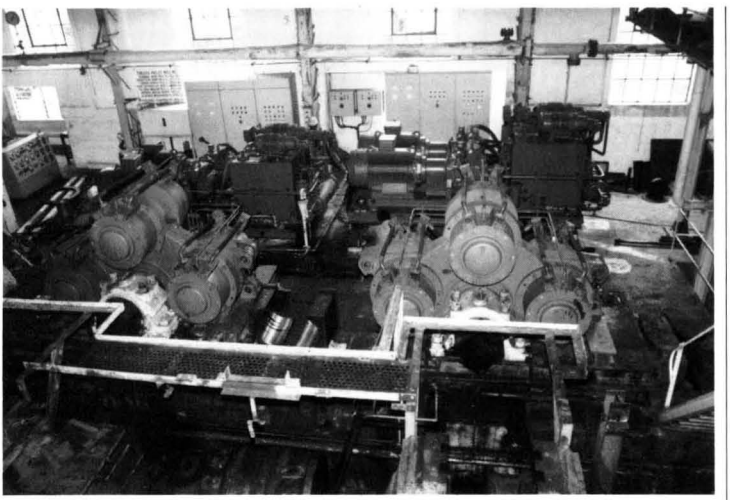


Fig. 5. The two drives assembled with square ended shafts ready for coupling to the cane mills; the power pack and electrical control cubicle are at the rear

the price tag attached. This is not quite the case for hydraulic drives which, being made up of modules, are much easier to up-rate. In addition, each of our six motors per mill has a nominal torque of 356,500 Nm and a maximum of 1114 Nm/bar, which gives the system the possibility of wide power variation, since peak pressure can go up to 320 bar and, in practice, at 15 tonnes of fibre/hr, oil pressure for the first mill is at 90 bar.

(5) *Reliability and maintenance*

We are not in a position, at this stage, to talk about reliability and maintenance; it would be premature to express an opinion on this matter, but experience gathered with hydraulic pumps and motors up to now speaks in their favour and can allow us to hope for high reliability and low maintenance, provided essential precautions are taken. Moreover, the new design and construction of Flender's Hydrex motor makes it possible for the first time to have hydraulic motors with a life span equal to that of the driven gears and is claimed by the suppliers to be 80,000 hours.

(6) *Simplicity of installation*

It is worth mentioning the simplicity of foundations, erecting and dismantling the hydraulic drives set-up. The power pack, i.e. the oil pumping system, is all on a single base-plate, may be lifted and handled as a single unit, and requires very light foundations. The final gear box, however, requires a base plate fitted with a pair of bearings well seated on heavy foundations, although the gear box itself, with its motors, is lifted as a single unit and put in place in a few minutes. Connecting hydraulic hoses is far simpler than aligning couplings and shafts. It is also worth mentioning that hydraulic motors may be mounted in any position.

(7) *Adaptability*

Although Union St.-Aubin ordered complete drives, from electric starters to tail-bars, one could very easily conceive of oil pumps driven by existing steam turbines, or a good intermediate or final wheel driven by hydraulic motors. The possibility of several pinions driving a single wheel is especially attractive as it would allow a much smaller wheel to transmit much more power, although more wear on the wheel is to be expected.

(8) *Space consideration*

The final gear box is small when compared with that of a conventional reduction train and this can be an advantage when lack of space is a problem. The power packs can be placed anywhere, although it is desirable to have them as near as possible to the gear box to keep pressure hoses short, and minimize pressure drop therein.

To end, may we give a brief description of the whole equipment:

Each mill has one power pack made up of two 260 kW squirrel-cage electric motors direct-coupled to positive-displacement variable-output hydraulic pumps, one oil tank, one oil cooler and two circulating pumps, one of which can also be used for inching the mill around at 0.3 rpm. The hydraulic pumps, which can work alone or in parallel, are connected to a manifold feeding six radial piston Hydrex hydraulic motors mounted in pairs, one facing the other and separated and interconnected by a pinion. The motors are flange-mounted on the gear box which is itself mounted on the final shaft and prevented from rotating by a torque arm fixed to the base plate supporting bearings and gear box.

The hydraulic drive is a constant torque system. The speed of the mill is changed by varying the oil output of the hydraulic pump and variation in power is automatically adjusted by a change in oil pressure.

Each motor is designed to operate at 150 bar, with a maximum of 250 bar and allowable peaks of 350 bar. The speed at the tail-bar, i.e. at the output shaft of the box, can be varied from 0 to 5.8 r.p.m. In practice, the oil pressure for the 1st mill is 90 bar.

Morocco sugar production, 1985[1]

In spite of a 10% increase in the beet area and an increase of nearly 14% in the cane area, 1985 yields were much lower than in 1984 and the crops lower than that year. Total sugar production fell from 393,602 tonnes, white value, to 347,487 tonnes in 1985. Consumption continued to grow, however, and the level of imports had to be increased. With better weather conditions in 1986 so that the factories can work at full capacity there should be a significant increase in the degree of self-sufficiency.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 151.

Study of humic acid in cane juice

By Varmeshwar Dubey* and Mahendra Prasad
(National Sugar Institute, Kanpur, India 208017)

Introduction

Considerable ambiguity exists about the nature and mechanism of formation of colorants in juice at various stages of processing. It has been reported that melanoidin, caramel and iron-polyphenol complexes are the compounds mainly responsible for darkening of juice. The knowledge accumulated so far relating to the structure and mechanism of formation of colorants is mostly confined to caramel[1-4], melanoidin[5,6] and phenolic complexes[7]. Adequate literature on the nature of colorants other than these three is not available. A literature survey, however, reveals that, in addition to these colorants, humic substances may also contribute to the colour of juice and the final sugar crystal. With this in mind, it was decided to investigate the colorant present in clarified (sulphitation) cane juice other than caramel, melanoidin and iron-polyphenols. The results of the investigation are reported in this paper.

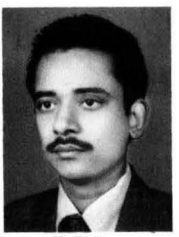
Experimental

Isolation of colorant from clarified juice

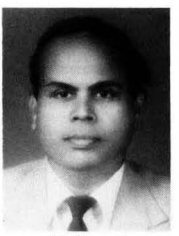
Raw cane juice was clarified by a sulphitation technique in the laboratory. The colorant present in the clarified juice was adsorbed on a column of activated carbon and eluted with an azeotropic mixture of pyridine and water. The eluant was dried in a vacuum oven at below 60°C, and the ether-soluble fraction used for further study.

Absorption and I.R. studies

The absorbance of aqueous colorant in the entire visible and u.v. region was recorded on a Beckman Model DU spectrophotometer. The absorption spectra of the colorant were also recorded in acidic and alkaline media. The infra-red absorbance of the solid colorant was recorded using a Perkin-Elmer Model 377 IR spectrophotometer employing KBr pellets. To observe the variation in absorbance due to H^+ and OH^- ions, the absorbance of the colorant solution at 256 nm was observed after adjustment of the pH to different levels between 0.5 and 12. The concentration of colorant was kept constant at 10 ppm in each case.



V. Dubey



M. Prasad

Molecular weight determination

The molecular weight of the colorant was determined by two standard processes, i.e. osmometry and viscometry. In osmometry, the principle that the osmotic pressure of a solution is proportional to its concentration at a constant temperature and is related to the molecular weight of solute by a simple equation (1) was applied.

$$M = CRT/P \qquad (1)$$

where C, T, P are the concentration, absolute temperature, and osmotic pressure of the solution, respectively, M is the molecular weight of solute and R is the gas constant. Colorant solutions of different concentration ranging from 1 to 5% were prepared in distilled water. The osmotic pressure of each solution was determined by Pfeffer's method utilizing a manometer and a porous pot with a copper ferrocyanide membrane deposited on its wall.

The molecular weight of a substance is related to the intrinsic viscosity of its solution by a mathematical expression

$$\log(\eta) = \log K + \alpha \log M \qquad (2)$$

where K and α are constants, (η) is the intrinsic viscosity and M is the molecular weight of the solute.

Very dilute solutions of colorant in acetone, of known concentrations in the region of 10^{-3}g/litre, were prepared. The densities and time of flow of solutions were measured by pycnometer and Ostwald's viscometer respectively. Viscosities and specific viscosities of each solution were calculated from equations (3) and (4) respectively.

$$\eta_c = t_c\eta_o/t_o \qquad (3)$$

$$\eta_{sp} = (\eta_c - \eta_o)/\eta_o \qquad (4)$$

where η_o and η_c are viscosities of pure and colorant-containing acetone, respectively, t_o and t_c are the flow times of acetone and solution, respectively, and η_{sp} is the specific viscosity.

Influence of decolorizing agents

In order to observe the action of some prominent decolorizing agents, 10 ml aliquots of colorant solution of known absorbance were treated separately, with 0.01ml each of H_2O_2 (3%), ortho-phosphoric acid (0.1M), acetic acid (0.1M) and formic acid (0.1M). The effect of solid decolorizers, viz. sodium bisulphite, sodium borohydride and lead nitrate, was also observed by treating 10 ml amounts of solution with 0.1 g of these compounds. The absorbance of each test solution was observed at 420 nm after treatment.

The effect of nascent hydrogen on the absorbance of the colorant solution was also observed. The nascent hydrogen was produced in the colorant solution by the action of sulphuric acid on zinc.

Influence of colorant on the sulphitation reaction

The effect of the colorant on the ionization constant of sulphurous acid was studied in order to see how it would influence the sulphitation reaction. Sulphurous acid was prepared by dissolving SO_2 gas in distilled water. A pH - metric titration of sulphurous acid with $Ca(OH)_2$ solution in the absence and presence of 100, 200, 300 and 400 ppm of colorant was performed at room temperature. The ionization constant was determined by a half-equivalence method.

* Present address: U.P. Council of Sugarcane Research, Shahjahanpur, India 242001.

1 Ramaiah & Nemade: *Proc. 13th Congr. ISSCT*, 1968, 386.
2 Weichen: *Proc. 14th Congr. ISSCT*, 1971, 1564.
3 Ramaiah *et al.*: *Proc. Sugar Tech. Assoc. India*, 1956, **24**, 69.
4 Agarwal & Misra: *I.S.J.*, 1974, **76**, 88.
5 Agarwal *et al.*: *Proc. Sugar Tech. Assoc. India*, 1972, **36**, 38.
6 Agarwal & Johary: *Sharkara*, 1974, **13**, (3), 89 - 95.
7 Gross & Coombs: *I.S.J.*, 1976, **78**, 69 - 73.

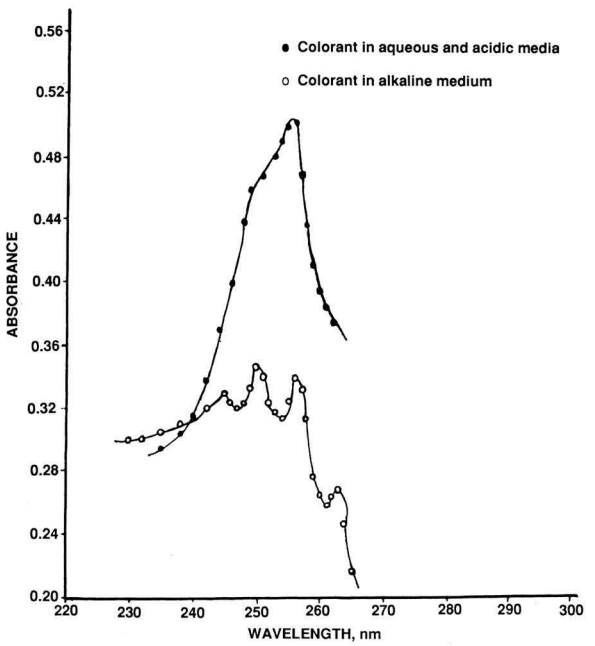


Fig. 1 Absorption spectra of colorant

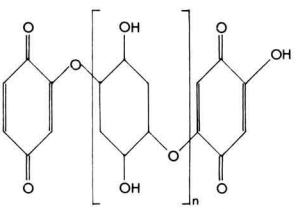
Results and discussion

Spectrophotometric properties

In Fig. 1 the absorption spectra of the colorant show sharp absorption maxima at 256 nm in aqueous and acidic solutions and at 245, 250, 256 and 264 nm in alkaline solution. These values differ distinctly from the absorption maxima of caramel and melanoidin which are reported to be at 280 and 298 nm, respectively. On the other hand, the above λ_{max} of colorant is analogous to the λ_{max} of humic acid[2,8].

In the I. R. spectra of the colorant, Fig. 2, a broad peak at 3330 cm^{-1} indicates the presence of OH- groups. Two peaks at 1590 and 1510 cm^{-1} show the presence of aromatic rings in the colorant. The presence of asymmetric and symmetric C-O-C groups is characterized by the peaks at 1250 cm^{-1} and 1040 cm^{-1} respectively. The occurrence of a peak at 1610 cm^{-1} confirmed the presence of a quinol group in the colorant. Some other peaks at 850 and 790 cm^{-1} show out-of-plane C-H bending.

The above spectrophotometric studies rule out any possible contribution of caramel and melanoidin to this colorant. On the other hand, the IR spectra also revealed the colorant to be humic acid having phenolic and quinonic groups. The structure of humic acid is illustrated below.



The identification of the colorant as humic acid is also supported by the

8 Mendoz & Stevenson: *Soil Sci.*, 1968, **102**, 95.

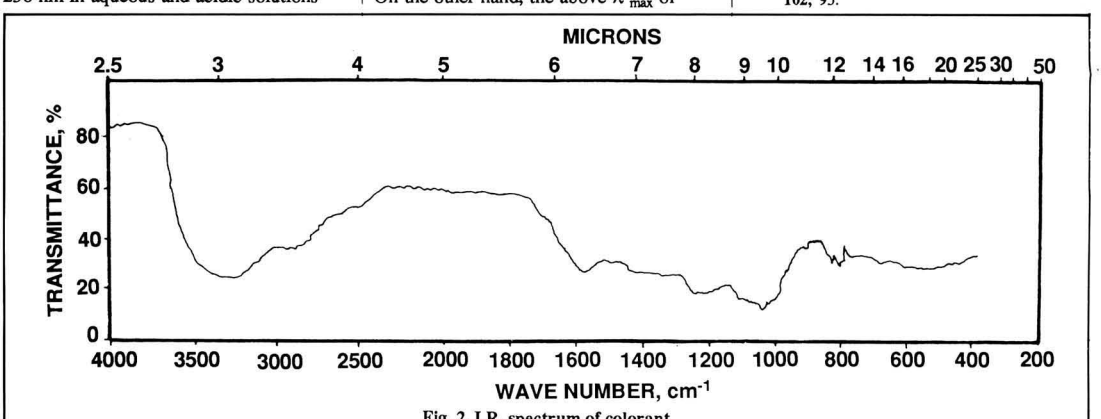


Fig. 2. I.R. spectrum of colorant

absorbance at 256 nm of its solutions at varying pH (Fig. 3). In acidic medium the absorbance of the colorant remains

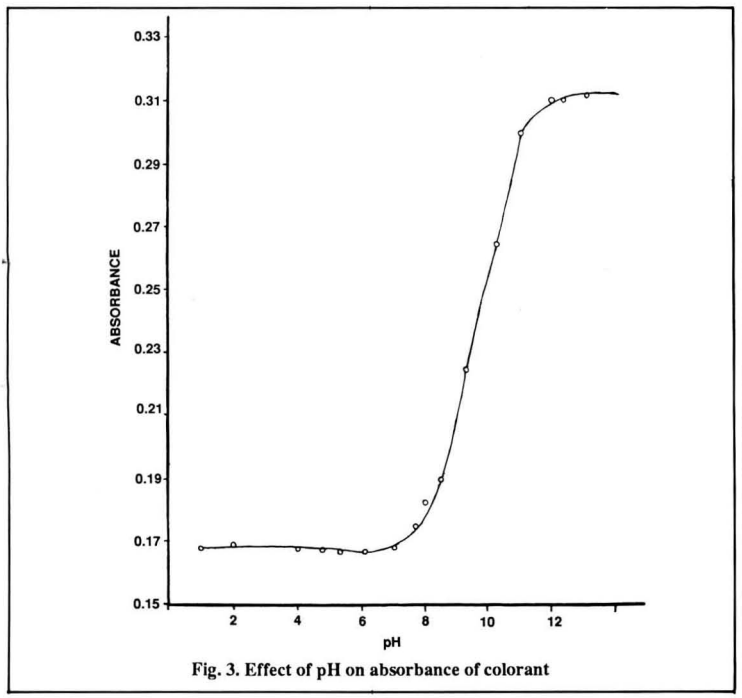


Fig. 3. Effect of pH on absorbance of colorant

almost constant at 0.17 but it increases abruptly to 0.31 in alkaline medium. On the basis of the above structure it is suggested that in acidic medium the quinone was changed to hydroquinone which has a benzenoid structure. On the other hand, in alkaline medium the hydroquinone of humic acid is changed to a quinonoid structure, as is common to all hydrophenols. This structural change of humic acid is illustrated in Fig. 4. In this figure structure (I) refers to the original structure of humic acid; in acidic medium structures (I) and (II) both exist in resonating form giving a lower absorbance value. In alkaline medium humic acid exists in solution as structure (III) giving higher absorbance.

In general, compounds having a benzenoid structure are colourless whereas in the quinonoid form they show colour. Thus it may be suggested that in an acidic medium the concentration of benzenoid structure (II) of the humic acid colorant increases whereby its absorbance value is lower. In alkaline medium the reverse occurs, i.e. the benzenoid structure changes to quinonoid structure (III), whereupon the absorbance value of the colorant increases abruptly.

Physico-chemical properties

The results of molecular weight determination also support identification of the colorant as humic acid. The osmotic pressure of solutions of the colorant at different concentrations is given in Table I. A plot of concentration versus π/C, where π is osmotic pressure and C is the concentration of colorant, was drawn as shown in Fig. 5. The average straight line drawn from these points has a negative slope of 0.008, which shows that the osmotic pressure does not rise proportionately as the concentration of humic acid increases. On increasing the concentration of colorant in solution, some of its molecules have polymerized, resulting in a decreasing number of molecules. Extrapolation of the trend line to zero concentration gives the value of π/C which is equal to RT/M. By substituting the values of R and T the molecular weight of the colorant is found to be 2.50×10^5.

The values of viscosity, specific viscosity (η_{sp}) and η_{sp}/c of colorant solutions of different concentrations are shown in Table II. For determination of intrinsic viscosity $(\eta_{sp}/c)_{c \to 0}$, a curve was plotted between concentration of colorant and η_{sp}/c as shown in Fig. 6. The straight line passing through these points shows a positive slope of 1.10

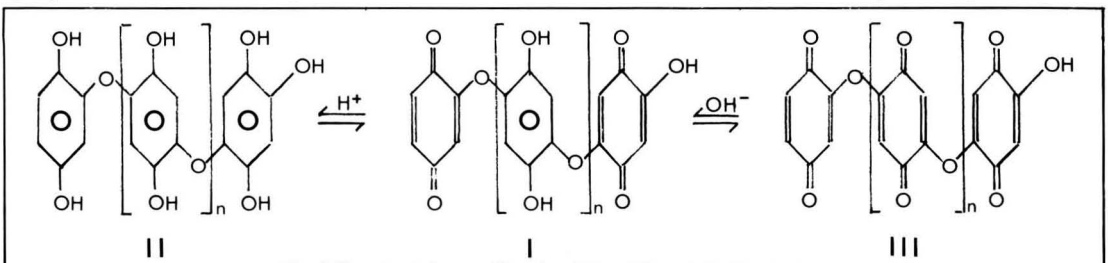


Fig. 4. Structural change of humic acid in acidic and alkaline medium

Table I. Osmotic pressure of colorant solution

Concentration (C) g/litre	Osmotic Pressure mm Hg	atm, π	π/C
10	0.77	1.01×10^{-3}	1.01×10^{-4}
20	1.50	1.97×10^{-3}	0.98×10^{-4}
30	2.50	3.26×10^{-3}	1.08×10^{-4}
40	3.01	3.96×10^{-3}	0.99×10^{-4}
50	3.71	4.88×10^{-3}	0.97×10^{-4}

Table II. Viscosity, specific viscosity and η_{sp}/C of colorant solution

Concentration (C), g/litre	Viscosity, η	Specific viscosity, η_{sp}	η_{sp}/C
0.00×10^{-5}	0.325	-	-
0.25×10^{-5}	0.328	0.009	3.6
0.50×10^{-5}	0.332	0.021	4.2
0.75×10^{-5}	0.335	0.031	4.1
1.00×10^{-5}	0.340	0.046	4.6
1.25×10^{-5}	0.344	0.058	4.6

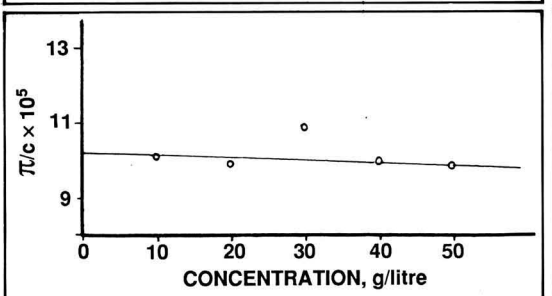


Fig. 5. Variation of osmotic pressure with concentration

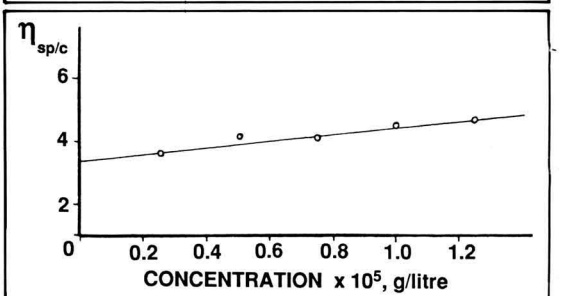


Fig. 6. Variation of specific viscosity with concentration

which is not consistent with the Chen & Schnitzer[9] plot for humic acid. Extrapolation of this line to zero concentration gives the value of intrinsic viscosity (η) of 3.30. The molecular weight calculated from this value of intrinsic viscosity is 1.95×10^5. This value of molecular weight confirms the colorant to be humic acid, which is highly polymeric in nature.

Data regarding the influence of some decolorizing agents on absorbance of colorant solution are given in Table III. Addition of lead nitrate to the colorant solution produced a precipitate which settled to give a supernatant liquid which was virtually colourless but showed absorbance of 0.18 at 420 nm. This was the maximum decolorization (75%) achieved by the various agents. This observation was consistent with identification of the colorant as humic acid because the latter forms an insoluble lead salt[10].

A marked decolorization (68%) was given by nascent hydrogen which, being a powerful reducing agent, is able to reduce the quinonoid structure of humic acid to a semiquinone radical. The semiquinone radical may be further reduced to diamagnetic phenolate. The existence of these two reducing products in humic acid has been also reported by Tollin *et al.*[11]. They possess a benzenoid structure as a result of which the absorbance value of humic acid is decreased. The reduction of humic acid by nascent hydrogen is illustrated in Fig. 7. The structure (I) refers to the humic acid having quinonoid features which reduces to the semiquinone radical (II) and diamagnetic phenolate (III). The structures (II) and (III) represent the colourless form.

The other reagents tested, viz. H_2O_2, H_3PO_4, HCOOH, CH_3COOH and $Na_2S_2O_5$, decreased the absorbance value of the colorant solution from 0.74 to 0.54, 0.46, 0.56, 0.52 and 0.24, respectively.

Table III. Effect of decolorizing agents on absorbance of colorant

Reagent used	Initial absorbance	Absorbance after treatment	Decolorization, %
H_2O_2	0.74	0.54	27.0
H_3PO_4	"	0.46	37.8
HCOOH	"	0.50	32.4
CH_3COOH	"	0.52	29.7
$NaBH_4$	"	0.59	20.3
$Na_2S_2O_5$	"	0.24	67.5
$Pb(NO_3)_2$	"	0.18	75.6
H_2 (gas)	"	0.74	0.0
H^+	"	0.41	44.6
H_2 (nascent)	"	0.24	67.5

9 *Soil Sci. Soc. Amer. J.*, 1976, **40**, 866.
10 Trimescu *et al.*: *Jena Rev.*, 1970, **15**, (2), 140.
11 *Biochim. Biophys. Acta*, 1963, **66**, 444.

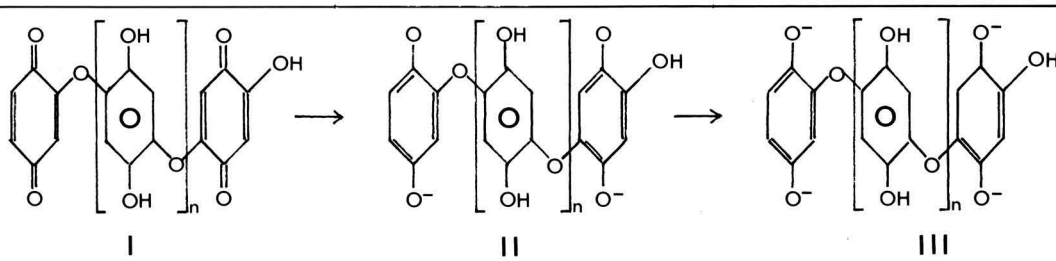


Fig. 7. Reduction of humic acid with nascent hydrogen

The above results confirm that the colorant isolated from clarified cane juice is humic acid.

Influence of humic acid on sulphitation

In the sulphitation technique of clarification, when SO_2 gas is passed into cane juice, it produces sulphurous acid which reacts with calcium hydroxide to form calcium sulphite. The precipitate of calcium sulphite helps in the absorption, coagulation and settling of impurities present in the juice. The formation of calcium sulphite depends on the ionization of sulphurous acid. Consequently, the effect of humic acid on the ionization of sulphurous acid was studied.

Sulphurous acid ionizes in two steps: in the first,

$$H_2SO_3 \underset{}{\overset{K_1}{\rightleftharpoons}} H^+ + HSO_3 \quad (v)$$

$$K_1 = \frac{(H^+)\,(HSO_3)}{(H_2SO_3)} \quad (vi)$$

$$\text{or } pH = pK_1 + \log \frac{(HSO_3^-)}{(H_2SO_3)} \quad (vii)$$

At the half-equivalence point equation (vii) reduces to

$$pH = pK_1 \quad (viii)$$

In the second ionization,

$$HSO_3^- \overset{K_2}{\rightleftharpoons} H^+ + SO_3^{--} \quad (ix)$$

$$K_2 = \frac{(H^+)\,(SO_3^{--})}{(HSO_3^-)} \quad (x)$$

$$\text{or } pH = pK_2 + \log \frac{(SO_3^{--})}{(HSO_3^-)} \quad (xi)$$

and likewise, at the half-equivalence point,

$$pH = pK_2 \quad (xii)$$

pH curves of sulphurous acid titrated with lime water are shown in Fig. 8. One curve refers to the titration data of pure sulphurous acid, whereas the other four are the titration curves of sulphurous acid containing 100, 200, 300, and 400 ppm of humic acid, respectively. It may be seen at a glance that the presence of humic acid in sulphurous acid has a marked influence on the titration curves, increasing the consumption of $Ca(OH)_2$ required for neutralization of the sulphurous acid. The consumption of calcium hydroxide was found to be proportional to the concentration of humic acid.

These titration curves showed two inflections. The first inflection in the case of pure sulphurous acid was observed at pH 2.75 and increased abruptly to pH 6.0 on addition of only 0.08 millimoles of $Ca(OH)_2$. In the presence of 100, 200, 300 and 400 ppm of humic acid the first inflection was observed on addition of 0.240, 0.246, 0.266 and 0.287 millimoles of $Ca(OH)_2$, respectively. On addition of 0.43 millimoles of $Ca(OH)_2$, the pH of pure sulphurous acid increased to only 6.95. Further addition of only 0.06 millimoles of $Ca(OH)_2$ increased the pH to 10.83, showing the second inflection in the titration curve. The second inflection, in the presence of 100, 200, 300 and 400 ppm of humic acid was observed after addition of 0.471, 0.492, 0.513 and 0.533 mmoles of $Ca(OH)_2$, respectively. Thereafter, further addition of $Ca(OH)_2$ showed constancy in the pH value of each solution.

The first and the second inflections in

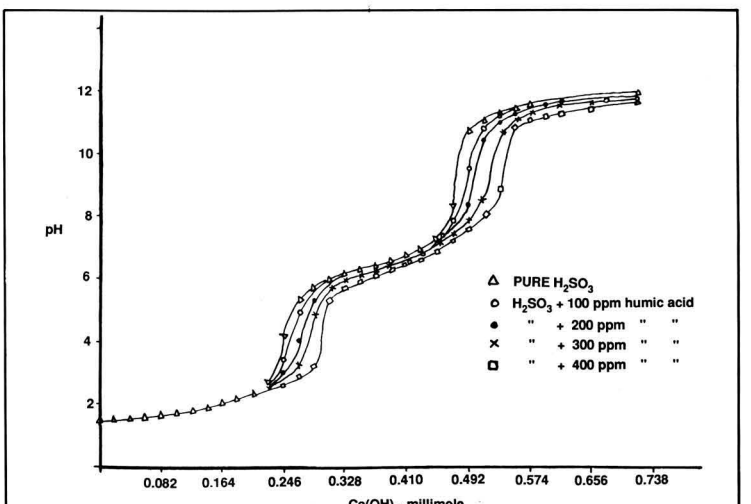


Fig. 8. pH-metric titration of H_2SO_3 containing different concentrations of humic acid

Table IV. First and second ionization constants of H_2SO_3 containing humic acid of different concentrations

Sample	pK_1	pK_2	K_1	K_2
Pure H_2SO_3	1.80	6.40	1.58×10^{-2}	2.98×10^{-7}
H_2SO_3 + 100 ppm	1.83	6.45	1.48×10^{-2}	3.55×10^{-7}
H_2SO_3 + 200 ppm	1.86	6.55	1.39×10^{-2}	2.82×10^{-7}
H_2SO_3 + 300 ppm	1.89	6.60	1.29×10^{-2}	2.51×10^{-7}
H_2SO_3 + 400 ppm	1.95	6.65	1.12×10^{-2}	2.24×10^{-7}

the titration curves corresponded to the complete neutralization of HSO_3^- and SO_3^{2-} ions in solution, respectively. With the help of equations (viii) and (xii) the ionization constants of pure sulphurous acid as well as in the presence of humic acid were calculated and are given in Table IV. It may be observed from this table that both the ionization constants of sulphurous acid are influenced by humic acid. Values of the first ionization constant of sulphurous acid, pure as well as in the presence of 100, 200, 300 and 400 ppm of humic acid, were found to be 1.58×10^{-2}, 1.48×10^{-2}, 1.39×10^{-2}, 1.29×10^{-2} and 1.12×10^{-2}, respectively. The second ionization constant of pure sulphurous acid was observed to be 3.98×10^{-7} and this was reduced in the presence of 100, 200, 300, and 400 ppm of humic acid to 3.55×10^{-7}, 2.82×10^{-7}, 2.51×10^{-7} and 2.24×10^{-7}, respectively. Thus, it is concluded that the presence of humic acid minimizes the ionization of sulphurous acid which results in low precipitation of $CaSO_3$ and has an adverse effect on the sulphitation reaction.

Acknowledgement

The authors are grateful to the Director, National Sugar Institute, Kanpur, India, for the facilities provided to carry out this work.

Summary

A new colorant has been isolated from laboratory-clarified cane juice using activated carbon and an azeotropic aqueous pyridine mixture. It was identified as humic acid on the basis of its adsorption maxima in the visible and infra-red spectra, by molecular weight measurements using osmometry and viscometry, and by its response to the action of some decolorizing agents. The influence of humic acid on the sulphitation of cane juice was studied and it was concluded that its presence in juice affects the ionization constants for sulphurous acid and increases the quantity of lime required for complete neutralization to achieve the optimum clarification.

Etude de l'acide humique dans le jus de canne

On a isolé un nouveau colorant aux dépens de jus de canne, épuré au laboratoire et utilisant du charbon actif et un mélange azéotropique de pyridine aqueux. On l'a identifié comme étant de l'acide humique. Cette identification eut lieu sur la base de ses maxima d'absorption dans les spectres visibles et infrarouge, par des mesures du poids moléculaire où on utilisait l'osmometrie et la viscometrie, ainsi que par sa réponse vis à vis de l'action de certains agents décolorants. On a étudié l'influence de l'acide humique sur la sulfitation du jus de canne. On a abouti à la conclusion que sa présence dans le jus affecte les constantes d'ionisation de l'acide sulfureux et qu'elle augmente la quantité de chaux nécessaire à une neutralisation complète en vue d'une épuration optimale.

Untersuchungen von Huminsäure in Rohrsaft

Ein neuer Farbstoff is aus Rohrsäften, die im Labor geklärt wurden, mit Hilfe von Aktivkohle und azeotropem wäßrigem Pyridin isoliert worden. Er wurde als Huminsäure auf Grund der Adsorptionsmaxima im sichtbaren und infraroten Spektralbereich, durch Molekulargewichtsbestimmung mit Hilfe von Osmometrie und Viskometrie sowie seiner Reaktion mit mehreren Entfärbungsreagenzen identifiziert. Der Einfluß der Huminsäure auf die Sulfitation von Rohrsaft wurde untersucht, und es wurde festgestellt, daß ihre Anwesenheit im Saft die Ionisierungskonstanten für schweflige Säure beeinflußt und die für die vollständige Neutralisierung benötigte Kalkmenge erhöht, um eine optimale Klärung zu erreichen.

Estudio de ácido húmico en jugo de caña

Se ha aislado un nuevo colorante de jugo de caña, purificado en el laboratorio, por uso de carbón activado y una mezcla azeotrópica de piridina acuosa. Se ha identificado como ácido húmico sobre el base de sus máximos de adsorción en los espectros visible y infrarojo, por medicion de su peso molecular empleando osmometría y viscometría, y por su respuesta a la acción de algunos agentes descolorizantes. Los autores han estudiado la influencia de ácido húmico sobre la sulfitación de jugo de caña y han concluido que su presencia en el jugo afecta los constantes de ionización de ácido sulfúroso y que aumenta la cantidad de cal que esta necesario para la neutralización completa con el fín de acabar una clarificación óptima.

South Africa sugar production, 1985/86[1]

The cane crop of 18,802,782 tonnes in 1985/86 was well below the 22,355,591 tonnes of the previous season but sugar production, at 2,117,055 tonnes was one of the highest on record because of good cane:sugar ratio (8.88) which compares with 9.43 in 1984/85 when sugar output reached 2,370,040 tonnes. Extraction at 97.47% once again was a record, with only two factories reporting values less than 97%. Boiling house recovery at 87.51% reflected the low mixed juice purity and was the second lowest recorded during the past decade.

Quebec sugar factory sale[2]

In their quest to turn over as many as 13 provincially owned corporations to the private sector, the Quebec government has agreed to sell the money-losing Raffinerie de Sucre du Québec to Lantic Sugar Ltd. who own and operate a number of sugar refineries in Canada. The selling price is $Can 50 million. Lantic are reported to be intending to close the Montreal plant for modernization, as well as to build a new corporate headquarters there.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 168 - 169.
2 *Dyergram*, 1986, (8 - 86), 3.

New books

Economic aspects of biotechnology

Andrew J. Hacking. 306 pp; 14.7 × 22.6 cm. (Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, England.) 1986. Price: £35.00

Biotechnology has been defined as the application of scientific and engineering principles to the processing of materials by biological agents to produce goods and services. Much research has been done to develop feasible and practical processes yet, for many involved in such work (including the author before he entered industry), knowledge of the costing and economic practicality of application of the processes is limited or absent. The present book is intended to repair this lack. It first examines the influence of the diverse markets, demand and pricing policies on biotechnological products, then the influence of general economic and accounting principles which illustrate the reasoning behind the development or abandonment of projects of equal scientific appeal. Production and pricing of raw materials is emphasized as probably the most significant single input, while fermentation costs are examined using data from existing industries, as are problems of downstream recovery and product purification. Enzyme catalysis is described with special emphasis on the cost saving benefit of immobilization. The impact of new genetic technology and its extraordinary success in attracting investment in venture companies is discussed. The sections likely to be of most interest to our readers are concerned with three biotechnical processes which have become of importance in the fairly recent past : alcohol manufacture as a fuel and chemical raw material, sweeteners (particularly HFS) manufacture from corn, and the treatment of wastes for both decontamination and recovery of valuable products such as methane and single-cell protein. The influence of political and economic factors on the first and the differences in a number of countries, particularly Brazil and the US, are discussed, together with an appraisal of the biotechnical contributions to world energy needs. The book places these topics in a wider context which should be considered by the advocates of particular technologies, adoption of which may or may not prove to be economical.

The South African sugar year book, 1984-1985

Glen Dewey (Ed.) 198 pp; 20.8 × 29.5 cm. (The South African Sugar Journal, P.O. Box 1209, Durban, South Africa.) 1985. Price: R 22.00.

The new year book is No. 55 in the series and includes a brief synopsis by the editor of the 1984/85 season in South Africa and a number of special articles and features on various aspects of the country's sugar industry, including an up-date on studies aimed at controlling the eldana borer pest. Reports are presented of the South African Sugar Association, the S.A.Cane Growers' Association, the S.A. Sugar Millers' Association, the S.A. Sugar Technologists' Association and their annual general meetings, and also on activities of the Sugar Milling Research Institute in 1984/85. An annual review of the milling season in southern Africa includes details of sugar companies, cane production, cane quality and extraneous matter, mill performance, sugar recoveries, etc., for South Africa and partly for Malawi, Swaziland and Zimbabwe, with data by individual factories tabulated for aspects of cane crushed; sugar produced; analyses of bagasse, juice, filter-cake, syrup and molasses; massecuite quantities and analyses; average monthly control data; cane varieties and rainfall; comparative data from 1925 onwards; and equipment used and power consumption in South African and Swaziland factories. A reference section contains information on the structure of the South African sugar industry and its enterprises, milling companies and industry statistics, with a section on neighbouring countries. The year book is the definitive up-to-date compendium of information on the sugar industry of South Africa, with that on the other countries as a bonus.

Laboratory manual for South African sugar factories including the Official Methods

436 pp; 14.3 × 24 cm. (South African Sugar Technologists' Association, c/o SASA Experiment Station, Mount Edgecombe, South Africa 4300.) 1985. Price: US $30.00.

The third edition of the South African laboratory manual has brought up to date the 1977 version as a result of the labour of the Factory Control Advisory Committee of the S.A.S.T.A. under the Chairmanship of Mr. J. B. Alexander. The new edition is in fact the seventh version of published chemical control methods, the first three having appeared as part of the Association's Congress *Proceedings* of 1927, 1930 and 1931 and the fourth as a book of "Recommended Methods". The 1985 manual incorporates various modifications to official methods, includes details of the gas chromatographic method which is now official for sucrose determination as well as being used for fructose and glucose in mixed juice and molasses. The various chapters cover definitions, mass determination of factory materials, calculations, sampling equipment, analytical equipment, reagents, sampling and analytical procedures for factory products and miscellaneous materials. A chapter is included on safety and first aid, and an index; the table of contents is so detailed, however, that it is likely to be of more use than the index. The book is well printed and appears in an open binding which is convenient to the user. It will, of course, be required reading for those concerned with factory control in South Africa but will also be useful in other countries in providing details of techniques and equipment which may well be applicable in their sugar industries.

Venezuela sugar expansion[1]

Sugar production growth has averaged an annual 19.5% during the past three years and it is expected to be a further 10% in 1986/87. By 1988/89, factories will be working at full capacity to produce 700,000 tonnes, white value. The eight state-owned factories currently produce 180,000 tonnes of sugar and the eight privately-owned factories 360,000 tonnes.

1 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 150 - 151.

Facts and figures

India sugar imports, 1985[1]

	1985	1984
	tonnes, raw value	
Brazil	244,155	214,363
Bulgaria	0	30,372
China	194,028	0
Cuba	108,512	27,023
Czechoslovakia	14,586	0
EEC	697,891	34,089
Korea, South	170,710	63,391
Malaysia	12,965	0
Philippines	64,597	23,824
Poland	79,087	0
Thailand	101,344	0
US	68,499	0
Vietnam, North	9,519	0
Yugoslavia	15,342	0
Total	1,781,235	393,602

Spanish beet sugar production, 1985/86[2]

Sugar production in the 1985/86 campaign in Spain is reported to have reduced to 887,246 tonnes, white value, or some 964,000 tonnes, raw value, which is approximately equal to domestic requirements. The production target had been set at 960,000 tonnes of *A*-quota sugar and 50,000 tonnes of *B*-quota sugar. Of this total output, 276,000 tonnes was produced in Andalucia, 68,000 tonnes in the Central region, 53,000 tonnes in the Ebro region and 490,000 tonnes in the Duero region. The total beet quantity processed was 6,605,000 tonnes.

New USSR sugar factory[3]

A 6000 tonnes/day beet sugar factory, supplied by Poland, is to be built at Khmelnitskii, in the Podolien region of the West Ukraine. In a 110-day campaign, it should produce 85,000 tonnes of white crystal sugar and 30,000 tonnes of molassed dried pulp. Sugar storage will be in three tower silos, each having a capacity of 15,000 tonnes, as well as a bagged sugar store.

Booker Agriculture Ltd.

The overseas activities of Booker Agriculture International had a challenging year; potential new sugar contracts were postponed and results were adversely affected by the weakness of the US dollar and Kenyan shilling against sterling. However, sugar projects in Kenya and Somalia achieved record productions and excellent progress was made at the Pelwatte project in Sri Lanka, which started commercial production in March 1986. At Ramu in Papua New Guinea there was a downturn in sugar sales and the crop suffered from pest infestation. Fletcher and Stewart again had a satisfactory profit with increased orders for sugar equipment and spares. Major contracts in Sri Lanka and Pakistan were completed and there is a healthy order book for 1986. In partnership with a local equipment supplier, the company won its first order for a newly developed continuous vacuum pan to be supplied to a beet sugar factory in West Germany.

Florida cane sugar crop, 1985/86[4]

Florida is the largest sugar producer of the United States of America, with 24% of the domestic sugar consumed in the country. It has seven factories, all producing raw sugar, and three refineries. The 1985/86 crop finished in March with slightly more than 13 million short tons of cane crushed to give 1,413,000 tons of raw sugar and 93 million gallons of molasses. The 1984/85 crop produced 1,412,000 tons of sugar from 12.9 million tons of cane. The area had a good growing season despite a late-December frost that damaged cane in many of the growing areas, which total about 380,000 acres.

Thailand sugar exports, 1985[5]

	1985	1984
	tonnes, raw value	
Bangladesh	18,628	58,182
Bulgaria	0	13,077
China	911,281	277,920
Ecuador	0	18,182
Egypt	0	5,943
Hong Kong	11,753	3,844
India	104,227	0
Indonesia	0	3,198
Japan	312,343	511,896
Korea, South	204,892	215,674
Madagascar	0	0
Malaysia	79,403	118,175
Morocco	0	37,461
Mozambique	0	48,482
Nepal	9,210	0
Pakistan	22,518	0
Philippines	0	62,035
Saudi Arabia	0	0
Singapore	1,358	12,357
Sri Lanka	30,013	0
Tunisia	0	13,060
US	33,985	38,910
USSR	37,818	4,124
Other countries	3,575	1,124
Total	1,781,004	1,443,644

Peru sugar imports[6]

Owing to dry weather in January and February, sugar production in Peru's cooperatives has slowed and stocks have fallen. Although the cooperatives are of the opinion that the shortage is insignificant, the government has decided to import 40,000 tonnes of sugar, to be distributed by the Sugar Cooperatives National Centre. The imports, which may be supplemented by further imports, will permit the building of a reserve.

Hawaii sugar factory closure plans[7]

Hamakua Sugar Company, on the island of Hawaii, has announced plans to phase out one of its two factories as part of a long-term consolidation plan to save the sugar industry on the Hamakua Coast. All cane grown on the company's plantations will be crushed at the main factory in Haina by early 1987, when the Ookala factory is closed. The closure will be in stages over 12-15 months. Production at the Haina factory will rise to 175,000 and eventually to 200,000 short tons of sugar per year, and will go to continuous operation. It is expected to have more electric power to sell to the Hawaii electricity utility.

Guyana sugar exports, 1985[8]

	1985	1984
	tonnes, raw value	
Canada	9,271	5,740
EEC	185,931	172,901
Portugal	11,481	0
Surinam	475	0
USA	22,721	36,113
Other countries	508	160
Total	230,387	214,914

Angola sugar production decline[9]

Agricultural potential in Angola is immense, although current estimates suggest that only around 2% of the arable land is under cultivation. Plantation-based cash crops have suffered a severe decline in production over the past decade. Sugar output has suffered despite the involvement of Cuban expertise; raw sugar production, put at 84,000 tonnes in 1972, was estimated at only 30,000 tonnes in 1984.

New distillery for Hawaii[10]

Hawaii is to have a 2 million gallons/year distillery, owned by Pacific Ethanol Products Inc., which has signed a contract with Oahu Sugar Company for the supply of 30,000 short tons of molasses per year. Testing of alcohol as a gasoline additive has been carried out in the Hawaiian market using imported alcohol.

Sugar factory maintenance book

A book "Maintenance techniques at sugar mills" is in preparation and will be published by GEPLACEA. Written by experts in the field, it will be sent to the 600 sugar factories in the GEPLACEA countries. Negotiations are under way for its translation and publication in English. Further details will be available from GEPLACEA, Av. Ejército Nacional 373 - 1er piso, 11520 México, D.F.

US Commodity Corporation loans[11]

Commodity loans outstanding to the Commodity Credit Corporation as at December 31, 1985, totalled $20,600 million, up from the level of $11,000 million of a year earlier, according to the US Department of Agriculture. The rise for beet sugar was small ($146 million against $133 million), while that for cane sugar was substantially higher at $164.3 million against $40.9 million as at December 31, 1984.

1 *I.S.O. Stat. Bull.*, 1986, **45**, (3), 29 - 30.
2 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 199 - 200.
3 *World Sugar J.*, 1986, **8**, (8/9), 31.
4 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 200 - 201.
5 *I.S.O. Stat. Bull.*, 1986, **45**, (3), 47 - 48.
6 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 204.
7 *Sugar y Azúcar*, 1986, **81**, (3), 8 - 9.
8 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, S172.
9 *Abecor Country Rpt.*, March 1986.
10 *Sugar y Azúcar*, 1986, **81**, (2), 8.
11 F. O. Licht, *Int. Sugar Rpt.*, 1986, **118**, 182.

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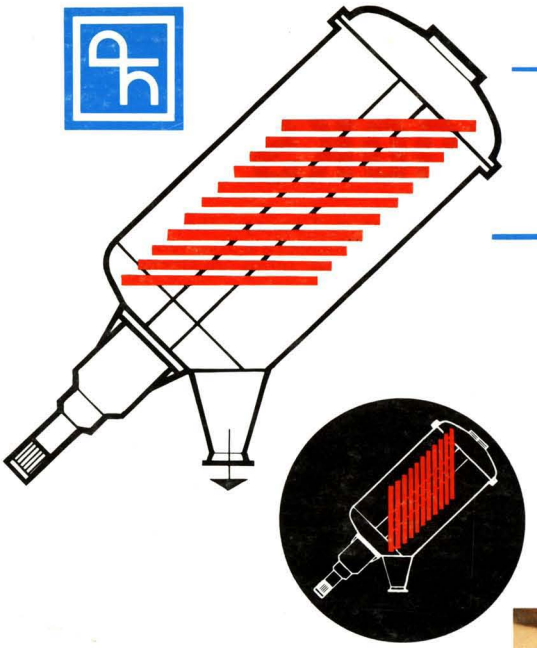

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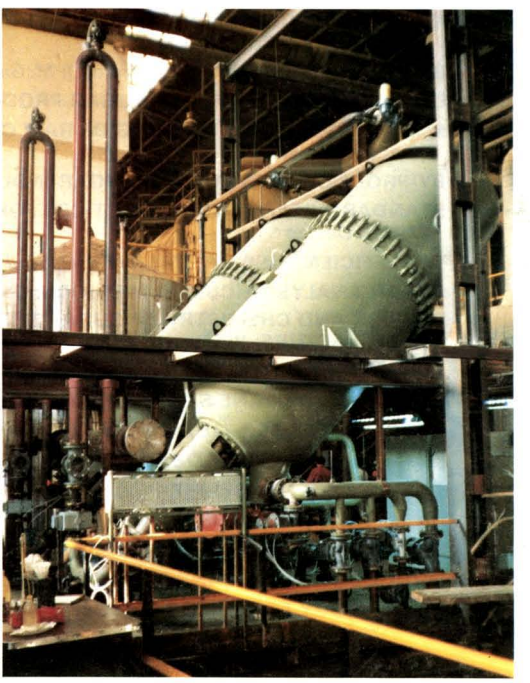

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