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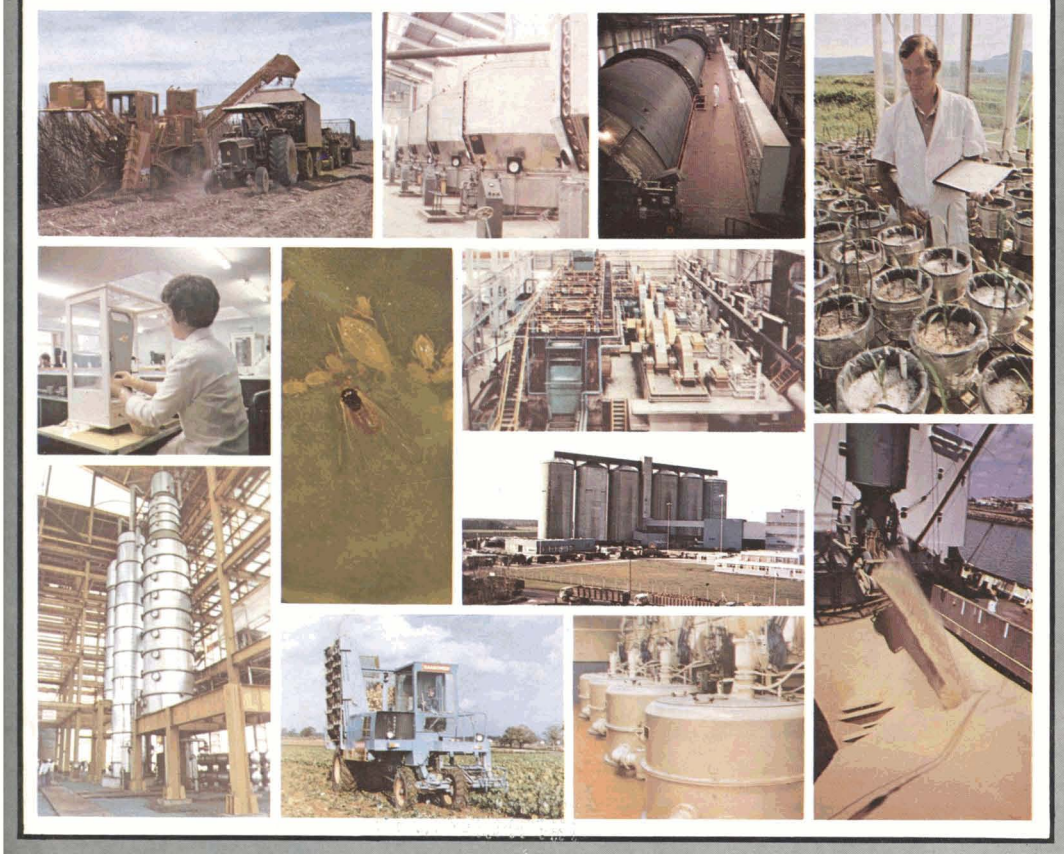

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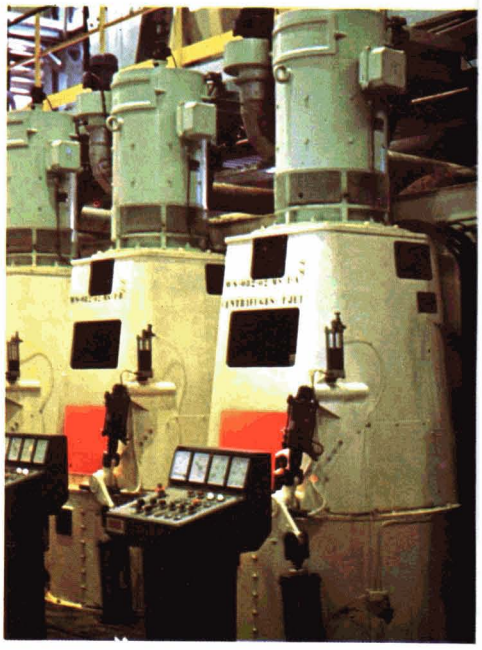

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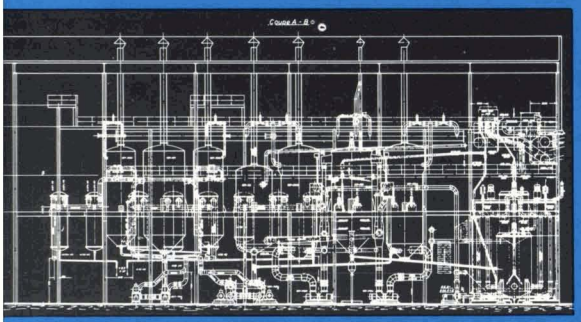

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NOTES AND COMMENTS

World sugar prices

Bearish influences on the world sugar market drove prices down in early September and the London Daily Price for raw sugar fell from £172 per tonne on September 1 to £153 on September 4, largely because of continuing reports of prospects for a bumper beet sugar crop in Western Europe, although there was an intermediate recovery owing to reports of Chinese buying and possible Russian purchases. The LDP(W) followed suit and fell from £166 on September 1, reaching £150 on September 7. Following only small quantities of white sugar released by the EEC authorities there was some revival from September 8 and both LDP and LDP(W) reached £169 on September 14. With the release of 100,000 tonnes of EEC whites, confidence was eroded and the price of raw sugar fell to £152 on September 18 while that of white sugar dropped to £158 the previous day.

Reports were then received of crop difficulties in the USSR and consequent buying interest, and also of limitation of EEC sugar exports by a segregation of stocks. There was a sharp response from the market and the LDP rose to £184 by September 29, ending the month at £180, while the white sugar price response was even greater and it climbed to £195 before dropping to £190 on September 30. From a discount against raw sugar up to September 11, the LDP(W)'s rise produced a premium which varied up to £16 during the second half of the month.

International Sugar Agreement

Following the fall in sugar prices since its previous meeting, the Executive Committee of the ISO decided at its meeting on September 9 to apply the required reduction to the global export quota to take effect from September 14. The quotas of individual countries were reduced, subject to the limit that they could not go to below 85% of the Basic Export Tonnages except where shortfalls had been declared. As a consequence the global quota was reduced to 12,557,365 tonnes, raw value, against a total of quotas in effect of 13,863,641 tonnes. A second declaration of shortfalls had to be made by September 30 and several were expected; these will probably not be reallocated until the total of quotas in effect falls below the global quota. As the quotas are largely academic so far as exports for this year are concerned, the changes had no effect on the sugar market.

At another meeting on September 16, the Executive Committee, which had discussed arrangements required should it be decided to negotiate a new Agreement, decided to form an expanded Committee to meet on October 26-27 to discuss the matter further. In the meantime the ISO Secretariat would prepare papers on the alternatives – renegotiation, or extension of the ISA for two years, together with improvements and amendments which would be necessary in the latter case. The EEC had requested permission to attend, while tentative bookings have been made for a negotiating conference in Geneva in April/May and September/October 1982 in case this decision was taken.

With a fall in the prevailing price under the Agreement to below 13.00 cents/lb, a reduction in the limitation of imports by members from non-members, from 75% to 55% of the average over the four year period 1973-76, came into effect.

EEC sugar stock proposals

After a meeting with the Commission on September 17, the European Committee of Sugar Manufacturers (CEFS) and International Confederation of European Beet Growers (CIBE) issued a joint statement that they had decided to withold part of C-quota sugar production from the 1981/82 crop and had urged the Commission to reduce exports of A- and B-quota sugar to rebuild Community stocks. Officials said that the request would be given serious consideration and announced on September 21 that 2 million tonnes would be set aside.

The market response was positive but cautious since no statement had specified the amount of sugar to be segregated by the Commission, and the producers have until February 1, 1982 before they are required to specify how much C-quota sugar is to be stockpiled. However, on September 30, the Commission decided to base its weekly sugar export authorization on the assumption of raising stocks by 600,000 tonnes.

Under EEC arrangements, any C-quota sugar held over from 1981/82 would automatically become A- or B-quota sugar for 1982/83 so that withholding of 1.4 million tonnes would almost certainly entail a reduction of beet plantings in 1982. C. Czarnikow note[1]: "Though very large crops are currently confidently expected, harvests are only at their very early stages and final totals are by no means assured. Of special concern in this context is the fact that any fluctuations in output will, of course, be reflected in the totals of C-sugar available. Meanwhile there may well be cases in which sugar has already been earmarked for export and producers may feel they cannot refuse to fulfil obligations.

"None of this, of course, directly affects the policy of the EEC Commission regarding releases and it would not be surprising if it were decided to retain a greater quantity of quota sugar this year. This could easily be arranged under existing regulations, but it might be expected that the Commission would look for some sort of comparable restraint in respect of C-sugar.

"There is no way of assessing how much sugar will eventually be stockpiled, but it does seem unlikely that the figure will reach the two million tons mark".

Sugar outlook in South America[2]

Sugar production in South America in 1981/82 is currently forecast at 13.4 – 13.9 million tonnes, raw value. The only countries where production can be expected to increase by a considerable margin are Brazil, Peru and Venezuela. The anticipated increase of production in the last two countries will be mainly a result of better average weather. Actual production in Argentina will depend on world market prices; if the present weak trend continues, production could drop to 1.4 – 1.5

[1] *Sugar Review*, 1981, (1564), 161.

[2] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 351 – 352.

million tonnes against 1.7 million tonnes in 1980/81.

The South American countries consume about as much sugar per caput as do the developed countries but the evidence of a decline in their rate of growth is much weaker. People with low income turn to sugar not because this is their ultimate desire but because it is a relatively cheap source of energy. Thus the saturation level of these markets may be higher, up to a certain level of income. Above that level, per caput consumption of sugar will start to decline fairly rapidly as income rises, but this is a stage not likely to be reached during the next decade. Per caput consumption is still clearly rising in most South American countries and, although income elasticities of demand are declining, they are still far from being negative.

Individual country forecasts, based in each case on the most appropriate curve, linear or non-linear, suggest a trend figure of 11.4 million tonnes for 1981/82 consumption (an increase of 3.5%). However, actual consumption growth could be somewhat lower if domestic prices are raised by a substantial margin. Production costs have risen substantially during the past two years and the fall in export prices may drive governments to sanction greater price increases. Based on the above consumption estimate, and ignoring stock changes, the 1981/82 exportable surplus could be 2 – 2.5 million tonnes, which compares with estimated net exports of 2.8 million tonnes in 1980/81 and 2.6 million tonnes in 1979/80. The high export performance of 1979/80 was partly a result of destocking which will not be possible to the same extent in 1981/82. Hence aggregate exports are likely to decline in the 1981/82 season.

EEC sugar policy attacked in GATT

An article by Ian Smith in F. O. Licht's *International Sugar Report*[1] described the history of the complaints by Australia and Brazil against EEC sugar policy and the reports of the GATT Working Parties set up to consider them. He observed that "there is no hiding the embarrassment that the Community has suffered on account of its unrestrained policy on sugar exports" and concluded that "there is little in the new regulation (the current sugar regime) which will convince other members of the Working Party of the Community's intention to limit sugar exports . . . Yet the Community cannot continue to disregard international opinion. Urgent consideration must be given to the application of meaningful reductions of EEC sugar exports."

A new complaint was made by Australia and Brazil at a special meeting of the GATT Council on September 22; the Australian delegate pointed out that three years had elapsed since GATT had first been asked to intervene on the issue and the lack of results put in question the Agreement's dispute settlement procedures. He claimed that the Community's export availability for 1981/82 had risen to 6 million tonnes, or 67% more than in 1978/79 as a consequence of expanded beet area in the face of falling prices. GATT decided to set up another Working Party to examine the matter.

The EEC Commission had announced the previous day that it would hold back 2 million tonnes of surplus stocks but C-sugar is the responsibility of the sugar producers, not of the Commission, and Australia was sceptical of the value of the announcement, especially since any decision to withhold stocks could be rescinded if the price improved.

The likelihood that the EEC will have a record exportable sugar surplus in 1981/82 is producing a rising chorus of complaints from other exporting countries. Such annoyance is nothing new – EEC policy on export subsidies has been under the microscope for the last couple of years – but the tone of the latest criticisms suggests that some Third World growers are beginning to run out of patience and are looking for substantive action on the part of the Ten to rectify what they see as continuing unfair trade practices. The head of the Ibero-American and Philippine Sugar Producers Confederation recently declared that the Community was "masterminding the collapse of world prices" by its alleged dumping of subsidized sugar.

The British Foreign Minister, currently President of the Council of Ministers of the Community, urged a debate with the aim of joining the ISA. The reaction of the French Minister, however, was chilly and he recalled France's long-standing objections to membership and criticisms of the Agreement as ill-constructed and ineffective. Of course, it would certainly have been much more effective if the EEC had become a member in 1977, although exports by France, the Community's largest sugar producer, would have been reduced.

US sugar import fees

Since October 1979 there had been no import fee for raw sugar in the USA and that on refined sugar had been the mandatory differential of 0.52 cents/lb. With the fall in the price of sugar on the No. 11 Contract of the New York market, the 20-day moving average fell to a point when automatic imposition of a 1 cent fee became applicable under the terms of a 1978 presidential proclamation. The US Department of Agriculture imposed the fee with effect from September 11, 1981, the refined sugar fee also rising to 1.52 cents.

Under the same automatic provisions, the fee was then adjusted, with effect from October 1, on a basis of a 20-day price average up to September 18 and was set at 1.531 and 2.051 cents/lb, respectively for raw and refined sugar, to apply to imported sugar, including that in transit, up to December 31.

Disastrous West Indies sugar crop[2]

No recent figures of 1981 sugar production have been issued by the Sugar Association of the Caribbean but it is clear that the 1981 crop will be a disastrous one. Persistent and heavy rains have fallen on the Caribbean area since the beginning of April, with monthly records in most countries showing rainfall twice or even three times the long-term average, and the rains are still continuing.

As a result, cane harvesting has been seriously delayed and some factories have had to close down temporarily from shortage of cane, with T.C.T.S. ratios in some cases reaching 13 against an average of 8-9. Harvesting has been seriously disrupted owing to inability to get the cane cut and transported from the fields. The crop has, as a result, gone on far longer than is economical and in one case has ceased long before all the cane has been reaped. Cultivation for next year's crop has also been affected, since the fields still have standing cane or are too wet to plough.

The Barbados crop is still continuing but, with only

[1] 1981, **113**, 543-548.
[2] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 470.

some 85,000 long tons of sugar produced from the estimate of 115,000, there are fears that, unless the weather improves and the expected heavy rains of August – October hold off, the final crop will be well below the estimate. In Guyana, heavy rains have caused the estimate for the year to be reduced from the original forecasts and it seems unlikely that much more than 300,000 tons of sugar will be produced. The Jamaican crop is now put at some 230,000 tons for which weather is partly to blame. There are no estimates for St. Kitts but the cane harvest there is unlikely to have avoided the effects of heavy rainfall in the area as a whole. Trinidad was forced to end the crop early, because of weather conditions, with a production of only around 90,000 tons against a forecast 150,000 tons. An optimistic estimate of 1981 production for the area is in the region of 750,000 tons and, with present conditions continuing, it is very likely that even this low figure will not be reached.

Indian sugar stockpile possibility[1]

The Indian Government is considering building up a buffer stockpile of sugar in order to smooth long-term supplies to the domestic market, according to the USDA's attaché in New Delhi. Local sugar prices have been very volatile in recent weeks, owing to a scarcity of the commodity and speculative hoarding by some merchants. The Indian sugar industry has suggested the establishment of a 1,000,000-tonne buffer stock but the government is thought to favour a smaller reserve of perhaps 500,000 tonnes for 1981/82. There are reports that the government, which recently bought 200,000 tonnes of sugar, may make further imports but officials are keeping quiet on the matter.

Sugar production capacity expansion[2]

It is generally recognized that the low level of world sugar production over the past two years was not caused by lack of capacity but by adverse weather in key sugar-producing areas. There seems to be unanimous agreement that production capacity is substantially above current demand. Reservations have been expressed on the feasibility of increasing production to meet projected levels of demand, owing to, in particular, the high investment cost of manufacturing capacity, although some expect supplies to be plentiful in the years ahead.

Little expansion is anticipated for most West European countries whereas the USSR's 1981/85 Five-Year-Plan calls for the erection of six new factories and increase in the total daily slicing capacity by 140,000 tonnes, and enlargement of the beet slice to 97 million tonnes. It is believed that the Soviet Union will have to continue to import 3-5 million tonnes annually, however. Official sources indicate a need for Poland to build new factories and expand existing ones to cut the campaign length and processing losses, but their proposals up to 1990 are thought inadequate.

Under a "special program", 31 new sugar factories are to be built in Rumania by 1985 and the processing capacity of the industry doubled. In view of past performance, however, it seems to be doubtful if these ambitious targets can be achieved. In Yugoslavia it has been decided to raise sugar production to 1.2 million tonnes a year by 1985 against an average of 695,000 over the past five campaigns. In Turkey seven existing factories have been expanded and two new plants built for the next campaign while further expansions will raise sugar production capacity by a total of 385,000 tonnes compared with 1980/81, so that imports will not be needed.

Cuba has launched a massive new investment plan to increase sugar production to at least 10 million tonnes, including 14 new sugar factories and enlargement of 40 existing plants. Harvest mechanization is to be expanded and new equipment introduced for ploughing, planting, etc. Energy consumption is to be cut and by-products utilization developed, with further investment in the country's bulk terminals and transport infrastructure. Mexico is to spend some $1500 million in its 1981/85 development program to raise production to 4.5 million tonnes, with rebuilding, expansion and modernization of 53 mills and construction of seven new ones. Apart from the joint Colombia-Venezuela project at Zulia-Urena which is to produce 100,000 tonnes of sugar per year, two more factories are to be built in Colombia with a production capacity of 84,000 tonnes.

By far the largest number of new projects have been reported from Africa, with most designed to increase self-sufficiency. They include a new 16,000 tonnes/year complex in Burundi, expansions of existing factories and new schemes in Ethiopia to raise production by 128,000 tonnes a year, and a planned complex in the Upper Niger Valley of Guinea to produce initially 35,000 tonnes and later 50,000 tonnes of sugar a year – no start-up date has been announced, however.

With the aim of self-sufficiency, a new cane sugar factory has started operating in Morocco and a beet sugar factory will operate next year, while further expansions should raise domestic output to 585,000 tonnes in 1985, 169,000 tonnes more than in 1981. The third Nigerian complex is expected to produce 100,000 tonnes of refined sugar when in full production, while a beet sugar factory, to be built this year, will meet a quarter of Tunisia's requirements.

The Jawenda project in Zaire is designed to produce 15,000 tonnes of sugar annually by 1983 but lack of funds and logistic problems indicate substantial delays. A 91,000 tonnes/year project is being studied in Zimbabwe, while expansion of the Triangle factory, due for completion by early 1982, will raise production by 50%. In Egypt the cane area is being expanded and a second beet sugar factory is to be built in the Nubariah area.

Two new factories are to be built in Bangladesh and other factories enlarged; it is hoped to make the country self-sufficient in sugar. A new factory is to be built at Pyinmana in Burma, while Indonesia plans to build six new ones in 1981 and a further 12 in 1982. Rehabilitation of 21 existing plants will be completed by 1983.

A new 30,000 tonnes/year factory was expected to come on stream in Iraq in 1981 while a new factory in Papua-New Guinea will enable self-sufficiency in sugar by 1983. Sri Lanka has signed a contract for erection of a new sugar factory with an initial capacity of 1200 t.c.d., expandable to 2000 t.c.d. Licences have been granted for erection of ten new sugar factories in India while steps are being taken to raise the cane crop from 154 million to 180 million tonnes during 1981/82 and 215 million tonnes at the end of the sixth plan period. In Pakistan credits have been granted for construction of three factories having crushing capacities of 2000-2500 t.c.d.

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[1] *Public Ledger*, July 18, 1981.

[2] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 483-487.

Isolation and pathogenicity of the ratoon stunting disease bacterium

By A. G. GILLASPIE, Jr.*, M. J. DAVIS†, R. W. HARRIS* and R. H. LAWSON*

Ratoon stunting disease (RSD) a major sugar cane disease of worldwide importance, was first recognised in Australia in 1944-45[1]. In 1973, a small, coryneform bacterium was reported to be associated with RSD[2,3,4]. The bacterium was observed in infected plants and plant extracts, and workers in many countries have confirmed the observations[5,6,7,8,9]. The bacterium has a smooth cell wall and measures 0.25 to 0.5 x 1 to 4 μm with lengths 10 μm or longer not uncommon[10]. Transmission electron micrographs[11,12,13] of the bacterium *in situ* and scanning electron micrographs[14] have shown that bacteria within tracheary elements of the xylem are usually associated with a matrix material.

Early attempts to culture the bacterium failed. Recently, we reported the isolation of the RSD bacterium in axenic culture and showed it to be the causal agent[15]. Here we detail the procedures used for isolation, medium preparation, and proof of pathogenicity. In addition, we compare the morphology of the bacterium in culture with that *in vitro* and *in situ* and present data on the serology of the RSD bacterium from different geographical areas and of a similar bacterium from bermuda grass in Taiwan.

Material and methods

Bacteria were isolated from plant material that was surface-sterilized. The cane was washed with soap and water, rinsed with water, then surface sterilized by washing it with 70% ethanol and flaming the alcohol. Bacteria-containing fluids were then extracted either by vacuum extraction[4], by low speed centrifugation (1000 rpm for 1 minute) of internodal sections, or by squeezing the stem with sterile pliers. The extract was streaked or spotted onto the SC medium (after the extract had been serially diluted in S8 medium) and incubated at 30°C. The lower dilutions were often overgrown by contaminants that obscured the RSD bacterial colonies.

The SC medium formulation is as follows: distilled water, 1000 cm^3; cornmeal agar (BBL‡ or Difco), 17 g, Phytone (BBL) or Soytone (Difco), 8 g; K_2HPO_4, 1 g; KH_2PO_4, 1 g; $MgSO_4$, 7 H_2O, 0.2 g; bovine hemin chloride (Sigma), 15 cm^3 of a 0.1% solution in 0.05 N NaOH, or a total of 15 mg. After the agar was dissolved, the medium was adjusted to pH 6.6 with 1N NaOH, and autoclaved 15 min at 121°C. The medium was cooled to 50°C in a water bath and then filter-sterilized (0.2 μm pore size). The following filter-sterilized preparations were added: bovine serum albumin fraction five (Sigma) 10 μm^3 of a 20% aqueous solution, equivalent to 2 g; glucose, 1 cm^3 of a 50% aqueous solution, equivalent to 0.5 g; cysteine free base, 10 cm^3 of a 10% aqueous solution, equivalent to 1 g. The liquid S 8 medium formulation differs from the SC medium in that the cornmeal agar is omitted and KH_2PO_4 is used at 1.5 g and K_2HPO_4 at 0.5 g.

Three bioassays for the presence of RSD were used to assess the pathogenicity of bacteria: (a) the development of salmon-pink discoloration in the stem tissues just below the meristematic area in young sugar cane cultivar CP 44-101[16]; (b) the development of an orange-red discoloration of the vascular bundles at the nodes of mature CP 44-101 cane[1], and (c) the wilting of sorghum-sudan grass hybrid NB 280S uprights[17]. The presence of the RSD-associated bacterium was also determined routinely both by the indirect fluorescent antibody

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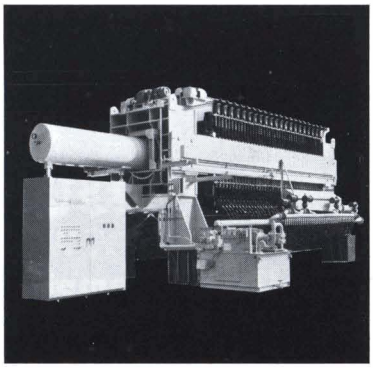

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Telex: 31124

(IFA) staining test[18] for which antiserum had been prepared against the RSD bacterium extracted from diseased sugar cane and by phase-contrast microscopy (x 1250).

The RSD bacteria from culture and from fibrovascular extracts were examined with a transmission electron microscope. Cells from broth culture were observed in preparations negatively stained with 1% phosphotungstate at pH 7.0. RSD-infected plant tissue was fixed in buffered 2% glutaraldehyde, post-fixed in 1% osmium, sectioned, and stained with uranyl acetate and lead citrate[13]. Bacteria from culture were pelleted by centrifugation, fixed in a mixture of 2% glutaraldhyde and 1.5% acrolein, post-fixed in 1% osmium and embedded in Epon 812 before sectioning.

Serological studies of bacterial isolates were performed in gel double-diffusion tests. The gel plates contained 0.5% agarose, 0.15 M NaCl, and 0.01 M phosphate at pH 7.2. Antisera were prepared in rabbits against whole cells of the bacteria. Cells of isolates to be used as antigens in these tests were disrupted by three passages through a French press, concentrated by freeze-drying, and resuspended in phosphate buffered saline. The antigens and antisera were placed in wells cut out in the agarose and incubated at 37°C for 2 days. Serological relatedness is determined by the formation of precipitin lines or bands between the antiserum and the antigen wells. Lines that merge or fuse indicate a relationship.

Results and discussion

The RSD bacterium was initially isolated from a diseased sorghum-sudan grass hybrid NB 280S plant that contained numerous bacteria. After 2 weeks of aerobic incubation on SC medium, the colonies were circular with a diameter of 0.1 to 0.3 mm, with entire margins, convex, and non-pigmented. We subsequently isolated the bacterium from diseased sugar cane from Brazil, Japan, Louisiana and South Africa.

The isolation method was tested on stalks from twenty cultivars of sugar cane from a field experiment comparing diseased and heat-treated progeny in Louisiana. The RSD bacterium was isolated from 29 of 33 stalks (88%) with a positive bioassay for RSD and from 7 of 46 stalks (15%) with a negative bioassay. This showed that the isolation of the RSD bacterium was approximately as sensitive for diagnosis as the bioassay method (juvenile symptoms on CP 44-101). The bacterium was observed by phase-contrast microscopy to be present in extracts from 35 stalks and absent in extracts from 44 stalks, and bacteria were isolated from 91% and 9% of these stalks, respectively. Therefore, microscopic observations were correlated with isolation of the bacterium. The above data indicate that this bacterium can be isolated from cane from different geographical areas and that there is a high correlation between disease and isolation of the bacterium.

Results of pathogenicity tests on sugar cane of eight pure culture isolates of the bacterium from diseased sugar cane from Brazil, Japan, Louisiana, and South Africa are given in Table I. All eight isolates caused RSD symptoms in immature CP 44-101 plants (88% of the plants) and in mature plants (98% of the plants). The RSD bacterium was re-isolated from 86% of the immature plants and 95% of the mature plants. The isolates from the Louisiana field test showed that all 36 isolates produced symptoms in immature CP 44-101 plants. In tests on sorghum-sudan grass uprights all 20 plants wilted characteristically 7 weeks after inoculation with a Louisiana isolate of the bacterium and the bacterium was re-isolated from each plant. None of 17 control plants wilted, nor were bacteria isolated from these 17 plants. In another test, isolates from Brazil, Japan, Louisiana and South Africa caused characteristic wilting of uprights. These data prove that the bacterium is the causal agent of RSD.

Table I. Pathogenicity on CP 44-101 and re-isolation of the sugar cane isolates of the ratoon stunting disease bacterium

Inoculum	Symptoms		Re-isolations	
	Immature plants	Mature plants	Immature plants	Mature plants
Brazil isolates[1]	25/27[2]	37/37	22	37
Japan isolates	13/18	20/20	9	16
Louisiana isolates	17/21	26/28	16	24
S. Africa isolates	22/23	33/33	21	31
Buffer only	0/5	0/7	0	0
Medium only	0/11	0/9	0	0
Noninoculated	0/4	0/12	0	0

1. Results from two isolates from each source.
2. Number of plants showing symptoms over the number of plants examined.

Ultrastructural comparisons of the cultured bacterium and the bacterium in diseased plants showed no apparent differences among the isolates (Figure 1). The bacterium in culture measured 0.25 to 0.35 x 1 to 4 μm and appeared to have been undergoing septate division. The bacteria were usually straight or slightly curved rods, but cells swollen at one end or in the middle were also observed. Mesosomes were often present and sometimes

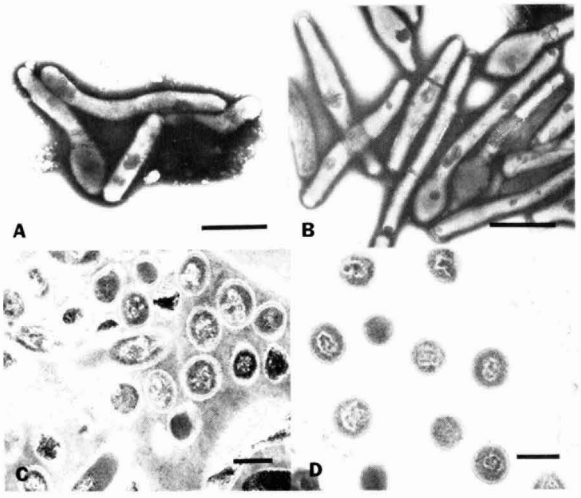

Figure 1. Electron micrographs of the RSD bacterium. (A) Negatively stained bacteria from xylem extract; (B) Negatively stained bacteria from culture (A and B bar = 1 μm); (C) Cross-section of bacterial cells in xylem of diseased plants (courtesy of Dr. J. F. Worley); and (D) Cross-section of bacterial cells from culture (C and D bar = 0.3 μm).

appeared to be associated with the presence of a septum. In ultrathin sections, no differences were observed in cell wall structure of isolates from culture or from diseased plants.

In IFA staining and microagglutination tests the bacterium in culture was indistinguishable from the bacterium selectively concentrated from plant extracts[18,19]. All of the sugar cane isolates reacted identically and were judged to be related to each other in agar gel double-diffusion tests (Fig. 2) because the precipitin bands merged and no extra bands were present. Isolates of a bacterium from bermuda grass from Taiwan showed partial serological identity with each other. One of these precipitin bands merged with the band from the RSD bacterium, but an additional band was present. These bermuda grass isolates were morphologically and ultrastructurally indistinguishable from the RSD bacterium, and were serologically related to the RSD bacterium. The bermuda grass isolates did not cause RSD symptoms in sugar cane, however.

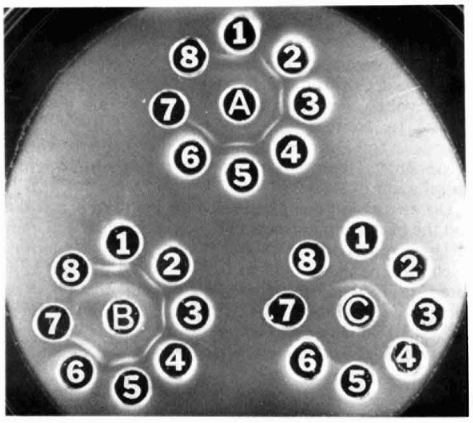

Figure 2. Serological reactions in double gel diffusion tests of bacteria isolated from sugar cane with RSD and from diseased bermuda grass. Centre well contained antisera: (A) RSD isolate from Louisiana; (B) Bermuda grass isolate from Taiwan; (C) Bermuda grass isolate antiserum absorbed with Louisiana isolate antigen. Outside wells contained disrupted bacterial cells: bermuda grass isolates, (1) BG1, (2) BG2; sugar cane isolates, (3) Louisiana, (4) South Africa, (5) Brazil, (6) Japan, (7) S 8 medium, (8) saline.

The RSD bacterium and the bacterium from bermuda grass morphologically appear to be members of the plant pathogenic group of coryneform bacteria. All of the isolates were aerobic, non-motile, gram-positive, non-spore-forming, non-acid-fast, catalase-positive, and oxidase-negative.

Summary

The procedures used for isolation and cultivation on an artificial medium of the ratoon stunting disease bacterium are described in detail. Tests demonstrating pathogenicity of the bacterium on sugar cane and on sorghum-sudan grass uprights are also described. The morphology of the bacterium in culture is compared with that *in vitro* and *in situ* and the serological properties of the bacterium are discussed.

Isolement et pathogénéité de la bactérie du rabougrissement des repousses

Les méthodes utilisées pour l'isolement et la culture sur un milieu artificiel de la bactérie du rabougrissement des repousses sont décrites en détail. Des essais démontrant la pathogénéité de la bactérie sur canne à sucre ainsi que sur des tiges de sorgho-herbe soudanaise sont également décrits. La morphologie de la bactérie en culture est comparée à celle *in vitro* et *in situ* et les propriétés sérologiques de la bactérie sont discutées.

Isolierung und Pathogenität des Ratoon Stunting-Krankheitsbakteriums

Die Verfahren für die Isolierung und Kultivierung des Ratoon Stunting-Krankheits-Bakteriums auf einem künstlichen Medium werden ausführlich beschrieben. Pathogenitätstests des Bakteriums an Zuckerrohr und an aufrechtem Sorghum-Sudan-Gras werden beschrieben. Die Morphologie des Bakteriums im Kulturmedien wird verglichen mit der *in vitro* und *in situ*, und die serologischen Eigenschaften des Bakteriums werden diskutiert.

Aislamiento y patogenicidad del bacterium del raquitismo

Los procedimientos empleado para el aislamiento y cultivo en un medio artificial del bacterium del raquitísmo se describen en detalles. Ensayos que demuestran la patogenicidad del bacterium en caña de azúcar y en tallos de un hibrido de sorgo y sudan grass se describen también. La morfología del bacterium en cultivo se compara con élla *in vitro* y *in situ* y las propriedades serológicas del bacterium se discuten.

[19] Gillaspie: *Phytopathology*, 1978, **68**, 529-532.

Correspondence

To The Editor,
International Sugar Journal,
Dear Sir,

Reference the article concerning sugar cane smut *(Ustilago scitaminea* Syd.) (*I.S.J.*, 1981, **83**, 39-40). The authors state that *U. scitaminea* is a serious disease in all cane-growing countries. I would like to qualify this statement. In the Santa Cruz department of Bolivia, the main sugar cane varieties are NA 56-26, Co 421, B 37161 (being withdrawn as it is susceptible to rust) and CB 38-22. It is extremely rare to find *U. scitaminea* in the cane, even though it was first reported in this area in the last century[1].

There is no known reason for such scarcity of the disease. However, it should be mentioned that three species of Coleoptera are usually found in association with the disease in sugar cane, as well as nearly always in association with a smut-like disease *(Sphacelotheca reiliana),* which is very common in the weed *Sorghum sudanensis.* Of the three species of insect, larvae, pupae and adults of two have been found feeding on the spore, but only adults of the third species.

It is arguable whether or not these insects contribute to control of the diseases. Some authorities have suggested that they may spread them.

It would be useful to hear of records of other insects found in association with *U. scitaminea.*

Yours faithfully,

C. J. Pruett
Misión Britanica en Agricultura Tropical,
Centro de Investigación Agricola Tropical,
Bolivia.

[1] Martin *et al.*: "Sugar cane diseases of the world", Vol. 1. (Elsevier, Amsterdam) 1961, pp. 329-330.

An analysis of Comfith as a raw material for sugar production

By B. M. HANSON, D. R. McGAW and W. A. MELLOWES
(Department of Chemical Engineering, University of the West Indies, St. Augustine, Trinidad)

Introduction

In the 1960s Miller & Tilby[1] developed a cane separating machine whereby sugar cane pith could be separated from the rind. In the machine, the cane stalk is first directed towards a splitter blade where the cane is split longitudinally into two halves. Each half then passes to its own separator section where the pith is scraped out from the inside by a set of rotating knives or scraper blades in such a way that the pith is collected separately from the rind. Before being ejected from the machine, the rind can be subjected to a second scraping on the outside, in order to remove its wax coating. A complete separation of pith (Comfith), rind (Comrind) and wax (Dermax) can thus be effected in a single processing unit. The following advantages arise from this separation:

(a) The Comfith contains the major portion of the pol of the cane.

(b) The Comrind and Dermax should contain those substances (e.g. inorganics, waxes and gums) which give rise to problems during standard sugar cane processing operations.

(c) The Comrind is in a suitable form to make fibreboard.

(d) Useful waxes may be extracted from the Dermax.

In an investigation on the use of the machine to demonstrate its potential for producing animal feed, Laurie, James & Mayers[2] have quantified the extent of the separation. They found that Comfith constituted 78-80% of the feed containing 93% of the pol in the cane, the Comrind constituted 18-20% of the feed containing 6% of the pol in the cane and Dermax 1.5-2.5% of the feed containing 1% of the pol in the cane.

Having regard to the first two advantages listed above and also to the fact that the material is in a finely divided state, Comfith should be an excellent raw material for an efficient sugar producing operation. The function of the work described in this paper was to carry out a detailed analysis on the material in order to evaluate its processing potential and to provide basic data for use in process design. This analysis may be conveniently sub-divided into three sections as follows:

(i) Composite material analysis, to determine the relative amounts of fibre, moisture and dry matter.

(ii) Expressed juice analysis, to determine the sucrose content, juice purity and levels of the various impurities.

(iii) Fibre analysis to examine its properties both on a macroscopic and microscopic scale.

The work was carried out in Trinidad using material obtained from a Canadian Cane Equipment C4 machine. Experimentation was conducted over approximately one calendar year, with the desired intention of noting any variations in analysis occurring throughout the year. The dry season, and hence normal crop, usually extends from January to June.

Composite material analysis

Standard methods were used for the analysis of moisture and fibre. The moisture was determined by oven drying to constant weight and the percentage dry matter by difference. The fibre content was determined by initially extracting the soluble solids and then removing the moisture by oven drying.

Typical compounded results obtained during the months of March, July and November are given in Table I. Each figure quoted in this table is the mean of at least four determinations.

Table I. Summary of composite material analysis

Average Analysis	March	July	November
% Moisture	72.2	72.9	73.3
% Fibre	7.9	8.1	8.4
% Dry matter	27.8	27.1	26.7

Juice analysis

Juice was obtained from Comfith by expression using a small kitchen press. Standard analytical techniques were used to analyse the expressed juice over regular intervals of time. Table II gives the methods of analysis together with typical compounded results obtained during the months of March, July and November. Each figure is the mean of between four and six determinations. No figures for waxes and gums are quoted as the amounts obtained from the tests were not measurable.

[1] Canadian Cane Equipment: U. S. Patents 3,424,611, 3,424,612, 3,464,877 and 3,464,881.
[2] *Proc. 1973 Meeting W. Indies Sugar Tech.* 344-356.

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Table II. Results of analyses conducted on Comfith juice

Analysis	Method	March	July	November
Brix	Refractometer	21.3	20.6	19.2
Pol	Horne's dry lead	18.87	18.11	16.12
Juice purity, %	–	88.6	87.9	84.0
Reducing sugars, %	Lane & Eynon	0.14	0.15	0.18
Sucrose, %	Clerget Method, Jackson & Gillis Modification No. 4	15.3	15.1	14.8
Ash, %	Gravimetric analysis	0.45	0.46	0.52
Protein, %	Kjeldahl analysis	0.5	0.5	0.68
Waxes & gums, %	Alcohol precipitation	–	–	–
Calcium, %	Atomic absorption spectroscopy	0.02	0.022	0.019

The reducing sugar content of the juice is shown to be highest in November, as expected. The low values obtained indicate the level of maturity of the cane and show that the juice came from fresh, unburnt cane. It could be argued that most of the growing parts of the cane were removed by the machine. Low reducing sugar values would favour good clarification and reduce browning of the juice during processing; however, they would not enhance sucrose recovery.

Fibre analysis

Approach. In order to evaluate the degree of preparation, to assess its suitability for extraction, the physical and structural characteristics of the insoluble solid portion of Comfith were examined by sieve analysis, determination of Preparation Index, and by microscopic examination.

(i) *Sieve analysis.* Samples of Comfith were oven-dried overnight at 105°C. After cooling, the samples were sieved for 10 minutes using standard laboratory screening equipment. Typical results over a ten-month period are shown in Table III.

Table III. Sieve analysis of insoluble solid portion of Comfith

Mesh No.	Mesh size, mm	Weight fraction retained on screen					
		January	February	March	June	July	November
5	3.35	0.0819	0.0813	0.0814	0.0627	0.0562	0.0770
8	2.00	0.2344	0.2248	0.2516	0.2120	0.2414	0.2148
10	1.68	0.1474	0.1521	0.1318	0.1521	0.1527	0.1471
14	1.20	0.1908	0.2027	0.2073	0.2027	0.1962	0.2182
18	0.85	0.1833	0.1822	0.1772	0.2019	0.1989	0.1939
30	0.5	0.1072	0.1110	0.1055	0.1194	0.1046	0.1000
>30	<0.5	–	–	–	0.0492	0.0490	0.0489
36	0.42	0.0496	0.0440	0.0371	–	–	–
>36	<0.42	0.0053	0.0015	0.0081	–	–	–

(ii) *Preparation Index.* In order to measure the Preparation Index, a suitable device based on that successfully used by Markham[3] was designed and built. The device consisted essentially of a mild steel framework mounted on a horizontal shaft passing through two roller bearings built into a metal stand. The framework was built to accommodate four one-gallon plastic bottles, two on one side and two directly opposite. The frame rotated at 40 r.p.m. about the axis, driven by a ¼ h.p. electric motor through a reduction gearbox. The bottles were mounted so that they revolved end over end.

This device was used in conjunction with a commercial blender to determine the Preparation Index using Markham's method. Average results are shown in Table IV.

Table IV. Preparation index for Comfith

Date	January	February	March	June	November
Preparation Index	96.4	97.6	98.0	95.6	95.0

(iii) *Microscopic examination.* Slides of dried Comfith material obtained from the various fractions in the screen analysis were made up and examined using a Carl Zeiss GLT Neofluar research microscope. These slides were further photographed with a Leitz 35 mm single-lens reflex camera using the microscope attachment. The slides were prepared in such a way as to provide both longitudinal and cross-sectional views of the cell structure. The magnification was about 100×.

A certain proportion of the material held up on the larger screens, i.e. Nos. 5 and 8, was fibrous in nature. Virtually all the material which passed through the No. 8 screen was basically cellular, however. A typical photograph of a cross-section of cellular material is shown in Fig. 1, of a side view of a cellular material in Fig. 2, and of fibrous material in Fig. 3. The cellular material was generally of diameter in the range 0.25 to 1.25 mm and length up to 5 mm. The material held up on the larger screens was often of a similar diameter to that held up on the smaller screens, but rather longer. The fibrous material, which represented a small proportion of the total, was generally 0.25 to 1.00 mm thick and could be up to 20 mm long.

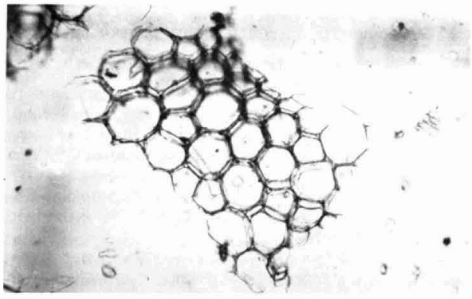

Fig. 1. Cross section of cellular material

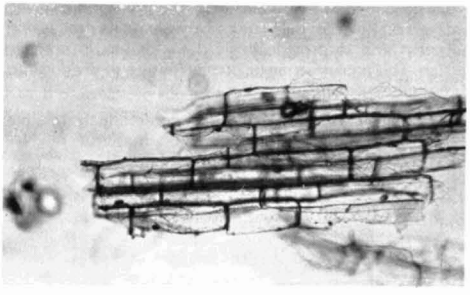

Fig. 2. Side view of cellular material

Discussion

Composite material analysis. Reference to Table I shows that only small differences in composite material analysis were noted throughout the year. Material obtained during

[3] *Proc. 43rd Congr. S. African Sugar Tech. Assoc.* 1969, 230-232.

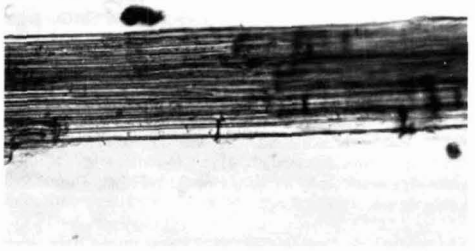

Fig. 3. Side view of fibrous material

the wet season had slightly higher percentages of moisture and fibre than material obtained during the dry season. Reference to Table I also shows that the fibre content of Comfith was only about 8%. This compares with the normal figure of between 11 and 16% for prepared cane. The low fibre content allows for easy extraction and probable reduction by way of absorption of the sucrose-rich juice by the fibre and its subsequent removal from the extraction vessel. This characteristic of Comfith should make it amenable to a diffusion type of process.

A significant feature of Comfith material is the small amount of associated extraneous matter. This extraneous matter is normally obtained from cane tops, leaf blades, shoots, stones and top soil. Such material is eliminated before separation. It is normally of low sucrose content and high in the undesirable components such as starch, soluble polysaccharides and reducing sugars. These undesirable components adversely affect sucrose recovery in the boiling house. In addition extraneous matter mixing with prepared cane can absorb as much as 3% sucrose loss[4] in material leaving the extraction unit.

Comfith juice anlysis

Reference to Table II shows a juice purity ranging from 84% to 89%. The low figure was obtained from cane sampled in the wet season which is out of the normal cropping period. Under normal operating conditions the average purity in Trinidad is expected to be~ 78 to 82%. Good pol recovery is expected in the boiling house if such Comfith juices are processed.

The low values for waxes, gums and calcium will reduce scaling problems during processing. The typical ash figure of 0.46% was lower than that of a typical mixed juice of 0.53%[4]. Pol recovery is affected by the ash which has a tendency to interfere with the crystallization of sucrose. The presence of reducing sugars enhances crystallization. The reducing sugar:ash ratio provides one of the bases for predicting expected final molasses purity. The reducing sugar:ash ratio obtained was approx. 0.33 which may be considered to be unfavourable[4]. It should be noted, however, that the formula quoted by Queensland's Sugar Research Institute for Expected True Purity would not be realistic in this case; another form of the equation needs to be used to allow for the higher purity juice.

Fibre analysis

Sieve analysis. The bulk of material was of particle size in the range 0.5 to 3.5 mm. Such material should give improved capacity throughput over the more coarsely prepared cane in a given extraction unit. Its fine size would make it an excellent material for a diffusion-type extraction process owing to the short fibre threads which can promote slippage at mills and give rise to poor feeding characteristics.

The mean Fineness Factor as defined by Rein[5] was calculated to be 0.94 and the average particle thickness as defined by Foster & Shann[6] was 1.43 mm. These values further demonstrate that the mean particle size is somewhat less than cane prepared by conventional means.

Preparation Index. Reference to Table IV shows that the Preparation Index varied from 95 to 98%, much higher than that for conventionally prepared cane. A seasonal variation was noted with the month of March showing the highest index. Cane at this time should be at peak maturity.

It was noted that the time to achieve constant concentration in the cold leach tumbler was under 10 minutes, suggesting the ready availability of juice for extraction.

Microscopic examination

The bulk of the material was cellular in nature, only a small proportion being fibrous. Good cane preparation was indicated by the discernible cell rupture at the outer edges of the material, as shown in Figs. 1 and 2. Furthermore, it was noted that smaller pieces showed a higher level of cell rupture. For example, for a piece of material of cellular cross-sectional area 0.12 mm², about 64% of the cells were observed to be ruptured. For another piece of area approx. 0.2 mm² this figure was reduced to about 40%. The high level of cell rupture demonstrates the ready availability of sucrose for extraction. It also indicates that a mechanism of washing would predominate over diffusion in any extraction process.

Conclusions

Comfith is a soft pithy material, mainly cellular in nature but with a small proportion of fibrous material. The juice contained in Comfith has a high pol, low calcium and ash contents and negligible quantities of waxes and gums. Fibre analysis showed a very high degree of preparation. Comfith should therefore make an excellent raw material for a sugar-producing operation. Since the short fibre length would present milling difficulties, a diffusion process for which it is ideally suited is probably the preferred extraction device, as indicated by laboratory experiments conducted in an investigation of its diffusional extraction characteristics.

Acknowledgements

The authors would like to thank Dr. J. Duncan for carrying out the microscopic work and Mr. M. Massiah for general assistance in the laboratory work.

Summary

A detailed analysis has been carried out on Comfith in order to evaluate its potential as a raw material for sugar production and to provide basic data for use in process design. Composite material analysis showed the fibre content to be much lower than for prepared cane. Expressed juice analysis indicated high pol and low quantities of the materials, e.g. waxes, gums, calcium, which give rise to processing problems. Fibre analysis by screen analysis, preparation index measurement, and

4 Meade & Chen: "Cane Sugar Handbook", 10th Edn. (Wiley, New York), 1977.

5 "A Study of the Cane Sugar Diffusion Process", (Ph.D. Thesis, University of Natal, South Africa), 1972.

6 *Proc. 14th Congr. ISSCT,* 1971, 1267-1280.

microscopic examination indicated a very high degree of preparation. It was concluded that Comfith should make an excellent raw material for a sugar producing operation, well suited to diffusional extraction techniques.

Une analyse de Comfith comme matière première pour la production de sucre

Une analyse détaillée a été effectuée sur Comfith dans le but d'évaluer ses possibilités comme matière première pour la production de sucre et d'obtenir des données de base à utliser dans l'étude du procédé. L'analyse du composé révèle que la teneur en fibre est nettement inférieure à celle de la canne préparée. L'analyse du jus exprimé montra une polarisation élevée et de faibles quantités de ces substances qui donnent lieu à de problèmes de fabrication, telles que les cires, gommes et le calcium. D'après l'analyse de la fibre par séparation, mesure de l'indice de préparation et examen microscopique, le degré de préparation est très élevé. On en conclut que le Comfith serait une excellent matière première pour une opération de production de sucre, se prêtant bien aux techniques d'extraction par diffusion.

Analyse von Comfith als Rohmaterial für die Zuckerherstellung

Zur Bestimmung des Potentials als Rohmaterial für die Zuckergewinnung und zur Erarbeitung von grundlegenden Daten für die Prozeßgestaltung wurde eine detaillierte Analyse von Comfith durchgeführt. Die Bestimmung der Materialzusammensetzung zeigte, daß der Fibergehalt sehr viel niedriger als bei aufbereitetem Rohr war. Die Analyse des ausgepreßten Saftes ergab eine hohe Polarisation und niedrige Gehalte an Stoffen wie Wachs, Gummi und Calcium, die die Verarbeitung erschweren. Die Fiberanalyse durch Siebanalyse, Bestimmung des "Preparation Index" und mikroskopische Untersuchungen zeigten einen sehr hohen Grad der Aufbereitung. Es wurde festgestellt, daß Comfith ein ausgezeichneten Rohmaterial für die Zuckergewinnung ist und für eine Fest/Flüssig-Extraktion geeignet sei.

Un análisis de Comfith como materia prima para producción de azúcar

Se ha hecho un análisis detallado de Comfith para evaluar su potencial como materia prima para producción de azúcar y para surtir datos básicos para uso en diseño para el proceso. Análisis de las materias componentes demostró que el contenido de fibra es mucho menor que en caña preparada. Análisis del jugo exprimido indicó un alto nivel de pol y bajas cantidades de las materias, por ejemplo ceras, gomas, calcio, que dan origen a problemas en fabricación. Análisis de la fibra por análisis con tamices, medida del Indice de Preparación, y examen con un microscòpio indicó un muy alto grado de preparación. Los autores concluyen que Comfith puede servir como un excelente materia prima para la fabricación de azúcar, siendo muy conveniente para técnicas de extracción por difusión.

The influence of raw cane juice constituents on juice clarification*

By G. S. SHEPHARD
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Introduction

Raw sugar cane juice clarification in South Africa currently utilizes the lime-defecation process in which the *in situ* precipitation of calcium phosphate is brought about by the addition of lime to juice to give a pH between 7.5 and 8.0. This precipitation reaction results in the primary flocculation of the impurity particles which are built into the calcium phosphate floc via the Ca^{++} ions adsorbed at the particle-juice interface[1]. The efficiency of juice clarification depends on the degree to which this primary flocculation scavenges the turbidity-producing particles of raw juice.

The subsequent separation of primary floc and clear juice which is accomplished by settling can be improved by the addition of polyacrylamide flocculants. These act by collecting together primary flocs into a large secondary floc with improved separation characteristics. The use of these flocculants has become standard practice throughout the sugar industry. They consist of long chain copolymers of acrylic acid and acrylamide in which the monomeric groups are randomly distributed along the molecular chain. They are characterized by two parameters, namely molecular weight and degree of hydrolysis (DH). This latter is defined as the % acrylate groups present on average in the molecular chain. It has been demonstrated that, for a particular juice sample, there exists an optimum DH at which the settling rate of the limed juice is at a maximum[2, 3]. At a similar or slightly higher DH, the turbidity of the resultant clear juice reaches a minimum. To achieve the best clarification, flocculants must be carefully chosen so as to operate near the optimum DH and thus ensure peak settling rates and low turbidity juices.

Over the past few years various aspects of juice clarification and the application of flocculants have been studied at the SMRI[2, 4]. The results presented in this paper were obtained while an investigation was being conducted into the possible causes of refractory juice behaviour. A laboratory settling unit was constructed in which the heating and liming of mixed juice can be performed under

G. S. Shephard

*Paper presented to the 17th Congr. ISSCT, 1980.

[1] Bennett: *Proc. 34th Meeting Sugar Ind. Tech.*, 1975, 22.
[2] Murray & Shephard: *Proc. 49th Ann. Congr. S. African Sugar Tech. Assoc.*, 1975, 53.
[3] Whayman & Crees: *Proc. 15th Congr. ISSCT*, 1974, 1175.
[4] Shephard: *Proc. 52nd Ann. Congr. S. African Sugar Tech. Assoc.*, 1978, 106.

careful control before the limed juice is passed into settling tubes held in a thermostatically controlled water bath. Here flocculant can be added and the settling rate of the flucculated suspension measured. After a predetermined time, samples of supernatant clear juice were removed for analysis. Turbidity was determined as the absorbance at 800 nm in a 1 cm cell using a Zeiss PM4 spectrophotometer. Other analyses, where required, were performed by standard SMRI analytical procedures.

Flocculants utilized in this study were Superfloc A110 (approx. 30% DH), Superfloc A130 (approx. 45% DH) and Superfloc A150 (approx. 60% DH). These DH figures were measured by Kjeldahl nitrogen analysis.

Results and discussion

An analysis of juice from various South African mills indicated that the normal requirement in flocculant DH is between 40 and 50%. A study was initiated to ascertain what factors might be of importance in determining this optimum DH. The physical properties of the system were investigated and a survey of particle zeta potentials was undertaken[2]. The values obtained for various samples of mixed juice ranged from 0.4 mV to −11 mV and, for the corresponding clear juices, between 0 mV and −13 mV. However, no close correlation could be found between these results and any property of juice clarification (initial settling rate, turbidity or optimum DH). The investigation into physical properties of the juice-particle system was thus replaced with an examination of the chemical composition of the system.

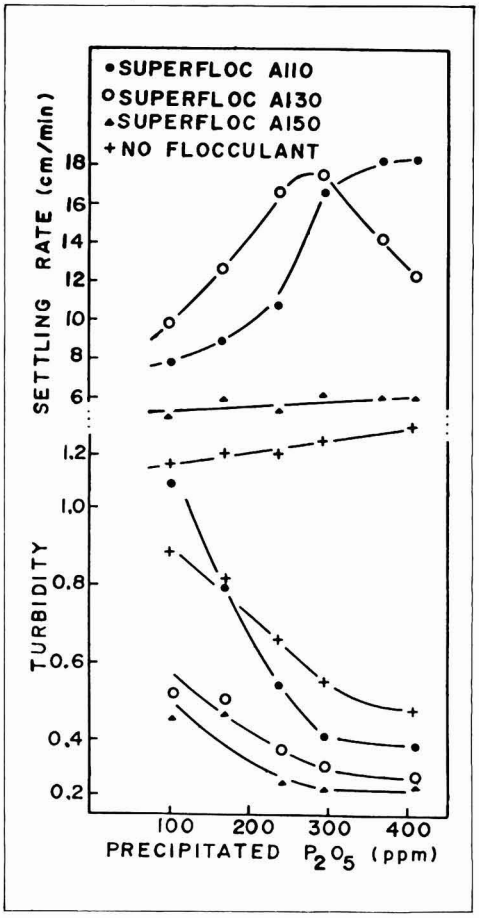


Fig. 1. Effect of amount of P_2O_5 precipitated on clarification with flocculants of varying degrees of hydrolysis (the amount of Ca^{++} in clear juice was 320 ppm)

The role played by phosphate in the clarification of sugar juice is well known[5]. Inorganic phosphate is frequently added to juices deficient in this constituent in order to achieve a clearer juice and faster mud settling. Fig. 1 shows how phosphate added as phosphoric acid to a mixed juice initially low in phosphate influences the initial settling rate and turbidity of the juice obtained using three flocculants. The graph illustrates the expected trends of decreasing turbidity and increasing settling rate as P_2O_5 levels are raised. An interesting feature is the presence of a maximum settling rate in the A130 curve near 300 ppm P_2O_5 after which a rapid decrease in settling rate is noted. The curve for the A110 flocculant appears to form a maximum near 400 ppm P_2O_5. Hence, at very high P_2O_5 levels, the Superfloc A110 (low DH) flocculant becomes superior to the intermediate DH A130 which is the optimum flocculant at low and medium levels of P_2O_5.

The explanation behind the presence of an optimum DH involves a balance between the requirements for strong adsorption to the primary flocs and for maximum extension into the juice phase in order to facilitate the inter-floc bridging by which mechanism large secondary flocs are formed[3]. Since the presence of excess phosphate might reasonably be expected to raise primary floc size, it appears from the shift in optimum DH seen above, that this balance is dependent on primary floc size or on surface area available for adsorption.

The adjustment of juice pH with lime results in the addition of a large amount of ionic calcium such that the precipitation of the phosphate is nearly complete. However, it has been noted in the past that addition of extra calcium to certain juices yields improved clarities[6,7].

It is thus interesting to note how the efficiency of clarification can change with varying Ca^{++} ion concentration in clear juice (Fig. 2). As the amount of phosphate in mixed juice was held constant at 320 ppm P_2O_5 the increase in calcium concentration in juice (added as calcium chloride to mixed juice) led to increasing phosphate precipitation such that at 100 ppm Ca^{++}, 85% and at 450 ppm Ca^{++}, 90% had precipitated. The behaviour of Superfloc A130 and A150 parallels that of the suspension without flocculants, whereas Superfloc A110, the low DH flocculant, shows an anomalous response, becoming by far the best at high Ca^{++} concentrations in clear juice.

Since it is via the adsorbed Ca^{++} ions that juice impurities are built into the primary flocs and also that the flocculants attach themselves to these flocs, the above sensitivity of turbidity to Ca^{++} concentration is to be expected. The shift in DH needed for optimum settling is brought about by increasing amounts of Ca^{++} adsorption which promotes the binding of the flocculant to the particle surface and results in an overbound intermediate DH flocculant (A130) and an optimum for the low DH A110 flocculant.

Owing to the importance of ionic calcium in the clarification process and since the removal of calcium by a

[5] Meade-Chen: "Cane Sugar Handbook", 10th Edn. (Wiley, New York) 1977, 124-128.

[6] Bennett & Ragnauth: *I.S.J.*, 1960, **62**, 13-16, 41-44.

[7] Sockhill & James: *Proc. 29th Conf. Queensland Soc. Sugar Cane Tech.*, 1962, 83.

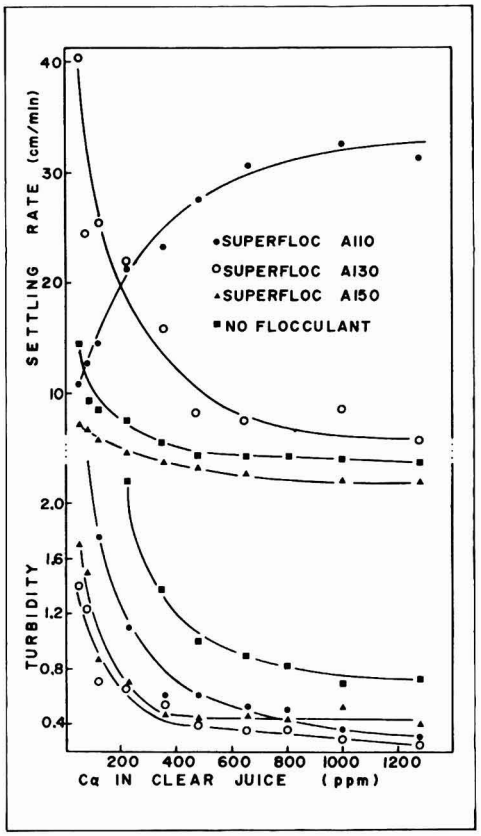


Fig. 2. Effect of quantity of Ca^{++} in clear juice on clarification (amount of P_2O_5 in mixed juice was 320 ppm)

strong sequestering agent such as EDTA can disrupt clarification[8], the effect of some other juice constituents capable of weakly complexing calcium ions was investigated. The effect of the organic acids, lactic, aconitic and citric acids (added to mixed juice as their alkali salts) on clarification is shown in Fig. 3. Clearly, these substances, although capable of forming Ca^{++} complexes, do not prevent the precipitation of calcium phosphate during clarification nor do they appear to change drastically the equilibrium of adsorbed Ca^{++}.

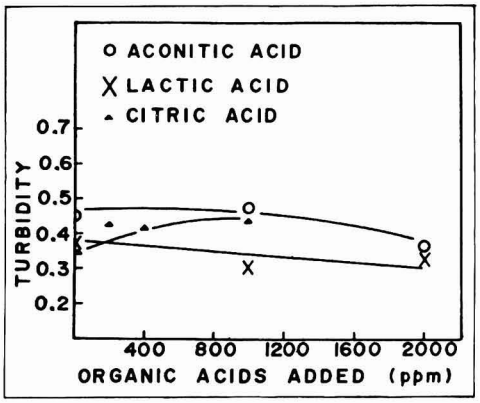


Fig. 3. Effect of organic acids added to mixed juice on clear juice turbidity

Another juice component which can influence the Ca^{++} equilibrium in solution is the sulphate ion through the formation of undissociated calcium sulphate. Fig. 4 shows the results of adding up to 1000 ppm SO_3 to three separate mixed juice samples. As is evident, the effect is variable and probably dependent on some other factor present in the juice.

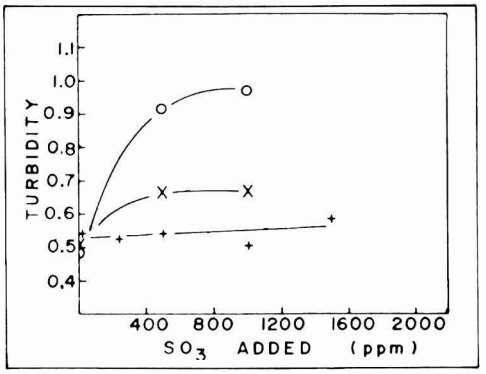


Fig. 4. Effect of sulphate ion added to mixed juice on clear juice turbidity

The presence of large amounts of magnesium ions in juice tends to solubilize Ca^{++} ions to some extent as shown in Table I. It can also be inferred that an extra amount of Mg^{++} is incorporated into the primary floc. As shown in Fig. 5, the effect of these changes on turbidity is negligible. An increase in Mg^{++} concentration in juice reduces the settling rate of the optimum flocculant and also emphasizes (in this case) that Superfloc A110 is the optimum at higher Mg^{++} concentrations whereas, at low Mg^{++} concentration, Superfloc A110 and A130 were equivalent. The exact mechanism behind these low-order effects cannot be determined from the data but is presumably related both to floc changes resulting from increased Mg^{++} concentration in the precipitate and also from changes in the surface equilibrium between adsorbed Mg^{++} and Ca^{++} ions, both of which have increased concentration in the clear juice.

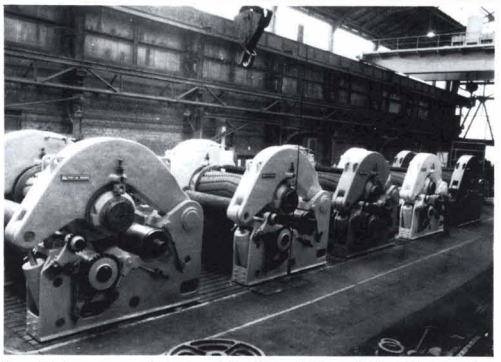
Table I. Analysis of juice samples

Sample	*No additional Mg^{++}*	*300 ppm Mg^{++} added*
Mixed Juice		
(i) Mg^{++} (ppm)	160	460
(ii) Ca^{++} (ppm)	55	55
(iii) P_2O_5 (ppm)	460	460
Clear Juice		
(i) Mg^{++} (ppm)	120	380
(ii) Ca^{++} (ppm)	165	210
(iii) P_2O_5 (ppm)	50	40

The deleterious action of starch in refining processes[9,10] has been well documented. It was thus considered that an investigation into the influence of starch on juice clarification would be of interest.

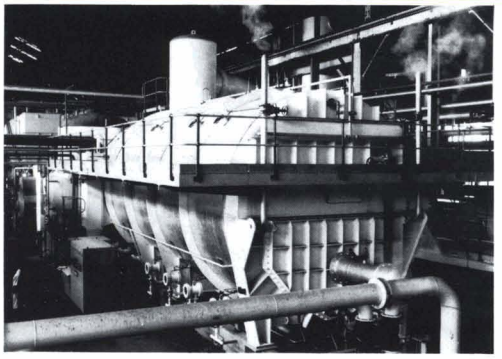
[8] Bennett: *I.S.J.*, 1959, **61**, 77-80, 109-111, 135-138.
[9] Murray, Runggas & Vanis: *Proc. 15th Congr. ISSCT*, 1974, 1296.
[10] Murray, Runggas & Shephard: *Proc. 50th Ann. Congr. S. African Sugar Tech. Assoc.*, 1976, 179.

The main feature of the FCB self-setting mill is that the top roller is solidary with top housing members acting as lever arms and having the top roller describe an arc of a circle when setting the feed opening. This particular design incorporates the following advantages among others: easy setting of mill ratio; constant mill ratio; increased capacity; higher extraction; reduced power peak; higher permissible roller wear; etc.
For the drive of their mills, FCB offer an elaborate range of steam turbines, reducers and transmission gears. FCB are also specialized in the drive of mills by electric motors. (Brochure N° 21091 upon request).



Assembly, in our works, of a tandem of five 1050 x 2100 mm (42" x 83") self-setting mills.

FCB must be given full credit for being the first manufacturers to offer their customers the possibility of performing continuous boiling. Today, FCB continuous pans are in operation in cane and beet sugar factories and in refineries for all the boiling strikes, and their production range covers the plant operators' full requirements. Other advantages are: heat saving; complete automation; improved sugar and exhaustion quality; reduced overall dimensions; low-cost investment, etc...
About 40 FCB continuous pans have already been sold in France, Reunion, Mauricius, South Africa, the Cameroons, Belgium, Chad, Thailand, Morocco, Senegal, etc. (Brochures N° 21103-Beet, or N° 21110-Cane upon request).



Continuous vacuum pan of 1040 hl capacity, for cane C strike, at the Gledhow sugar factory (South Africa).

● "COMPACT" automatic batch centrifugals are mainly used for processing high-purity products. They are constantly updated through the incorporation of state-of-the-art features (e.g., microprocessors allowing complete automation of crystallisation shops). They are produced in 3 versions with basket sizes 48" x 30", 48" x 42" and 54" x 42" and respective load capacities of 700, 1000 and 1300 kg. (Brochure N° 21100 upon request).
● "FC" continuous centrifugals are suitable for almost all massecuite curing operations:
– The FC 1000 series (basket dia. 1000 mm) is fitted either with 34° basket for low-grade massecuites, or with 30° basket for affination and B massecuites, or with 25° basket (runoffs separation) for beet 2nd strike massecuites, cane B strike affination and A strike.
To avoid crystal breakage, the FC 1000 can be equipped with 3 m, 4 m or 5 m dia.casings. It is also possible to adapt, on centrifugals with 30° and 25° baskets, a device allowing almost instantaneous sugar melting.
– The FC 1250 series is equipped with a 1250 mm dia., 34° basket. Centrifugals of this series are high-capacity units used for beet 3rd strike and affination and cane C strike and affination. (Brochure N° 21108 upon request).

Centrifugal station of the N'Koteng, Cameroons, cane sugar factory. In the foreground, four "COMPACT 411" centrifugals. In the background, five continuous "FC 1000" centrifugals.

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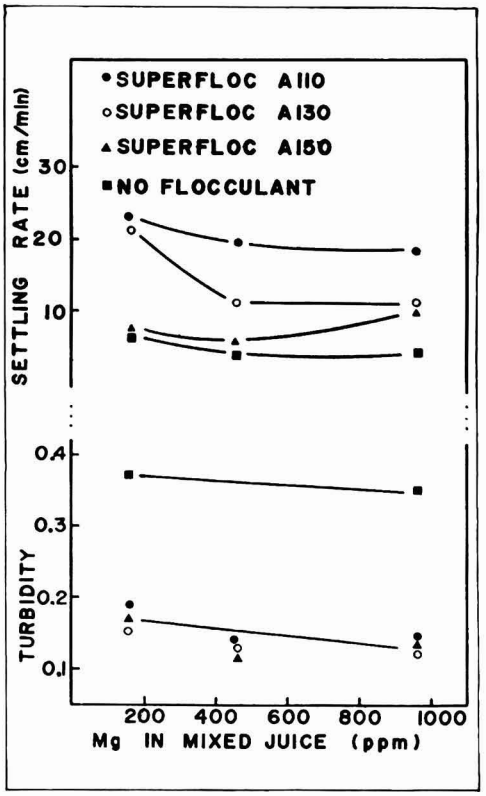

Fig. 5. Effect of the Mg^{++} concentration in mixed juice on clarification

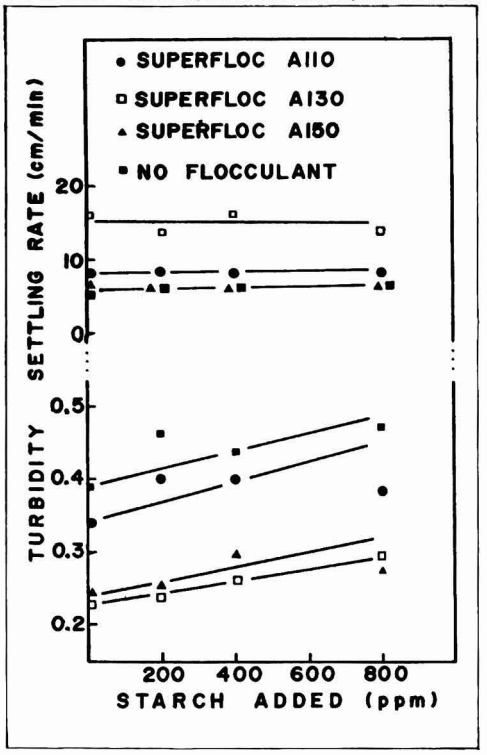

Fig. 6. Effect of starch added to mixed juice on clarification

Fig. 6 indicates that the addition of large amounts of starch to mixed juice prior to the calcium phosphate precipitation causes no change in settling rates. At the same time, a very slight increase in turbidity occurs, probably owing to the known effect of starch as a protective colloid[10]. Thus this juice constituent appears to show no refractory behaviour with regard to clarification parameters. The essential difference between the refinery phosphatation process and the raw juice phosphatation process lies in the manner in which the calcium phosphate is precipitated and in which it scavenges the impurities.

Refinery phosphatation occurs via a coagulation mechanism in which a large number of small calcium phosphate crystallites are precipitated and coagulate with impurities. Starch can act efficiently as a protective colloid of these crystallites. In the case of juice clarification, the large number of suspended impurity particles with adsorbed Ca^{++} ions in their outer layers act as natural nuclei for the precipitation reaction. The impurities are built into the floc via a bridging mechanism (flocculation) and the protective action of starch is minimal.

Another factor of some interest in juice clarification is the return of filtrate to mixed juice. Here, two factors need to be distinguished, viz. the ratio of filtrate return to mixed juice and the insoluble solids concentration in the filtrate. Although their combined effect needs a three-dimensional graph for its true representation, Figs. 7 and 8 show important points. Figure 7 illustrates for a filtrate return rate of 20% how differing % solids in the return affect

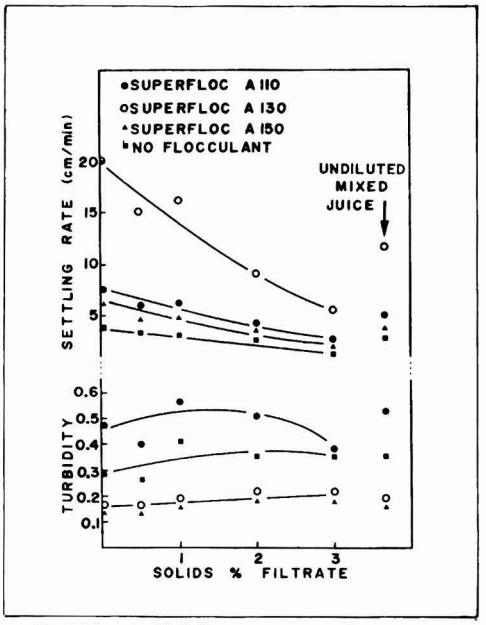

Fig. 7. Effect of solids % filtrate on clarification of a mixed juice diluted with 20% filtrate. The points on the extreme right show the values from undiluted mixed juice

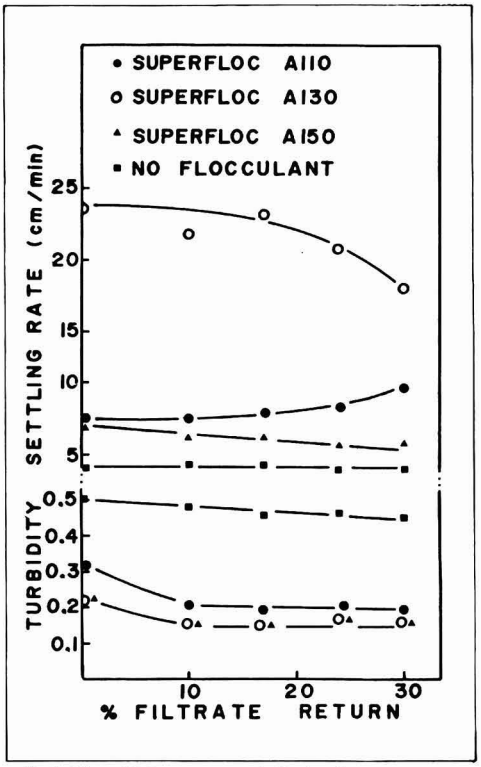

Fig. 8. Effect of % filtrate return on clarification of a mixed juice (the % solids in the filtrate was 0.8%)

clarification. Also indicated are the values for the undiluted mixed juice. Clearly, the return of very low impurity filtrate merely dilutes the juice impurities and provides a greater settling rate as the overall % insoluble impurities will be lowered. This is expected to yield a superior settling rate as the settling process will be less hindered[11]. The influence of Brix changes in the range 10-18° Brix on setting rates appears to be minimal[12]. Similarly, at high purity levels in the filtrate return, a much slower settling results from the greater concentration of insoluble solids to be settled. That this settling rate decrease is due more to the % insoluble solids present than to changes in floc structure is suggested by the turbidity figures which show no worsening at high filtrate levels. The soluble phosphate and calcium levels of the mixtures shown in Table II indicate how some of the calcium phosphate returned in the filtrate is redissolved in mixed juice to become available again for precipitation during clarification.

Table II. Analysis of mixed and clear juice

Sample		*Mixed juice*		*Clear juice*	
		Ca^{++} ppm	P_2O_5 ppm	Ca^{++} ppm	P_2O_5 ppm
Undiluted mixed juice		65	150	200	25
Mixed juice + 20% filtrate:					
Filtrate	0% solids	55	130	180	20
	0.5% solids	70	145	185	25
	1% solids	85	140	190	20
	2% solids	130	160	200	20
	3% solids	140	190	200	25

Conclusion

The normal lime defecation process with the use of flocculants is a complex subject and is affected by a wide range of variables. This paper has considered how some of the juice non-sugars can affect clarification or flocculant performance. In certain cases, clarification itself can suffer while, in others, a change to a flocculant of different DH can restore optimum performance. It appears that none of the factors considered here is responsible for the refractory behaviour of certain juices observed from time to time. Thus there remain still more constituents in juice whose influence is presumably more critical than those considered here.

Summary

The manner in which a variety of juice constituents influence the lime-defecation process was investigated with particular reference to the behaviour of polyacrylamide flocculants with varying degrees of hydrolysis. Clarification performance was assessed by initial settling rate and turbidity measurements, while juice factors studied included phosphate, calcium ion, organic acids, sulphate ion, magnesium ion and starch concentrations in juice. The effect of filtrate return on clarification is also discussed.

L'influence des constituants du jus brut de canne sur la clarification du jus

La manière dont une variété de constituants du jus influence le procédé de défécation à la chaux a été examinée en se référant en particulier au comportement de floculants polyacrylamides à divers degrés d'hydrolyse. L'aptitude à la clarification fut déterminée par la vitesse de sédimentation initiale et par des mesures de turbidité, tandis que les facteurs du jus étudiés comprennent les concentrations en phosphates, en ion calcium, en acides organiques, en ion sulfate, en ion magnésium et en amidon dans le jus. L'effet du retour de filtrat sur la clarification est également discuté.

Der Einfluß von Inhaltsstoffen des Rohrrohsaftes auf die Saftreinigung

Die Art und Weise, wie verschiedene Saftinhaltsstoffe den Kalkungsprozeß beeinflussen, wurde besonders hinsichtlich des Verhaltens von Polyacrylamid-Flockungsmitteln unterschiedlichen Hydrolysegrades untersucht. Der Reinigungseffekt wurde durch die Niederschlagsmenge zu Beginn und Trübungsmessungen bestimmt, während die Untersuchung der Inhaltsstoffe sich auf Phosphate, Calciumionen, organische Säuren, Sulfationen, Magnesiumionen und den Stärkegehalt des Saftes bezogen. Die Wirkung der Filtratrücknahme auf die Reinigung wird ebenfalls besprochen.

Influencia de los constituyentes del jugo de caña en la clarificación

La manera en que una variedad de constituyentes del jugo influyen en el proceso de defecación con cal fue investigada con partícular referencia al comportamiento de floculantes de poliacrilamida con diferentes grados de hidrolisis. La efectividad de la clarificación fue evaluada mediante la velocidad de sedimentación inicial y mediciones de turbidez, mientras que los factores del jugo estudiados incluyeron concentraciones del ion fosfato, del ion calcio, de ácidos orgánicos, del ion sulfato, del ion magnesio y de almidón. Se discute además el efecto del retorno del filtrado en la clarificación.

[11] Crees, Hale & Whayman: *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 191.

[12] Shephard: Unpublished data.

SUGAR CANE AGRONOMY

Studies on the dry matter production of sugar cane. I. Character of dry matter production in the process of growth of autumn-planted sugar cane. M. Shimabuku, M. Kudo and Y. Miyagi. *Bull. Okinawa Agric. Expt. Sta.,* 1980, (5), 1-15 *(Japanese).* – Accumulation of dry matter during growth was studied in seven different cane varieties. In all cases there was a gentle initial increase followed by a sharp increase to a plateau level, with eventually a decline or further increase, depending on the variety, the difference being due to the appearance of dead stalks. High-yielding varieties were characterized by high canes, erect leaves, low ratio of dry weights of non-photosynthetic to photosynthetic organs, and non-flowering habit. The crop growth rate was mainly affected by the magnitude of the leaf area index in the early growth period and by net assimilation rate in the later periods. The leaf area index was positively correlated with mean temperature, hours of sunshine and solar radiation level. Both growth rate and leaf area index reached a maximum and then declined.

Effect of kucha (calcareous heavy clay soil) application on growth and yield of plant sugar cane cultivated on sterile acid soil (kunigami maaji). M. Higa and K. Tamaki. *Bull. Okinawa Agric. Expt. Sta.,* 1980, (5), 17-23 *(Japanese).* – Field trials using N:Co 310 cane and four replications of randomized block design were carried out with levels of 0, 200, 400, 600 and 800 tones.ha^{-1} of the kucha soil. The soil pH was increased by the treatment, and stalk weight was increased, although stalk number was unaffected, the increase occurring in stalk length and diameter after the stage of vigorous growth. Leaf area and number did not vary until the ripening stage when they were greater than in cane from untreated soil. Although 200 tonnes.ha^{-1} produced little effect, 400 tonnes.ha^{-1} and more increased cane yield by 10%. Brix and available sugar content were not affected.

Determination of phosphorus adsorption maxima as measured by Langmuir isotherm for four sugar cane soils. C. C. Wang and I. J. Fang. *Taiwan Sugar,* 1980, **27,** 48-54. – Trials over 15 years with four soils showed great variation in their ability to adsorb applied P, the quantity adsorbed being little affected by the amounts previously applied to the soil. Adsorption varied between 42.8 and 71.9% of that applied and the maximum adsorbed was 7209 kg.ha^{-1} for one soil, while the other three had maxima between 2254 and 2795 kg.ha^{-1}. Acid soils showed greater Langmuir constants than an alkaline soil. The equilibrium between solution P concentration and P adsorption maximum is discussed in relation to the cane yield response to P fertilizer.

Comparison of Dowpon MS and Dowpon for weed control in sugar cane fields. H. J. Yeh and J. T. Wang. *Taiwan Sugar,* 1980, **27,** 62-63. – Dowpon is the sodium salt of 2,2-dichloropropionic acid, while Dowpon MS is a new formulation of the Na and Mg salts. Both are of similar efficiency in cane weed control but, although Dowpon MS still cakes after long storage, the cake breaks easily and dissolves readily in water, unlike Dowpon.

Methods used to improve the health status of plant sources during the 1970's. B. T. Egan. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 83-87. – A survey is presented of the progress of provision of healthy seed cane material in Queensland over the period 1970/80, with an account of plant source inspections and the legislation and methods employed to ensure healthy seed cane. The results achieved are discussed as well as some limitations which apply.

Alternatives to aerial spraying for vine control in the Lower Burdekin. G. J. Ham, H. L. Boyle and P. J. McGuire. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 89-96. Concern about the possible health hazards through drift of aerially applied 2,4-D and 2,4,5-T for control of vine weeds in cane led to trials with a high-clearance tricycle 5-row sprayer with the above and two other herbicides (Diuron and DPX-410); the Diuron was applied alone and with 2,4-D formulations at hilling-up. All gave good control of the vines, only light vine stands developing where control was not complete; this was observed at 2½-3 weeks and at subsequent inspections up to 20 weeks. Control of grass weeds was an additional benefit. No adverse effect on the cane was observed.

Conception of pedological studies necessary for the creation of an agro-industrial sugar complex. Account and review of a concrete case in the Ivory Coast. R. Bertrand, G. Bourgeon and A. Ange. *Agron. Trop.,* 1980, **35,** 9-24 *(French).* – The methodology applied to pedological studies as an initial step in the possible development of a major agro-industrial undertaking is described, with the sugar factory of Ferkessédougou in the Ivory Coast taken as example. The types of map used in a survey of the soils and topographical features are shown.

Focus on weed control in sugar cane in French-speaking West Africa. J. P. L. Deuse and D. Bassereau. *Agron. Trop.,* 1980, **35,** 84-85 *(French).* – Increasing problems are arising in a number of West African cane-growing countries as a result of shortage of manual labour for weed control and the occurrence of weeds that are resistant to conventional herbicides. The main grasses and other weeds found in Cameroon, Chad, Dahomey, Gabon, Ivory Coast and Upper Volta are indicated, with particular mention of *Striga* sp. (witch weed, a parasitic plant that appears in cane fields after cultivation), which is found mostly where other food crops have been grown previously but is relatively simple to eradicate. The need for a coordinated weed management scheme is stressed.

Calcium and magnesium applications needed in North Queensland. A. P. Hurney and A. A. Matthews. *Cane Growers' Quarterly Bull.,* 1980, **43,** 86-90. – Since many fertilizer mixtures contain no Mg or Ca, cane cropping is a constant drain of these two elements from the soil. Records show that in certain areas of North Queensland the soils are becoming deficient and this is limiting cane growth and crop yield. Orange freckle is becoming more widespread in the region and is a disorder associated with Mg deficiency. It responds well to $MgSO_4$ application and yield is raised, as also occurs

when lime is added to the soil. A much larger response is obtained from application of combined Ca + Mg, however, and trials are being conducted on the best forms and levels. It is stressed that the economics of applying Ca + Mg should not be assessed on only one crop response but should include results from subsequent years.

Add lime – increase productivity. D. V. Calcino. *Cane Growers' Quarterly Bull.*, 1980, **43**, 90-92. – Some of the soils of the central district of Queensland are deficient in Ca and the cane shows symptoms including yellow and weak younger leaves, spindle death, yellow spots on older leaves turning dark reddish-brown with dead centres, and freckling on the upper surfaces of leaves. Leached, coarse-textured soils respond to use of agricultural lime, but some sandy soils with clay subsoils do not respond. There is no yield advantage to applications higher than 4 tonnes.ha^{-1} of lime and application is best as a broadcast treatment on fallow soil, disced-in later. Initial strip trials are recommended to gauge response. The response in the plant crop is usually sufficient (9 tonnes. ha^{-1} higher cane yield) to cover the cost of the lime and additional response in ratoons represents profit; a single application is sufficient for a single crop cycle after which further lime is necessary.

Will sulphur be next? Anon. *Cane Growers' Quarterly Bull.*, 1980, **43**, 97-98. – Until 20 years ago, S was applied to the soil in the standard N and P fertilizers, ammonium sulphate and superphosphate. With their replacement by other forms in which it is present only as an impurity, trials in the 1960's were carried out to see if S addition was necessary. It was concluded that S in rain and irrigation, plus residual S, was sufficient to meet cane crop requirements, but recent pot experiments in sandy soils from poor growth areas in two districts have shown good response to S application, and deficiency has been confirmed in a field trial at Mossman. Deficiency symptoms include pale yellow spindle and upper leaves, with older leaves remaining green, and a mauve discoloration of the edges and up to a quarter of the surface of the upper leaves.

A novel fertilizer unit. L. G. W. Tilley. *Cane Growers' Quarterly Bull.*, 1980, **43**, 106. – A cane grower at Bingera has bought a second-hand concrete mixer truck which he uses to mix fertilizers to his own requirements and to deliver to the fields where he uses it to load his distributor equipment. He is able to buy in bulk from his fertilizer distributor, so reducing its cost, and handling in the mixer truck is quicker than with 50-kg bags.

An alternative to aerial spraying. P. J. McGuire. *Cane Growers' Quarterly Bull.*, 1980, **43**, 107. – Because of the increasing cost of aerial spraying and concern over public safety, growers in the Burdekin area are shifting to the use of boom sprays for application of herbicides to control vine weeds, and their methods and good results are described.

Dual row planting in Mackay. L. S. Chapman. *Cane Growers' Quarterly Bull.*, 1980, **43**, 108. – Trials were carried out in which a number of combinations of double-row spacings were employed; the best compromise as regards ease of cultivation and harvest was 172 x 30 cm, although this produced no yield increase. Details are give of observations in respect of germination, early growth, fertilization and harvesting, and it is concluded that, while the lack of yield advantage might be due to lack of experience in working dual rows, the cost of modifying present single-row equipment would outweigh any benefit to be gained.

Field test with a fertilizer replacement. C. Richard. *Sugar Bull.*, 1980, **58**, (15), 10, 14. – Trials were conducted by a Louisiana cane grower, Robert Boudreaux, of a biological soil inoculant consisting of soil bacteria, mycorrhizal fungi and algal spores in a water medium. An untreated control was employed as well as a plot on which anhydrous ammonia was added. While the latter gave a doubled cane and sugar yield compared with the control, the more expensive Agri-Life treatment increased cane yield slightly, but reduced the cane sucrose content, giving no net benefit.

Results of herbicide trials in the 1978-79 season. Anon. *Rpt. Syndicat des Fabricants de Sucre de la Réunion*, 11 pp *(French).* – A detailed account is given of herbicide trials conducted in Réunion in 1978-79. The results are given in the form of tables in which all the monocotyledons and dicotyledons are named, with indications of the incidence of each at the seven locations (representing four soil types) and of their degree of sensitivity/resistance to the various herbicides tested. In all cases, plant cane was grown at the sites; four named varieties were involved as well as a number of unamed varieties at one location. While Karmex, Gesaprim, Perflan, Velpar, Velpar + Karmex, Sencoral, Sencoral + Karmex, Primextra and Dual + Karmex provided good control of the broad-leaf weeds, none of them proved satisfactory against grasses, particularly perennial species.

Herbicide trials. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (Syndicat des Fabricants de Sucre, Réunion),1979, 31-34 *(French).* – *Cyndon dactylon* (couch grass) control with Bromacil (Hyvar X) was tested; effective control was obtained by applying 7.2 or 10.8 kg.ha^{-1} at planting (growth of the weed was somewhat weak 3-4 months after treatment by comparison with the results obtained with 3.6 kg.ha^{-1} Bromacil). Spraying the herbicide directly on the grass was ineffective because of the thickness of the carpet and hence inability of the chemical to penetrate it. Tests are to be conducted to establish the persistence of the herbicide and its phytotoxicity to cane. In trials with a number of herbicides applied for general weed control, Sencoral at 2 kg.ha^{-1} a.i. gave the highest cane yield (119.9 tonnes. ha^{-1}), while the lowest yield in the treated plots was given by Ronstar at 1 kg.ha^{-1} a.i. (102.1 tonnes.ha^{-1}); the yeld in the control plot was 92.6 tonnes.ha^{-1}. Of various chemicals tested for control of *Rottboellia exaltata* at an advanced stage of growth, the only one to prove effective was Gesapax Plus (1.85 kg.ha^{-1} MSMA + 0.9 kg.ha^{-1} Ametryne); a slight necrosis at the edge of the cane leaves that followed treatment disappeared two months later. The same treatment has also proved effective against *Paspalum dilatatum,* a grass which has become troublesome in a very short period of time; however, in view of the fact that MSMA is an arsenic compound, tests are to be conducted to establish residual quantities of arsenic in sugar and by-products.

Chemical ripening of sugar cane suckers. H. J. Andreis and R. P. DeStefano. *Sugar J.*, 1980, **43**, (1), 26-27. Suckers are immature shoots which, when harvested

with mature stalks, reduce the juice quality. The sucrose content had been found to increase on application of Polaris ripener, six weeks before harvesting, and new trials were conducted with aerial spraying of cane with both Polaris and Mon 8000, another Glyphosate formulation which acts as a ripener. Although Mon 8000 could be used in smaller dosage and at a smaller interval before harvest, the improvement it gave in sucrose content in the suckers was not as great as that obtained using Polaris; with the latter, it was possible to harvest all the suckers without detriment to juice quality, whereas with Mon 8000 the effect of spraying was to reduce the harmful effect of accidentally harvesting the suckers.

Study on the response of variety Ja 60-5 to fertilization with (different) levels of nitrogen and potassium. H. Santiesteban A., M. E. Sánchez F., A. Jiménez M. and J. N. Suárez S. *Centro Azúcar,* 1978, **5**, (3), 35-48 *(Spanish).* – Trials were conducted with the title variety on a slightly acid humic carbonate soil in Cienfuegos using 80 $kg.ha^{-1}$ of P and four different levels each of N and P. No responses were observed to the latter two and it is recommended that they be omitted from the fertilization of the area.

Determination of the area and the shape of experimental plots, and the optimum number of replicates for experiments in sugar cane. J. L. Pérez C. and N. Milanés R. *Cienc. Agric.* (Cuba), 1979, (4), 111-115 *(Spanish).* Trials using different sizes and shapes of experimental plot were made in respect of the weight of cane produced; from the results it was concluded that the optimum was an area of 50 m^2, with 5-8 replications. There were no significant differences in respect of yield from differently shaped plots.

Variability in the criteria for sugar cane yield. N. Milanés R. *Cienc. Agric.* (Cuba), 1979, (4), 117-126 *(Spanish).* Optimum size and number of samples and experimental plot area in plant cane and different ratoons were studied as regards their suitability for sugar analyses. Likewise, a method of estimating cane yield in experimental plots was determined by comparing eight methods of estimation. The plot size did not affect sample size and number of samples in plant cane and ratoons. There were no significant differences in sample size. Four samples was the optimum number in each experimental plot, where the best method of estimating sugar cane yield is to count all the stalks in two furrows, one on the outside of the plot and one inside, and to weigh 20 stalks taken from all over the plot.

The climate and sugar cane growth in Taiwan. W. H. Tung. *Rpt. Taiwan Sugar Research Inst.,* 1980, (87), 1-14 *(Chinese).* – Crop growth data and climatic factors over a period of 12 years have been analysed for spring- and autumn-planted canes in an attempt to identify the most significant climatic influences on growth and in order to be able to predict growth. Spring-planted cane showed lower yelds and greater variation than autumn-planted cane. Temperature in February/March and rainfall in April/May appeared to be the most significant factors, while others included typhoon and rain distribution during summer, and winter monsoon in October/November. Further studies of combining factors and multiple correlations need to be made.

Factors affecting diurnal trends of ^{14}C fixation in sugar cane. D. J. Midmore and C. R. McDavid. *Trop. Agric.,* 1980, **57**, 203-209. – The diurnal patterns of radioactive carbon fixation, translocation, stomatal resistance and sucrose content in the free space of the storage tissue were monitored for two cane varieties. Fixation was related to irradiance early and late in the day, but a characteristic mid-day decline in both fixation and translocation was found to be unrelated to irradiance or stomatal resistance. There was inconclusive evidence to support the hypothesis that the free space, by acting as a temporary storage site during periods of intensive photosynthesis, may contribute to the alleviation of product repression of photosynthesis.

A study on the cropping pattern of sugar cane and wheat for efficient use of land and resources. P. K. Bose and K. Thakur. *Indian Sugar,* 1980, **29**, 771-775. – An account is given of trials on systems of intercropping wheat and cane over three years. Although intercropping reduced germination, tillering, plant population and yield of cane, juice quality was not affected and the economic return was higher from the two crops. The least effect on cane was found with November planting of wheat and February planting of cane in space left at the time of wheat planting (a cane yield of 519 *vs.* 723 $quintals.ha^{-1}$ for cane planted alone in November). The yield of cane was lower the later was its planting date; with planting in April, after harvesting of wheat, it was not possible to make a profit (cane yield only 239 $quintals.ha^{-1}$). Planting in February after harvesting of a short-duration brassica crop gave a cane yield of 584 $quintals.ha^{-1}$ and the two crops gave a better return than cane alone.

Present position on use of the chemical ripener Polaris and its large-scale testing and exploitation. K. C. Rao. *Maharashtra Sugar,* 1980, **5**, (8), 21-23. – A summary is presented of the results of trials on Polaris as a cane ripener in India which have shown a positive response. Suitable application equipment is available and large-scale trials are called for, since there are places such as coastal areas and in Tamil Nadu where recovery could be improved by judicious application of the ripener. It is pointed out, however, that in some comparative trials of Polaris and sodium metasilicate, the margin of profit with the latter was greater owing to its lower price.

Effect of subsurface drainage on sugar cane growth and yield in fine-textured soils. P. L. Wang, S. J. Yang and Y. T. Chang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (88), 19-34 *(Chinese).* – Subsurface drainage experiments with drains at 1.2 and 0.8 m depth and at spacings of 15, 20 and 25 m were compared with surface drainage as the control. The water table level fell much quicker after heavy rain than with surface drainage, reaching at least 65 cm after 48 hr compared with only 21 cm in the control plot. Development, nutrient uptake and sprouting of ratoon cane were substantially better in the subsurface drained plots than the control; owing to improved aeration and better physical environment in the root zone, the number and length of the millable stalks and cane yield increased significantly, the latter being 17, 40% and 37% better in plant cane, 1st and 2nd ratoons, on average. The criterion for profitability in the Taiwan Sugar Corporation is amortization within 10 years; this condition should be met by the return on the investment cost for drainage installation if the price of export sugar is higher than $200 per tonne.

CANE PESTS AND DISEASES

Assessment of zinc phosphide-treated bait acceptance by cotton, black and Florida water rats and determination of acute oral toxicity of zinc phosphide to these species. L. W. Lefebvre, N. R. Holler, D. G. Decker and N. J. Shafer. *Proc. Amer. Soc. Sugar Cane Tech.*, 1977, 81-85. — The median lethal doses of zinc phosphide for the title rats were determined. No major differences in acceptance of bait were found between 1.88% zinc phosphide on oat groats and the same quantity of phosphide on cracked corn. Pre-baiting with untreated oat groats appeared to enhance consumption by and mortality of black rats, but not the other two species. A difference in the mortality rate was found between the cotton and black rat after accepting the treated oat groats: 67% of the cotton rats were killed against only 21% of the black rats.

Sexual competitiveness of irradiated male sugar cane borer moths and their F_1 male progeny. J. W. Sanford. *Proc. Amer. Soc. Sugar Cane Tech.*, 1977, 126. — Percent egg hatch was used to evaluate sexual competitiveness of irradiated adult male cane borers (*Diatraea saccharalis*) and their first-generation male progeny. Treated and untreated males were caged with untreated females in various ratios. The treated male parents were comparable in competitiveness to untreated males, However, the progeny from treated males was not competitive with that from untreated males.

Integrated control of the insect pest complex in sugar cane. R. A. Agarwal. *Indian Sugar*, 1980, **29**, 649-658. Advice is given on control of various insect pests by chemical, biological and agronomic means at planting and before, during and after the monsoon period.

The feasibility of screening sugar cane seedlings for resistance to *Argyroploce schistaceana* (Sn.). Y. S. Pan and S. L. Yang. *Rpt. Taiwan Sugar Research Inst.*, 1979, (86), 41-48. — Seedlings from 15 sugar cane crosses were artificially inoculated at 2 months with the first instar larvae of the moth borer, and those showing symptoms of attack were eliminated. The surviving seedlings were transplanted in the field and propagated. The degree of larval infestation was determined one year after planting of the progeny. The extent of seedling elimination and reduced rate of attack in the progeny of selected seedlings, in which parentage included resistant and moderately resistant clones, indicate that seedling evaluation for resistance is practical.

Effects of higher temperature on the development and fecundity of *Corcyra cephalonica* Stainton. W. Y. Cheng, T. H. Hung and J. K. Hung. *Rpt. Taiwan Sugar Research Inst.*, 1979, (86), 51-61 *(Chinese)*. — Between 26° and 32°C, incubation temperature did not adversely affect pupation and mating of emerged moths; these were badly affected by a temperature of 36°C. At 34°C the larval stages did not appear to be affected, nor pupation, the egg production and fertility of the adults were reduced, particularly if the relative humidity were reduced from 44-82% to 20-30%. The moth is a host for moth borer egg parasite *Trichogramme australicum*.

Control of sugar cane early shoot borer in Madhya Pradesh. O. P. Dubey. *Indian Sugar Crops J.*, 1979, **6**, 91-93. — Trials over three years for chemical control of *Chilo infuscatellus* Snell showed that Endosulphan sprayed at the rate of 1.0 kg a.i. per ha over setts in the furrows at the time of planting was the most effective means, followed by treatment with gamma-BHC, Heptachlor and Trichlorofon, all at the same application rate. No deleterious effect on germination was observed.

Cytrolane — a new insecticide for the control of the sugar cane shoot borer (*C. infuscatellus* Snell). M. S. Duhra and J. S. Sandhu. *Indian Sugar Crops J.*, 1979, **6**, 94-95. — Cytrolane, a new chemical, proved as effective as gamma-BHC in controlling *C. infuscatellus* when both were applied at 1.0 $kg.ha^{-1}$. Technical BHC applied at a rate such that the dose of its gamma-BHC content was 1 $kg.ha^{-1}$ also gave the same level of control and was cheaper than the purified material.

Survey of sugar cane pests in Madhya Pradesh. A. N. Kalra and A. K. Mehrotra. *Indian Sugar Crops J.*, 1979, **6**, 96-98. — A survey was made of cane pests in the state during 1962-66, and the results are recorded. *Tryporyza nivella* or top borer was a serious pest as was the shoot borer *Chilo infuscatellus*. The root borer *Emmalocera depresella* occurred to a relatively high extent only in one district, while only mild incidence of the pink borer *Sesamia inferens* and internode borer *C. sacchariphagus* was found. Termite damage occurred in some districts, as did attack by *Pyrilla perpusilla*, the white fly *Aleurolobus barodensis*, the mealy bug *Saccharicoccus sacchari* and the scale insect *Melanaspis glomerata*. The occurrence of a number of natural parasites and predators is recorded.

Ratoon stunting and mosaic diseases. Factors contributing to declining sugar cane yields in Louisiana. H. Koike. *Sugar Bull.*, 1980, **58**, (13), 12-14. — From an average of 30 short tons per acre in 1960, cane yields in Louisiana have declined to an average of 20 tons per acre in 1979. The decline is attributed to the effects of the two major diseases attacking sugar cane in the state, viz. mosaic and ratoon stunting. Mosaic has caused elimination of some varieties such as CP 52-68 and L 60-25 and has spread in moderately resistant varieties to such an extent that roguing is no longer practical. The current leading variety, CP 65-357, occupying about 62% of the Louisiana cane area, is highly infected in most districts. The incidence of ratoon stunting has also increased and has a cumulative damaging effect on cane which is also infected with mosaic. The highest yields in Louisiana are found where heat treatment of setts for ratoon stunting control is applied, and it is recommended that such control measures should be generally applied for control of both diseases.

Effect of defoliation on sugar cane yields. G. Arceneaux, R. E. Folch and J. D. Ayala. *Sugar J.*, 1980, **42**, (11), 12-14. — An attempt was made to evaluate losses in cane production and quality resulting from damage caused by the leaf-chewing caterpillar *Calisto pulchella*, a cane pest in the Dominican Republic. Treatments included 0, 25, 50 and 100% defoliation, corresponding to the fraction

of lamina removed; midribs and sheaths were left intact. It was found that 25% defoliation did not affect cane yield, while 50% caused a drop of 2 tons per acre. An average of more than 4 tons.acre^{-1} was significant in three out of six tests involving 100% defoliation and in the mean of the series. There were varietal differences in the effects of defoliation. The yield of sugar % cane was unaffected by up to 50% defoliation while there was an average fall of 1% sugar in cane with 100% defoliation. The relatively low losses call into question the economics of control measures to reduce the pest population.

Screening for sugar cane smut resistance in Florida. D. G. Holder and J. L. Dean. *Sugar J.,* 1980, **42,** (11), 16-17. – A total of 895 clones have been tested for reaction to cane smut, *Ustilago scitaminea,* in a cooperative trial by the US Sugar Corporation at Clewiston and the USDA Sugarcane Field Station at Canal Point. Of the 38 varieties grown commercially in Florida, 26 were rated as resistant or intermediate and 12 as susceptible. Of 12 varieties grown in Louisiana, all were resistant. The degree of resistance required for a variety to be grown economically in Florida is not yet known and production losses from smut infection will be watched closely in order to establish it.

Testing sugar cane varieties for smut resistance in North India. M. R. Gupta. *Sugar J.,* 1980, **42,** (11), 21. – Fifteen cane varieties were tested by dipping 30 setts in a spore suspension, incubating overnight under high humidity at about 30°C and then planting between rows of infected and susceptible cane. Secondary infection was determined by dusting of smut spores on the test rows at 3 and 4 months of age. Only Co 1148 proved resistant (less than 1% infection), while Co 312, Co 453, CoS 728 and CoS 7923 were moderately resistant (1.1-5% infection). The use of resistant varieties is the best method of avoiding losses but, owing to the development of different strains of the fungus, it is desirable that even resistant canes should not be grown continuously for too long in the same locality. Hot water treatment of setts at 50°C for 2 hours is one method of controlling the disease in plant cane, but disease incidence and loss is usually greater in ratoons.

Studies and observations on rust disease in Queensland. C. C. Ryan and P. E. Ledger. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 71-73. – Rust, caused by the fungus *Puccinia melanocephala,* was first observed in Queensland in October 1978 and eight months later had spread to all cane areas in Queensland and New South Wales. A monitoring program was established to follow development of the disease in 1980, and young plants were screened for resistance to rust. Trials were made in the glasshouse for assessing the activity of 21 fungicides against the fungus, and eight were selected for field trials. Of these, Bravo, Dithane M-45, Plantvax 75W and Polyram 2000 gave best control. Trials were carried out to assess yield loss; however, rust intensity declined so much that they were abandoned. Evidently, the disease fluctuates markedly from year to year, depending on the suitability of conditions for spore production and infection.

Continued experiments with non-volatile nematicides in North Queensland sugar cane fields. K. J. Chandler. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 75-82. Trials carried out in 1979 are reported, which are intended to improve understanding of factors governing the effective use of Aldicarb (Temik). They showed that better nematode control and higher cane yields were obtained at sites subject to rainfall or irrigation soon after application than at sites which received no incident moisture but where the granules were placed in moist soil near to or above the plants. Thus Aldicarb appears to achieve maximum benefit by leaching from its carrier rather than simple diffusion in the soil moisture. The failure of Aldicarb-treated plots to respond in the absence of supplementary Ca and Mg indicates that many of the minimal responses on light soils in North Queensland may be partly due to growth limitations imposed by nutrition imbalance.

Studies on the relationship between germinating position of cane buds in the soil and smut infection. S. Yamauchi. *Bull. Okinawa Agric. Expt. Sta.,* 1980, (5), 39-43 *(Japanese).* – In a field of germinated setts, those which were infected with smut had germinated from a bud depth of 0-12 cm, 80% of them germinating from 0-6 cm deep. The healthy cane had germinated from buds 3-18 cm deep, almost all germinating from below 6 cm. When using artificial infection by inoculation of a suspension of smut teliospores, the infection rate was higher in a furrowed plot than a non-furrowed one. It is concluded that infection by invasion of smut hyphae occurred in the shallower portions of the soil.

Biology and habits of *Campsomeris annulata* (Hymenoptera:Scoliidae), a monoparasitic ectoparasite of a sugar cane white grub, *Anomala albopilosa* (Coleoptera: Rutelidae). M. Nagamine. *Bull. Okinawa Agric. Expt. Sta.,* 1980, (5), 45-51 *(Japanese).* – Laboratory studies were made on *C. annulata.* It showed no interest in the 1st and 2nd instar larvae of *A. albipilosa* but laid eggs to parasitize the non-aggressive 3rd instar larvae of the later feeding stage of the early non-feeding yellow larval stage. These hosts were usually killed by the parasite and the rate of successful egg-laying decreased markedly. Similar behaviour was found with the 2nd instar larvae of *Melolontha masafumii* which are almost identical in size with the *A. albipilosa* 3rd instar larvae. The egg and larval periods of the parasite on the host were 2-5 and 9-15 days, respectively, while the pupal period in cocoon was 43-49 days and longevity of the female after emergence was 2-3 months. Three generations of the parasite appear possible per year, but as the white grubs are in an active feeding stage in the summer, some other hosts may be necessary for continuous propagation of the parasite.

Anti-coagulant rodenticides tested. Anon. *Cane Growers' Quarterly Bull.,* 1980, **43,** 96-97. – Trials were carried out on comparison of cane damage by rats baited with Difenacoum at 0.84 and 1.68 kg.ha^{-1}, Brodifacoum at 1.68 kg.ha^{-1} and Diphacinone at 0.84 and 1.68 kg.ha^{-1}, the standard treatment being thallium sulphate at 0.84 kg.ha^{-1} and unbaited control fields. Difenacoum gave as good control as thallium sulphate at the same rate, and the number of rat-bitten stalks was reduced further when the rate was doubled. Brodifacoum was less effective, while Diphacinone cannot be recommended.

CANE SUGAR MANUFACTURE

Coal firing of sugar mill boilers. J. M. Hunt and R. J. Wilson. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 127-131. — With the low-fibre cane grown in Australia, the use of supplementary fuel is common. The current cost and availability of oil are causing managements to consider the use of coal as a substitute, and the paper refers to earlier experiences, in Australia and elsewhere, with the use of coal to supplement bagasse in raw sugar factories and other industries. Combustion aspects of combined and alternative firing are considered as are the mechanical and physical aspects of introducing coal to new and existing furnaces, and the influence this has had on the design and performance of boiler plant and its ancillaries.

Coal as a fuel in bagasse fired boilers. R. M. Jones and D. F. Maddison. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 133-136. — One of the boilers at Millaquin sugar factory was adapted to burn a mixture of coal and bagasse, and an account is given of initial experience with the mixed fuel. Although mechanically simple and economically attractive, there were some handling and control problems. Few difficulties arose when burning up to 6% coal in the mixture — sufficient to provide a surplus of bagasse — but with greater quantities, and especially with 40% coal or more, combustion was felt to be uncontrolled and losses were high. It could be that separate firing of coal, unmixed with bagasse, would be desirable.

The use of sawdust as an auxiliary boiler fuel at Proserpine. K. Howell and F. Doolan. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 137-140. — A sawmill close to Proserpine factory faced a problem in disposal of sawdust and scantlings, which totalled some 18 tonnes per day, and trials were made on burning it in combination with bagasse. An account is given of these and aspects of burning sawdust. It could be stored in the open and time did not mar its burning quality. Moisture content was similar to that of fresh bagasse but the density was about 400 $kg.m^{-3}$ against 160 $kg.m^{-3}$. Calorific value was about one-third higher at normal moisture content. The forced draught fans needed to be operated constantly when sawdust was burnt since, unlike bagasse, natural draught was insufficient and the fire went out if the fans were stopped. The sawdust replaced about one-third of its weight in oil fuel.

A computer-based maximum demand indicator for electricity monitoring and control. G. D. Dyne and R. J. McIntyre. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 141-145. — In order to economise on bought electric power, a computer program was prepared for continuous comparison of actual *vs.* target demand for bought power. An account is given of the application of the system which made use of the factory's computer and provided an inexpensive means of reducing costs.

Corrosion fatigue in mill roller shafts. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 155-158. — A description in given of the discovery of fatigue cracking on the surface of the roller shafts of the Pleystowe spherical roller bearing mills. The nature of corrosion fatigue is discussed as well as its prevention, particularly in respect of mill roller shafts. Points to bear in mind in future roller design to prevent fatigue are listed.

Direct measurement of mill drive turbine and gearing efficiencies. D. M. Jenkins and G. M. Jorgensen. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 159-165. Methods of measuring torque at both high and low shaft speeds using strain gauges have been used successfully to evaluate the performance of a steam turbine mill drive. The accuracy of the methods used was not sufficient to make a full evaluation of the gearbox transmission efficiency. While this was an evaluation of a particular turbine, the importance of nozzle area and supply pressure in limiting power output emerged. In developing methods to measure tailbar torque, some phenomena associated with bending of the bar inherent in the coupling design and misalignment became apparent. An explanation of these fluctuations in torque signals is offered, as well as a method of instrumentation to avoid the effects on torque measurement. In addition, measurements of shear and axial stresses due to bending have been made on a full size tailbar under operating conditions.

Two methods for mill torque control. A. E. Waring and J. E. McLaughlin. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 167-172. — Cane supplied to Goondi mill has the lowest fibre content in Australia, and minimization of supplementary fuel requirements demands mill performance to give the lowest possible bagasse moisture. The last mill is not fitted with hydraulics but uses CSR toothed feeder rollers and is turbine-driven. The combination has led to stalling, shear pin failures, damaged chutes and excessive torques, and a control system has been installed to increase turbine revolutions before these conditions occur. Changes in the system during 3 years' operation are described. The feed chute control is a conventional level control while the override control uses the first stage pressure of the turbine to control the turbine; from a base speed of 1800 rpm at 220 kPa, speed rises to 3500 rpm for a rise of 60-80 kPa in first stage pressure. The pressure signal is fed to a proportional controller from which the output is fed into a high select relay along with the signal from the level controller and effectively forms the torque control for the mill. Proportional controller settings have been adjusted over a period to restrict the rate of command signal, because of the rapid response of the Woodward PG-PL direct-acting governor employed. In 1979 the system operated throughout the season and average bagasse moisture was 46.05% against 47.2% a year earlier. At Victoria mill, different cane varieties impose variable loads on the mill and the relief devices were activated, resulting in severe stop-start conditions in the flow of cane. By relaxing mill settings, the harder canes were milled satisfactorily but extraction fell with softer canes. In a new system, the bottom section of the feed chute back was hinged and arranged to be moved by a power cylinder actuated by a controller in response to the pressure signal from the first stage of the mill turbine. The movement of the hinged section thus decreases or increases the feed mat thickness in response to the turbine pressure in a continuous manner, allowing smoother operation.

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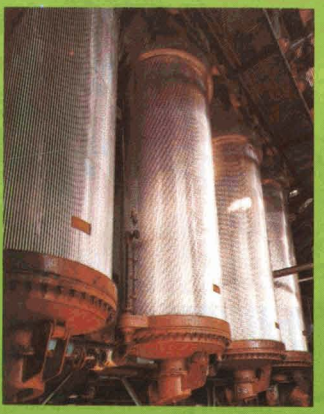

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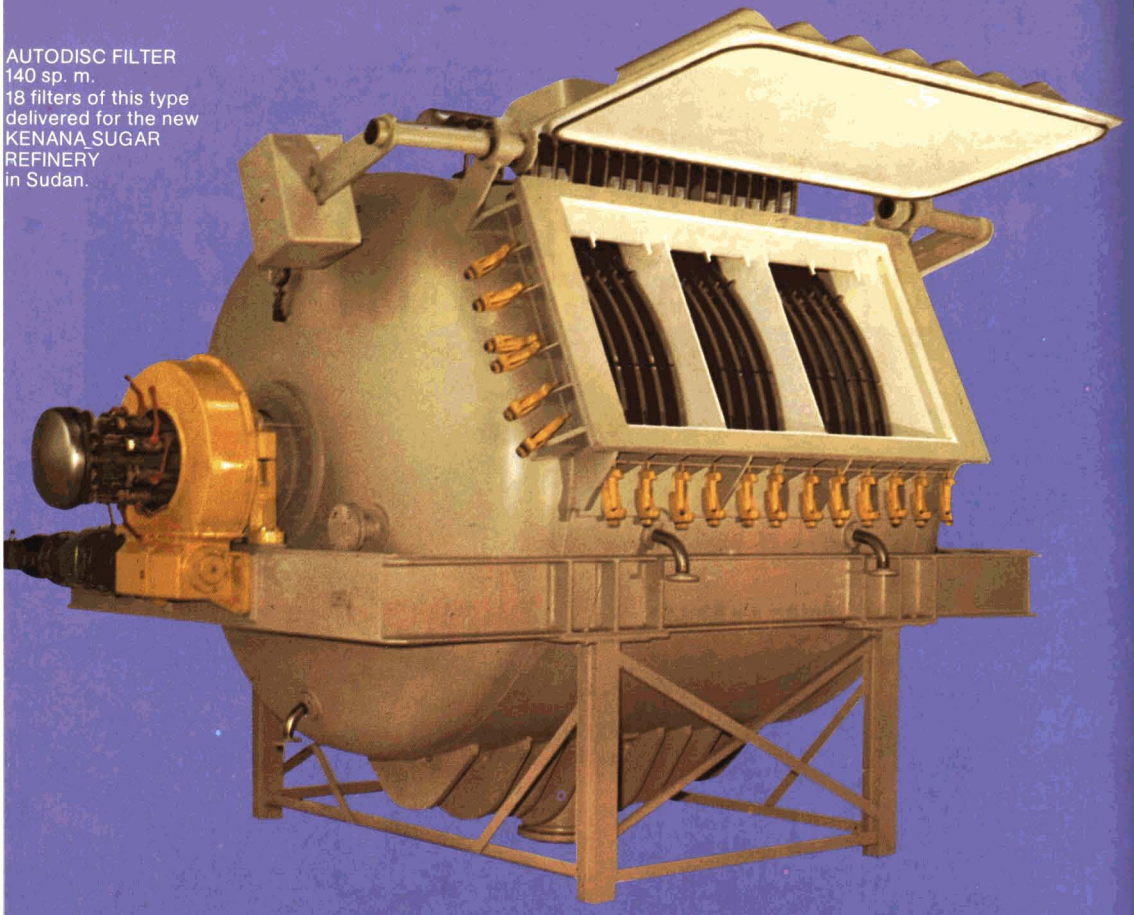

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Successful bearing modification to a BMA K1000 centrifugal. M. J. C. Rieck. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 173-175. – The bottom bearing on the spindle of the BMA K1000 continous centrifugal had shown an unacceptable failure rate, but this was found to be reduced by keeping the machine running even if not in operation. Modifications had raised the throughput from 3 to more than 12 tonnes per hour, requiring a drive power rise from 30 to 45 kW, which had added to the radial load on the bearing. A new SKF double-row spherical roller bearing was fitted to one machine at Isis mill in 1978, and showed no sign of wear at the end of the 1979 season. It replaced the original double-row angular contact ball bearing which is simpler to fit, but the use of the more complicated bearing and the need to employ a competent technician for assembly is considered justified, and the other machines at Isis are to be modified in the same way.

A plant trial of a direct vapour contact juice heater. P. G. Wright and R. T. Hutchinson. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 177-184. – A plant trial of a device for the direct-contact primary heating of raw cane juice with evaporator vapour is described and information given on its performance as regards approach temperature, capacity and controllability, The design, developed jointly by Walkers Ltd. and Sugar Research Institute staff, followed the general principles of a rain tray condenser, with allowance for extra volume above the rain tray for juice frothing. Neither frothing nor blockage or the rain tray holes with juice solids proved a problem and the heater was found to perform very well with the approach temperatures of the outlet juice to the saturated vapour temperature in the body of the heater often less than 1°C. Good juice temperature control was achieved using a control loop operating on a butterfly valve in the vapour inflow line. The application of the device for primary juice heating is briefly reviewed. Further tests for full secondary heating of juice are planned.

Automation of the low grade (centri)fugal station at Goondi using reflectance meters. R. W. Hutchins, N. G. Skippen and A. G. Lendon. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 185-194. – With modification of the centrifugal station from a mixture of batch and continuous to all-continuous, while the crystallizer station remained as a batch system, a control system was required which could cope, under minimum supervision, with gradual and sudden changes of massecuite head in the supply vessel feeding the centrifugals. Previous work[1] had shown that reflectance meters could be used to control *C*-sugar purity, and this was adopted for 1979. An account is given of the system and trials to test the performance of the centrifugals under reflectance meter control of the feed rate. It was possible to maintain a given *C*-sugar purity for many hours without adjustment, and the control system was successful in greatly reducing the requirement for supervision of the station. The meters did not give an absolute measure of sugar purity over longer periods, however, and work is necessary to confirm that adjustments to the set-point are necessary because of changes in sugar surface properties and not because of calibration drift. Some variation in *C*-sugar purity at constant reflectance could be attributed to changing steam:water ratios applied.

Massecuite viscosity – some observations with a pipeline viscometer. J. N. Ness. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 195-200. – A series of measurements were made of flow of massecuite through a jacketed tube from a reservoir above, under air pressure, the whole being maintained at constant temperature. The flow rate was measured and shear rate and shear stress calculated from the tube dimensions, pressure and head difference, using different samples of massecuite and different temperatures and tubes. From the results, the effects of temperature, tube dimensions, end effects and time dependency were examined and are discussed. It is concluded that, to obtain the true shear stress-shear rate curve from pipeline viscometry, allowances must be made for the influence of wall and end effects, and measurements must be made on each massecuite with at least nine different tubes (three diameters and three lengths). Alternatively, the pipe used must be of sufficient diameter that wall effects are minimized and be of a sufficiently large length:diameter ratio that entrance effects can be neglected.

Breakage of sugar crystals on impact. R. J. Swindells and E. T. White. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 201-209. – Experimental study showed that crystal breakage on impact with a target increased with higher velocity and greater crystal size. Surprisingly, raw and refined sugars showed different results. Changes in impact angle gave unexpected results, greater damage occurring at 60° than at 90°; this may be due to multiple impact with the crystal ricocheting to strike the wall of the collection box and suffer further damage. Coating the impact surface with rubber reduced the amount of breakage, and a liquid surface gave far less breakage; this was not greatly affected by the viscosity of the liquid or the thickness of the liquid layer over 2 mm. The implication of the results is that crystal breakage in a continous centrifugal may be reduced by (i) lowering the velocity of crystal impact with the casting, (ii) reducing the angle of impact, and (iii) impacting with a liquid surface, e.g. a thin stream of liquid flowing down the inner surface of the casing.

Development of a continuous seed crystal preparation technique. R. Broadfoot and R. T. Hutchinson. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 211-219. Possible methods for continuous production of seed crystal footings for low-grade boiling are discussed and the desired characteristics of such a footing described. The design of a cooling crystallizer for continuous controlled growth of milled sugar slurry in a concentrated molasses is considered, and an account given of such a unit constructed with a capacity equivalent to 18 tonnes.hr^{-1} of final massecuite and evaluated at North Eton sugar factory. Results fell short of predicted seed production, mainly because of inadequate cooling water supply. The trials indicated, however, that the design offers a potential for continuous production of seed crystal of consistent quality suitable for both batch and continous low-grade pans. Some practical difficulties with molasses pre-concentration and with the stirrer arrangements need to be overcome before the system is fully suitable for commercial use.

Trial of defeco-melt-phosflotation without sulphur. A. C. Chatterjee, A. F. Golandaj, S. R. Kalswad and H. R. Apte. *Maharashtra Sugar,* 1980, **5**, (6), 19-20, 22-28, 30-33. – See *I.S.J.,* 1981, **83**, 215.

[1] Miller & Wright: *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 79-84.

BEET SUGAR MANUFACTURE

Thermal degradation of sugar in condensates used to feed boilers. E. D. Yarmilko and V. D. Tsyutsyura. *Sakhar. Prom.*, 1980, (6), 39-41 (*Russian*). — Investigations are reported in which sucrose in model solutions of 0.001-0.1% concentration was heated at a temperature in the range 175-280°C, i.e. approximating to the conditions in a boiler. The degree of degradation was established from the pH and conductivity. Graphed results showed that both pH and conductivity closely reflected the changes in sucrose degradation but were not significantly affected by the length of time the solution was heated, so that either parameter was considered a suitable basis for an instrument to detect the presence of sugar in condensate used as boiler feed.

The fourth Syrian sugar factory of Czechoslovak make before being put into operation. M. Skrabal. *Czechoslovak Heavy Ind.*, 1980, (7), 2-8. — A detailed and illustrated account is given of the 4000 tonnes daily slice beet sugar factory at Deir ez Zor under construction in Syria. It will receive beet from an area of about 12,000 ha and produce white sugar for domestic use and possible export to neighbouring Arab countries. The plant, supplied through Technoexport, is built by the Czechoslovak Engineering Works at Hradec Kralove.

Wet dust separation from pulp dryer waste gases. Campaign experiences with the first large-scale unit in West Germany, 1979. F. Amding. *Zuckerind.*, 1980, **105**, 547-553. *(German).* — Details are given of the wet dust separation system installed by Keller Lufttechnik GmbH & Co.KG at Munzel sugar factory, where the predominance of westerly winds means that the pulp dryer waste gases are usually blown over the neighbouring residential areas during the campaign. The hourly throughput of the pulp dryer is about 30 tonnes, and the equivalent hourly dust content of the waste gases about 50 kg (280 $mg.m^{-3}$ wet). The gases are first treated in a cyclone for removal of coarse dust particles, after which they are treated in a second cyclone for fine particle separation. The dust-laden water passes under gravity to a settling tank, from which the separated dust components are recycled to diffusion together with press water, while some of the diffusion water is passed through the dust extractor to absorb SO_2 from the waste gases; the other water from the settler is injected into the recirculation system. Hence, during the campaign no waste water emanates from the dust separation system, which reduces the SO_2, N oxide and total C content by 20-40%.

Sucrose crystallization kinetics applied to the Quentin low-grade boiling. V. Maurandi and G. Mantovani. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 23 pp. — Molasses exhaustion depends to a large extent on the method of conditioning massecuite in the crystallizers. The most fundamental parameter is crystallization rate, and this may be expressed by an equation which represents a family of curves showing, for every value of the non-sugars:water ratio, a maximum when supersaturation and viscosity increase. For molasses produced following use of the Quentin process, the maximum crystallization rate corresponds to a supersaturation of 1.3-1.35, when the NS:W ratio is 2.7-3.4. The surface reaction order is a little higher than 1 at 40°C and higher than 1.1 at supersaturation, according to a statistical method devised by the authors. Bearing in mind that mutual motion between crystals and mother liquor in the mixers is practically nil, crystallization rates were obtained for stationary crystals weighing about 170 g. From viscosity data and using a probability method, it is possible to evaluate the surface reaction resistance, when experimental and calculated values of crystallization rate may be compared. For good exhaustion it is considered that Quentin molasses purity should be 75 at most. Four hours are needed for the temperature of massecuite to fall to 60°C in the mixer, at a supersaturation of 1.3; with an eventual temperature of 40°C, the final molasses supersaturation should be 1.04. Economic, mechanical and technological factors limit the value of the NS:W ratio, which should be as high as possible for maximum recovery. The effect of the NS:W ratio value on the time necessary to hold massecuite in the mixer to achieve cooling from 60° to 40°C while maintaining supersaturation at 1.3 to maintain maximum crystallization rate is discussed, as is the effect on viscosity of the NS:W ratio and the ratio of exchange of Mg for Na + K. Pre-spinning and slow reheating are mentioned as means of lowering the massecuite consistency.

The UK view of the future energy scene. B. Hutchinson. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 22 pp. — A survey is presented on the significance of energy in the modern world, on the present energy situation and reserves, and the future of fossil fuels — oil, coal and natural gas. Prospects for the United Kingdom are summarized and measures which should be taken with steam raising plant are listed.

First steps in vapour compression. T. Lubienski. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 26 pp. — Mechanical vapour compression is one method of achieving balance in an evaporator station, i.e. to supply the vapour demands of the factory for heaters and pans and to evaporate the thin juice to the required Brix without passing heat to the condenser. Two installations in the British Sugar Corporation are intended to meet that aim; the Wissington plant consists of two electrically driven Roots compressors, while the larger vapour volume at Bury St. Edmunds requires use of a steam turbine-driven centrifugal compressor. Both systems are described and the results achieved discussed. Both have proved simple to operate, with easy and effective control using the variable-speed drive. When required, thick juice Brix can be controlled by the output of the compressor. No problems have been reported with surging at Bury, and only slight wear has occurred.

The influence of colour and ash content of syrups on white sugar quality. A. Rossi and V. Maurandi. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 18 pp. — Crystallization of white sugar from syrup is discussed, and it is pointed out that co-crystallization of $CaSO_4$ and inclusion of impurities within the

crystals will occur to a greater extent, the lower the purity of the original syrup and the higher the ash content. An account is given of trials at an Italian sugar factory on modification of the boiling scheme in order to reduce white sugar colour and ash. Originally a three-boiling scheme was employed, with affination and remelting of the 2nd and 3rd sugar to return to the thick juice used for 1st product boiling. One variant boiled the 1st product sugar on 2nd and 3rd product remelt with part of the thick juice used as feed toward the end of the strike while the remainder of the thick juice was used as feed for the 2nd product together with 1st product run-off. In the 2nd variant, the part of the thick juice used for the 1st product feed was demineralized by ion exchange treatment. Two more schemes were used in which the thick juice fractions used in 1st product boiling were sulphited with SO_2 gas after addition of NaOH. Both factors reduced the colour and ash in the white sugar, sulphitation being particularly effective. Laboratory and pilot plant trials are continuing on further modifications whereby the thin juice is deionized and the thick juice decolorized on anion exchange resin. Both have given good reduction of white sugar colour, purity and yield, but require more energy and increase the waste water pollution load.

Methods of beet handling: their effects on beet breakage and sugar losses. D. F. A. Horsley. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.,* 1980, 19 pp. – A survey has been carried out to assess the type, extent and sugar loss consequences of breakage of beet roots during passage from the fields to process, with special attention to the various methods employed at British sugar factories for unloading of road trucks on which all beet is currently received; this includes wet unloading with Elfa guns, tipping of truck loads into a hopper, and tippling of loads by means of platforms which are raised at one end so that the whole truck and its contents are tilted. Factors that affect breakage, particularly the height of fall, fanginess of the beets, nature of the surface, etc., are mentioned, and an attempt is made to estimate the sugar loss. Tipping methods involve losses about double those with wet unloading. A summary is made of measures for reducing damage and the considerable losses revealed by the survey.

The environment and York sugar factory. W. Marsden, M. F. Branch and W. H. Hodgson. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.,* 1980, 38 pp. Over the years, the city of York has spread so that the sugar factory, once some distance away, is now mostly within the city's borders and is consequently affected by legislation to prevent nuisance. The history of the effects of urban planning and measures taken by the factory management are described, with accounts of means adopted to abate specific nuisances – settling pond odours, pulp dryer odours and exhaust dust and waste water pollution – with particular attention to the activated sludge plant used for the last.

Processing frozen and deteriorated beet. R. S. Palmer and S. C. H. McCarey. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.,* 1980, 32 pp. Beets which become frozen deteriorate rapidly on thawing and cause problems in processing owing to their increased dextran and reducing sugars and reduced sucrose contents. Damage can be minimized by proper clamping but, after recent mild winters, some farmers did not attend satisfactorily to clamping in the 1978 crop so that frost-damaged beet started to arrive at Ely sugar factory. A system of screening of loads by visual inspection was instituted, and quality improved when loads of damaged beets were refused. Freezing of loads in trucks caused problems with unloading and, since tipping involved a hazard of overturning, all trucks had to be unloaded wet. Low ambient temperatures caused difficulties in fluming, and condensate addition helped to some extent. Maintenance of transport water quality required additional lime and anti-foam oil. The higher amount of mud and stones increased knife usage markedly, and it was necessary to cut bigger cossettes to compensate for the lower strength of deteriorated beet. Slice rate was reduced to permit continuous diffuser operation. Even with higher than normal addition of formaldehyde and sulphuric acid, lactic acid production during diffusion increased. The deteriorated beets gave juice which did not clarify properly and the cloudy juice led to filtration problems and higher lime and flocculant usage. Dextran in juice reduces the size of $CaCO_3$ particles, making them less easy to filter; by adding Sturcal F, a preformed $CaCO_3$ in aragonite form, the precipitated material accumulated on this and benefited filtration. Problems arose in evaporation owing to variations in juice supply because of filtration problems and at times it was necessary to recycle water. Another problem was scaling caused by the high lime salts content. The falling juice purity made boiling more difficult and white sugar yield fell relative to that of low-grade sugar, while molasses loss increased as did boiling times.

The conversion of Peterborough factory to white sugar production, 1978/79. J. P. Vessey. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.,* 1980, 22 pp. – A detailed account is given of the planning involved in changing from raw to white sugar production from a daily slice of 5500 tonnes and construction of a 60,000 tonnes storage facility; this includes the civil engineering, plant installed, electrical work, instrumentation and control, etc. Operation problems in the factory and silo are summarized.

Percolating extraction of sugar beet cossettes. H. Zaorska. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.,* 1980, 22 pp. – As extraction of the sugar content of beet cossettes becomes more complete, other non-sugars are also extracted, and there is consequently a limit beyond which it is less economical to extract the sugar than to leave it in the pulp. A laboratory extraction unit has been used to analyse the juice and brei contents during percolation extraction, and it is concluded that it is best to leave 0.2-0.3% of sucrose in pulp.

Fluidized-bed dryers for sugar. H. Dabrowski. *Gaz Cukr.,* 1980, **88**, (5), 142 *(Polish).* – Reference is made to tests on fluidized-bed dryers at two Polish sugar factories: at Miejska Gorka a vibratory-fluidized bed dryer reduced the sugar moisture content from 0.4% to 0.04% and the temperature from 60° to 38°C at an hourly throughput of 10 tonnes; at Strzelin, the moisture content was reduced from 0.8% to 0.04% and the temperature from 65° to approx. 40°C in a vertical, free-fall model, at an hourly throughput of about 20 tonnes. Crystal damage by abrasion has been found to be considerably less than in mechanical dryers.

LABORATORY STUDIES

A serious look at titratable acidity. F. A. Martin. *Proc. Amer. Soc. Sugar Cane Tech.*, 1977, 92-95. Titratable acidity, as a measure of cane juice quality after a frost, is discussed and methods of determining it surveyed. It is stressed that the method involving titration against phenolphthalein was developed at a time when all cane was being manually harvested in Louisiana, whereas now almost all of it is mechanically harvested. This means that juice samples are often dirty (because of the trash and mud accompanying the cane), and colorimetric detection of the end-point in such samples is impossible, so that modification of the method, with electrometric determination being used, is necessary. Moreover, divergence has been found between the acidity of juice samples extracted by roller mill (for which the method was originally devised) and that of samples extracted by a pre-breaker press after core sampling. This difference should be investigated, as should the relationship between titratable acidity and the content of gums plus dextrans.

Investigation of changes occurring in sugar beet during storage. I. General questions concerning carbohydrate metabolism in sugar beet. K. Hangyál and R. Lásztity. *Cukoripar*, 1979, **32**, 207-211. **II. Nitrogenous non-sugars metabolism.** *Idem: ibid.*, 1980, **33**, 9-14 (*Hungarian*).

I. The metabolic processes that occur in stored beet are explained, covering the degradation of sucrose, via glucose and fructose, to pyruvate and, via the citrate cycle, to formation of cytochrome oxidase. The metabolic pathways are indicated, and the important stages described in greater detail (the monosaccharide phosphate cycle, glycolysis and the citrate cycle, and formation of soluble end-oxidases), and those factors affecting beet respiration briefly discussed.

II. Descriptions are given of the metabolic processes involving nitrogenous constituents in the sugar beet, including nitrate assimilation and the role of ferredoxin in reduction to nitrite, ammonia assimilation and the formation of amino-acids and amides, the part played by nitrogen in carbohydrate metabolism, the effect of climatic factors on nitrogen metabolism in the beet, and changes in the composition of nitrogenous components, which under normal conditions are insignificant. The relationship between sucrose metabolism and nitrogen metabolism is indicated.

Fluorimetric determination of sugars on high-performance thin-layer chromatography plates. B. Büchele and J. Lang. *HRC CC, J. High Resolut. Chromatogr. Chromatogr. Commun.*, 1979, **2**, (9), 585; through *Anal. Abs.*, 1980, **38**, Abs. 5C20. – A method is described for preparing fluorescent derivatives of aldoses and ketoses on the TLC plate; no treatment except heating is required. Spots (0.2 µl of 0.1% solution of the sugars) were applied to plates precoated with Silica gel 60 and chromatograms were developed twice for 4 cm with 17:3 acetonitrile:1% ammonium carbonate solution. Detection was by covering the plate with a sheet of glass, heating for 10 min at 160°C and examining the fluorescence excited by radiation of 366 nm. All aldoses and ketoses of the Merck sugar reference standard kits showed intense fluorescence after such treatment; sugar alcohols (e.g. mannitol, sorbitol and meso-erythritol and -inositol) and (1 → 1) linked di- and oligo-saccharides (e.g. sucrose, raffinose and trehalose) did not. The detection limit for glucose was 10 ng.

Selective detection of fructose and sucrose by means of 1-chloro-2,4-dinitrobenzene and ion exchange resin. S. Z. Qureshi and S. Anwar. *Fresenius' Z. Anal. Chem.*, 1979, **298** (1), 46; through *Anal. Abs.*, 1980, **38**, Abs. 5C21. The test solution is boiled with H_2SO_4 and Dowex 50W-X8 (H^+ form) beads impregnated with 1-chloro-2,4-dinitrobenzene. Fructose and sucrose (down to 14.4 and 3.2 µg, respectively) give an orange colour on the resin. Glucose, lactose, xylose, rhamnose and arabinose give negative results. Colours given by organic compounds likely to interfere are listed.

Separation of higher sugars using HPLC Amine Modifier I. K. Aitzetmüller, M. Boehrs and E. Arzberger. *HRC CC, J. High Resolut. Chromatogr. Commun.*, 1979, **2**, (9), 589-590; through *Anal. Abs.*, 1980, **38**, Abs. 5F7. – The use of the cited modifier to convert a conventional silica HPLC column into a highly efficient column for sugar analysis is described. At a modifier concentration of 0.01 to 0.03% in the 79:46 acetonitrile: water mobile phase, the impregnation of the silica allows use of high proportions of water in the mobile phase without adverse effect on the separation of glucose from fructose. Retention times are stable. Unbranched sugars are eluted according to the number of hexose sub-units present, but cyclodextrins are eluted much earlier than in the absence of the modifier. Acids remove the modifier from the column by salt formation, so that the technique cannot be applied to samples (e.g. soft drinks) containing citric or ascorbic acid; large amounts of salts also interfere.

Effect of polysaccharides on the viscosity of final molasses. E. R. Fleites, L. Marimon and M. Darias. *ATAC*, 1979, **38**, (2), 28-33 *(Spanish)*. – Dextran was added in various proportions to a final molasses and the viscosity measured, the experiments being repeated ten times and the results subjected to statistical analysis. Dextran in the range 500-5000 ppm produced an increase in viscosity with a highly significant correlation ($r = 0.988$) between the amount of dextran and the increase.

Improved thin-layer chromatographic method for sugar separations. M. Ghebregzabher, S. Rufini, G. M. Sapia and L. Lato. *J. Chromatogr.*, 1979, **180**, (1), 1-16; through *Anal.Abs.*, 1980, **39**, Abs.1D95. – The use of pre-coated non-impregnated Silica gel 60 plates for one- and two-dimensional separations of carbohydrates and related compounds is described. Benzeneboronic acid and H_3BO_3 (at different concentrations) were added to the organic elution systems in order to investigate their effects on the rate of migration of the sugars. The migration of some sugars was partially inhibited by H_3BO_3, and most of the sugars tested could be separated in a one-dimensional single-elution mode. Benzeneboronic acid produced an increase in the R_f values of certain sugars; however, some tailing occured, except in systems also containing both benzene and a benzoate. Components of complex mixtures of carbohydrates of

clinical interest could be separated by two-dimensional TLC with eluents containing H_3BO_3 or benzeneboronic acid.

Determination of potassium in beet by 14-MeV neutron-activation analysis. M. Berrada, M. A. Misdaq and P. Thalouarn. *J. Radioanal. Chem.*, 1979, **54**, (1-2), 361-366; through *Anal. Abs.*, 1980, **39**, Abs. 1G2. – The diffusion of K^+ into beet cells was studied by immersing samples of beet, cut into discs (20 mm x 1 mm), in solution containing various amounts of KCl and $HgCl_2$. After a 24-hr immersion, the samples and standards (prepared from mixtures of graphite and K_2CO_3) were irradiated for 10 min at an average flux of approx. 5×10^8 n.cm^{-2}.sec^{-1}; after a 1-min decay period, K was determined by measuring the activity, due to the $^{39}K(n,2n)^{38}K$ reaction, with a 67-cm^3 Ge(Li) detector and computer-based pulse-height analyser. The contribution to the measured peak area from ^{38}Cl, produced in the $^{37}Cl(n,\gamma)^{38}Cl$ reaction, was 1%.

The determination of the inorganic component of raw sugars. R. J. Noakes, D. P. Schweinsberg and N. J. Sichter. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 227-233. Work carried out by the Department of Chemistry of the Queensland Institute of Technology, in Brisbane, on the determination of inorganic constituents of raw sugar is described. Atomic absorption and flame emission spectroscopy were used to determine Mg, Ca and K (using direct dilution of the sample), Fe, Mn, Na and Zn (using pre-concentration by sulphate ashing of the sample – this was also used for Mg, Ca and K), and Cu (using pre-concentration by an ion exchange method which was also used for the other elements). Inductively coupled plasma spectroscopy was employed for other elements that could not be measured by atomic absorption spectroscopy; Al, Ba, Mo and Ni were measured quantitatively, while Cr, Co, Cd, Pb, B and Se were scanned, but their concentrations were too low to be determined.

Enzymatic and liquid chromatographic analysis of sugars in process materials. P. C. Ivin. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 235-245. – Enzymatic and liquid chromatographic techniques have been assessed for their utility in analysis of sucrose, fructose and glucose in process materials in a cane sugar factory. While the enzymatic techniques are inferior to liquid chromatography in that the latter is not subject to the same type of interference, they require relatively inexpensive equipment and would be more adaptable to a sugar factory environment. Both methods should be seen as complementary techniques for determining the three sugars in low-purity materials with improved accuracy and comparable precision to that obtainable with present routine procedures.

Comparison of different methods for determination of the dry solids content of sugar syrups of varying purity. G. Pollach, L. Wieninger and H. Berninger. *Zuckerind.*, 1980, **105**, 451-456 *(German)*. – A number of methods for molasses solids determination were compared: (1) vacuum oven drying on sand at 65°C[1], (2) drying on filter paper at 105°C, using a modification of the Josse method[2], (3) as (2) in principle, but with pre- and main drying carried out under vacuum at 105°C for 18-24 hr, (4) the Karl Fischer titration method, (5) refractometric measurement, and (6) density measurement. Comparison between the first four methods showed that (1) and (3) gave higher values than (4) (with a mean deviation of +1.25% and +0.61% absolute, respectively), while method (2) gave values which were lower by an average of – 0.63% and – 0.62% (in two series of tests, one conducted on a routine basis throughout a campaign at a sugar factory). The mean divergence between methods (1) and (4) was in close agreement with values given in the literature. A micro-method developed by the Canlubang Sugar Estate Laboratories[3] gave values which were on average lower by 0.80% absolute than results given by (1). Comparison between theoretical values for pure sucrose solution and values given by (1), (2) and (3) showed that the results given by the filter paper methods were closer to the theoretical values than were those given by vacuum oven drying on sand and appeared to give better reproducibility, while also requring less time than the Karl Fischer titration method, which would be of advantage only at higher dry solids contents such as in the case of syrups. Comparison between (5), (6) and (2) showed that refractometric measurements differed from values given by (2) by a constant relative deviation, whereas there was random fluctuation in the differences between the values given by (2) and (6). An equation has been developed for calculation of "true" dry solids from refractometric and polarimetric values which is valid for Quentin molasses.

The relationship between the corrected sugar content and chemical composition of sugar beet. O. C. Akyar, M. Cagatay, E. Kayimoglu, A. Ozbek and S. Titiz. *Zuckerind.*, 1980, **105**, 457-466 *(German)*. – See *I.S.J.*, 1980, **82**, 348.

Biochemical sugar losses during (beet) storage. K. Hangyai and R. Lasztity. *Zuckerind.*, 1980, **105**, 466-468 *(German)*. – Changes in the activities of invertase and of pectolytic enzymes and in the concentrations of invert sugar, mono- and oligosaccharides and lactic acid were invstigated in stored beet that had been grown under varying conditions of irrigation, nitrogen fertilization and vegetation period. While the results indicated that agronomic conditions affected the biochemical sugar losses, no sound conclusions could be drawn from the investigations, probably because of the small number of tests, the extreme nature of the conditions and the considerable scatter in the results.

Pulp dryer volatiles. I. Some constituents of factory pulp dryer exhaust vapours. J. F. T. Oldfield, M. Shore, N. W. Broughton, C. W. Harvey, R. Parslow and J. C. Bailey. *Sucr. Belge*, 1980, **99**, 111-118, 143-168. See *I.S.J.*, 1980, **82**, 347.

Investigation of changes occurring in sugar beet during storage. III. Methodology of determining invertase activity. K. Hangyal and P. Meresz. *Cukoripar*, 1980, **33**, 53-57 *(Hungarian)*. – A short survey is presented of chemical and enzymatic methods of determining invertase activity, and an outline is given of the automatic Contiflo analyser which has been adapted to pre-determination of invert sugar by photometric measurement of the colour formed by reduction of potassium ferricyanide in a buffered solution.

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[1] *Proc. 17th Session ICUMSA*, 1978, 183-184.
[2] Browne & Zerban: "Sugar analysis", 3rd Edn. (Wiley, New York), 1955, pp. 30-31.
[3] *Proc. 17th Session ICUMSA*, 1978, 184.

BY-PRODUCTS

New pelleted animal feed. J. Harland. *British Sugar Beet Rev.*, 1980, **48**, (1), 39. – Brief mention is made of a fodder, Green Keil, which is based on dried molassed beet pulp and dried grass. It contains 14% crude protein and, when fed to sheep in trials, increased the lambing percentage and fleece weights and improved the condition of the ewe.

Effect of feeding alkali-treated sugar cane bagasse on the growth of crossbred goat kids. N. K. Powar, A. P. Deshmukh and I. G. Chavan. *Maharashtra Sugar*, 1980, **5**, (4), 23, 25-26, 28. – Bagasse was sprayed with 0, 3, 6 or 9% NaOH and impregnated with a mixture of wheat bran, urea and gur before being fed to female kids of almost identical age and weight. Results of the trials showed that spraying with 3% NaOH gave the greatest weight gain; while this was not as high as the gain achieved with a special concentrate mixture, the bagasse mixture was cheaper.

Sugar cane *versus* corn *versus* ethylene as sources of ethanol for motor fuels and chemicals. E. S. Lipinsky. *Proc. Amer. Soc. Sugar Cane Tech.*, 1977, 152-162. – A comparison is made of the estimated costs of alcohol manufacture from sugar cane, corn and ethylene; these costs would be almost equal at a cane price of $66 per tonne dry weight, a corn price of $100 per tonne and an ethylene price of $264 per tonne. The value of vinasse is unknown, although it is critical to the case of sugar cane. Acceptance of alcohol: gasoline mixtures as motor fuel is considered to depend more on tax policy decisions than on technical considerations. Of three ethanol derivatives that could be manufactured, acetic acid is considered more promising than acetaldehyde which in turn is regarded as more promising than ethylene.

Spray-drying of molasses. T. Vaja and K. Csajághy. *Cukoripar*, 1979, **32**, 227-230 *(Hungarian)*. – Experiments on spray-drying of molasses for use as animal fodder are reported in which the molasses of 60°Bx was sprayed and spun at 20,000 rpm to give a final product of 98.6% dry solids which could be stored in plastic bags. The product is sufficiently hygroscopic that, once the bag is opened, the contents should be used within four hours.

Recycling of vinasse (complete and hot). J. B. Fontes. *Brasil Açuc.*, 1980, **95**, 31-34 *(Portuguese)*. – Production of alcohol involves production of 7.3 volumes of vinasse which is a waste of considerable nuisance as a pollutant. With the great increase in alcohol production in Brazil, vinasse disposal is a worsening problem, but the author's work shows that it can be ameliorated by recycling the vinasse (93% water) for dilution of the fermentation raw material after initial removal of insoluble material such as colloids, clay, bagacillo, etc. Recycling ten times reduces the disposal problem by 90% and the heat content of the vinasse contributes to elimination of gases, sterilization of the must, etc. If the final vinasse is used as a fertilizer, its K content is tenfold higher and it can serve as a useful ingredient in composting.

Effect of K_2SO_4 addition in the cultivation of yeasts on vinasse. V. Gambale. *Brasil Açuc.*, 1980, **95**, 35-37 *(Portuguese)*. – Five species of *Candida* were grown on vinasse to which K_2SO_4 was added. It was concluded that it acted as an inductor for biomass and protein production by *C.macedoniensis* when used in suitable quantities (0.30-0.60 $mg.cm^{-3}$).

Steel-making reducer or fuel or portable solid from sugar cane. J. S. A. Neto and S. H. Kling. *Brasil Açuc.*, 1980, **95**, 59-67 *(Portuguese)*. – Calculations are made of the amounts of alcohol (by fermentation after hydrolysis), dry fuel and coke (obtained from briquetted residual lignin) which could be made from bagasse and cane tops.

Utilization of a sugar factory by-product: pressed pulp. J. P. Vandergeten and R. Vanstallen. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1979, **47**, 119-144 *(French, Dutch)*. – Information is given on practices used in Belgium in the treatment and handling of pressed beet pulp used in the form of silage as a feed supplement for beef and dairy cattle. Observations from the 1978/79 campaign are reported, and advice is given on various aspects of pulp treatment, including transport, so as to obtain the best silage. Composition and feed value data are given for silage from 16 silos. It is stressed that the dry solids content should not fall below 22% so as to avoid rapid formation of undesirable organic acids and increased fermentation losses, while the higher osmotic pressure associated with increased dry solids favours development of butyric bacteria (responsible for unpleasant odours) and proteolytic bacteria, both of which groups are also sensitive to acidity, while lactic bacteria are much less sensitive to both factors. Mention is made of the value of silage as a feed supplement, and of trials on re-ensilage and pulp enrichment, which have given promising results.

Production and chemical properties of nitrogenous and phosphorous concentrates based on beet pulp. M. S. Dudkin, L. V. Kaprel'yants and P. M. Darman'yan. *Izv. Vuzov, Pishch. Tekh.*, 1980, (2), 33-34 *(Russian)*. Details are given of a method for production of a feed concentrate from a mixture of beet pulp, urea and orthophosphoric acid. The concentrate, produced in the form of briquettes, contains typically 10.61% moisture, 6.2% total N, 38.5% crude protein, 4.5% P and 1.76% free sugars.

Using frozen sugar cane for alcohol production. J. E. Irvine. *Sugar Bull.*, 1980, **58**, (13), 16-17. – The incidence of frosts in Louisiana shortens the crushing season in one out of ten years, since the juice deteriorates and dextran formation prevents crystallization of sugar. Tests over a considerable number of years have indicated that the juice from frozen cane would remain suitable for fermentation to alcohol and the fact that it becomes sour would not be a hindrance, since it would have to be adjusted to pH 4.5-5 in any case.

Alcohol from sugar cane. II. R. Stutz, R. Bruno, R. Gómez and R. Traverso. *La Ind. Azuc.*, 1979, **86**, 302, 310-312, 314-317 *(Spanish)*. – In Argentina only two distilleries recover the CO_2 produced in fermen-

tation, but this is possible elsewhere. When considering production of alcohol from 4000 tonnes of cane per day it is possible to use a simple process and plant, of relatively low capital cost, in which low-pressure steam consumption is about 5 kg per litre of alcohol produced; alternatively, a more sophisticated plant will consume only 3 kg steam per litre, but requires higher pressure boilers, and greater automation for better control, with consequently higher cost. Taking into consideration the energy needed for cultivation, harvesting and transport of cane, expressed in terms of fuel alcohol equivalent, it is calculated that in a plant processing 4000 tcd and producing 70 litres of alcohol per tonne, the "net" alcohol production will be 254,400 litres per day. A series of appendices give details of calculations involved.

Foaming in submerged citric acid fermentation on beet molasses. M. Berovic and A. Cimerman. *Eur. J. Appl. Microbiol. Biotechnol.*, 1979, **7**, (4), 313-319; through *S.I.A.*, 1980, **42**, Abs. 80-459. – As chemical antifoams are often needed in fermentation processes, their effects on *Aspergillus niger* were tested. Of ten compounds added at 1% or 2% to molasses agar, four promoted growth of *A. niger* by up to 5% while the other six inhibited it by up to 14%; thus the antifoams are not toxic. Most of the compounds decreased the respiration rate of *A. niger*. Their effects on the volume of foam generated in ferrocyanide-treated beet molasses are shown in graphs; the data enable the most effective compound to be chosen for given conditions. Biomass and citric acid formation in a 5-litre fermenter in the presence of 2% Atlas G5600 are shown in a graph.

The Regensburg 30,000-tonne pellet silo. E. Muhlack, U. Schröter, M. Kunz and W. Glauser. *Zuckerind.*, 1980, **105**, 481-484 *(German)*. – Details are given of the 30,000-tonne capacity silo constructed at Regensburg sugar factory for the storage of pelleted beet pulp at a temperature of 15-25°C and 60-65% relative humidity; pellet dry solids content is $\geqslant$ 90%.

Selection of thermotolerant yeast strains for biomass production from Sudanese molasses. E. T. A. El S. Idris and D. R. Berry. *Biotechnology Letters*, 1980, **2**, (2), 61-66; through *S.I.A.*, 1980, **42**, Abs. 80-613. – Yeast strains from two refineries in Scotland were screened for growth at 40°C; the thermotolerant strains were cultured at 40°C in a medium based on Sudanese cane molasses and containing 0.5% sugars and 0.1655% urea. Several strains which yielded 29-42% biomass on sugars were identified. Tests on four of these strains showed that they were resistant to 15 minutes' incubation at 55°C, unlike three mesophilic strains.

Effects of various conditions on the production of citric acid during fermentation of molasses by *Aspergillus niger*. A. A. Rokosu and C. A. Anenih. *Enzyme and Microbial Tech.*, 1980, **2**, (1), 61-62; through *S.I.A.*, 1980, **42**, Abs. 80-614. – *A. niger* was cultured for nine days in media containing 10, 12 . . . . 22% w/v cane molasses, at pH 4, 4.5, 5, 5.4, 6 or 6.5 and at 22, 24 . . . . 34°C. The maximum yield of citric acid, 19.5% w/v, was obtained in media containing 16% molasses at pH 5.4 and 28°C.

Treatment of molasses media with Trilon B in citric acid manufacture. E. S. Mints and L. F. Ivanova. *Khlebopek. Konditer. Prom.*, 1979, (4), 36-37; through *S.I.A.*, 1980, **42**, Abs. 80-615. – In hot solution at appropriate pH, Trilon B (disodium EDTA) forms very stable chelates with metal ions, at adequate rates of reaction. Tests on the use of Trilon B to improve the ash composition of molasses media, before or after 6-10 min boiling with $K_4Fe(CN)_6$, for citric acid fermentation are reported. For 70 out of 122 molasses samples, the best yields were obtained with 20-60% less than the standard dose of ferrocyanide, i.e. with 800-1600 mg/300 g molasses; the optimum dose of Trilon B was usually 100-300 mg. Such addition decreased the pH by 0.15-0.3, so that less H_2SO_4 or more soda had to be added, and increased the citric acid yield by 10-50% (on average 17.5%). Test procedures are outlined for simultaneous determination of the doses of ferrocyanide and Trilon B needed for a particular molasses; use of Trilon B gave a narrower range of optimum ferrocyanide doses.

Possible means of reducing the thermal energy consumption in molasses sterilization and distillation in bakers' yeast and alcohol distilleries. H. J. Koch and H. Seetge. *Lebensmittelind.*, 1980, **27**, 157-162, 207-209 *(German)*. Investigations of methods of reducing energy consumption in both batch and continous molasses sterilization processes are reported. In the batch process, a 26% reduction was made possible by use of heated cooling water, from the main condenser of the distillation plant, for preparation of the molasses wort. In the continuous process, a 69% reduction was obtained by diluting the molasses 1:1 with water and heating from 32° to 66°C, the mixture then being passed via a separator to a plate heat exchanger; the molasses was cooled to 40°C on discharge, and the resultant heat used to raise the temperature of the incoming wort from 30° to 65°C. In distillation, a reduction in energy consumption can be obtained by reducing the reflux ratio and using indirect heat for the column. The molasses wort takes heat from vinasse in a tubular heat exchanger and enters the column at a temperature (96°C) which is 5-10° below that of the vinasse discharge temperature.

Plant scale trials on recovery and recycle of yeast for the production of alcohol. H. C. Bhandari, B. K. Malik and L. R. Juneja. *Maharashtra Sugar*, 1980, **5**, (6), 47-49, 51-54. – See *I.S.J.*, 1981, **83**, 315.

Computer control of a direct-fired pulp dryer. P. Mosel, E. Feuerstein, P. Peters and G. Scholze. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 39 pp. – The development of drying regulation by the analogue method between 1955 and 1975 is shown by three representative examples. From 1975 to 1977, experiments were carried out at Plattling sugar factory which produced a mathematical model of the drying process and a digital regulation concept based on this. The method and aim of this work are described. Subsequently, a test of this regulation concept using a Siemens 310K process computer on a rotary dryer and computer-controlled operation of three rotary dryers is described, and the results obtained are presented.

Application of statistical design of experiments to investigation of the sizing process. Z. Herrera, F. Ramos M., E. González and R. Castro. *Centro Azúcar*, 1979, **6**, (2), 99-108 *(Spanish)*. – A report is presented on the application of statistical methods to experiments in which a number of factors were varied during the manufacture of cardboard from bagasse and wood to optimize the sizing process.

PATENTS

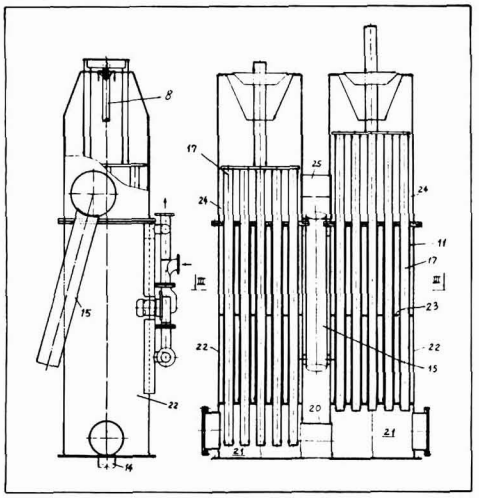
UNITED STATES

Beet harvester. H. Ammermann, of Clara City, MI, USA. **4,184,550.** March 24, 1978; January 22, 1980.

Cane harvester. J. M. Mizzi, of Ingham, Queensland, Australia. **4,194,344.** May 8, 1978; March 25, 1980.

Crystallizer. R. F. Madsen, of Nakskov, Denmark, *assr.* A/S De Danske Sukkerfabrikker. **4,194,557.** January 4, 1978; March 25, 1980.

The crystallizer comprises two sections 22 connected in parallel. Massecuite is supplied through inlet pipe 14 to pipe 20 feeding the two sections. These contain a number of pipes 11 surrounded by a cooling medium and opening at their top ends into two chambers 24 which are interconnected through pipe 25 to which an outlet pipe 15 is fitted. On the cooling medium side baffles 23 are provided to increase the flow rate under the action of a circulating pump. In each pipe 11 is a cylindrical plunger 17 of somewhat smaller diameter than the pipe so that an annular space is formed. All plungers are interconnected and are moved up and down by hydraulic cylinder 8.



The connexion is such that when the plungers in one section are up the others are down and *vice-versa* (although they can be arranged to operate in the same direction if the large pressure variations caused are acceptable). The plungers may be smooth pipes or pipes with scrapers or of varying diameter along their lengths. Their movement provides greater heat transmission and also keeps the cooling surfaces clean.

Reduction of colour impurities in sugar-containing syrups. J. C. Melville, J. M. Beatty and J. H. Satcher, *assrs.* Holly Sugar Corporation, of Colorado Springs, CO, USA. **4,196,017.** January 29, 1979; April 1, 1980. – Partly purified raw sugar is dissolved to a syrup (containing 50-80% sugar) and treated at about 80°C with an oxidizing bleach (hydrogen peroxide or ozone) at 5-1000 ppm (20-50 ppm) by weight of sugar. The two are mixed for 2-5 minutes and 50-750 ppm (100-500 ppm) on sugar weight of a (long hydrocarbon chain quaternary ammonium or tertiary amine or pyridinium) cationic surfactant (dihexadecyldimethylammonium chloride and/or dioctadecyldimethylammonium chloride) added, mixed for 5-10 minutes, a defecant [50-1000 ppm (100-300 ppm) each of $CaCl_2$ and Na_2CO_3] added [50-1000 ppm (100-300 ppm) of activated carbon and 125-2500 ppm (250-750 ppm) of a filter aid added], the whole mixed thoroughly (for about 20 minutes) and the solids content of the mixture filtered off (through a filter which removes particles >0.5 μm) to give a purified solution (which may then be inverted by treatment with acid).

Cane harvester. D. J. Quick, of Bundaberg, Queensland, Australia. **4,196,569.** August 16, 1978; April 8, 1980.

Beet harvester. V. D. Haverdink, J. E. Maust and F. C. Livesay, *assrs.* Deere & Co., of Moline, IL, USA. **4,197,916.** September 29, 1978; April 15, 1980.

Manufacture of crystalline fructose from high fructose corn syrup. B. K. Dwivedi and S. K. Raniwala, *assrs.* Chimicasa GmbH, of Chur, Switzerland. (A) **4,199,373.** April 13, 1979; April 22, 1980. (B) **4,199,374.** December 22, 1978; April 22, 1980.

(A) A fructose-containing syrup [either 88-96% (92-94%) pure or HFCS], essentially free of colour impurities, is (brought to 90-95% concentration by weight and) seeded with 2-15% (5-15%) of seed crystals having a particle size of $\geq$250 μm (50-200 μm), having the same general composition as the solution, at a temperature of 120°-160°F and the seeded solution held at 50°-120°F (50°-90°F) [and 50% (35-45%) R.H.] [for 6-72 hr (12-72 hr)] to provide for substantial crystallization of the fructose (and glucose) from the solution and thereafter recovering these crystals and drying them (at $<$50% R.H. and 110-160°F) to provide a free-flowing mixture (which is ground to less than 18-mesh particle size).

(B) HFCS of 50-98% ($>$90%) fructose content is mixed with [0.5-2 volumes (about 1 volume) of] a volatile alcohol, acceptable in food (ethyl alcohol), to provide a homogeneous clear syrup having a water content of $<$0.25. The solution is seeded with fine (0.05-0.5 mm) particles (0.5-5% by weight of crystalline fructose or glucose) (stirred for 5-10 hr) allowed to stand (for 3-12 hr) and free-flowing fructose particles having a mesh size $<$400 mesh recovered (washed with EtOH and dried).

Preparation of bagasse dissolving pulps and producing rayon having a degree of polymerization of at least 800. E. J. Villavicencio, of San Angel, Mexico, *assr.* Process Evaluation & Development Corporation. **4,199,399.** October 25th, 1978; April 22, 1980. – The bagasse

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

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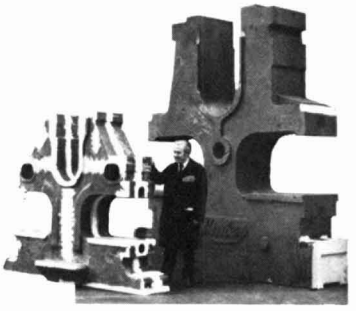

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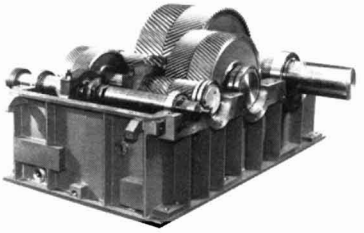

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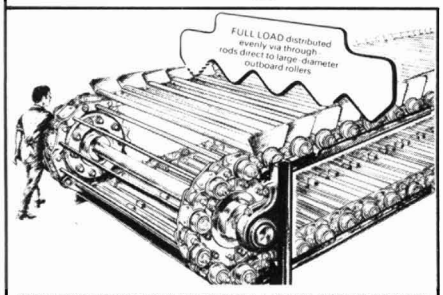

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fibre is prehydrolysed with water at 100°-220°C under autogenous pressure for 5-90 minutes at a water:fibre ratio of 1:1-15:1. The silica content is then leached out with an alkaline liquor containing 4-10% (8%) (5%) NaOH w/w and 10-18% (12%) (15%) Na_2SO_3 w/w on oven-dry fibre, the NaOH:Na_2SO_3 ratio being 1:1-1:3 and the liquor pH 10.5-11.5 (10.8-11.2) (10.8-11), this pH being maintained through the first half of the digestion. The digested fibres are bleached with a 4-stage process employing 0.5-1.5% ClO_2 plus 2-4% Cl_2 on dry fibre weight, extraction with 2-4% NaOH at >50°C, again with 0.5-1.5% ClO_2 and then with either 0.5-1% available Cl_2 as NaOCl or a further treatment with 0.25-1.0% ClO_2. The pulp is recovered (washed with water and dried to <10% water content) and has an Elrepho brightness of >8.5.

Flocs for filtration and deionization prepared from cationic and anionic emulsion ion exchange resins. B. P. Chong, E. G. Isacoff and J. W. Neely, *assrs.* Rohm and Haas Co., of Philadelphia, PA, USA. **4,200,695.** September 18, 1978; April 29, 1980. – A floc of beads of one or more (weakly acidic) cation exchange resins and one or more (weakly acidic) anion exchange resins in a weight ratio of 1:9-9:1 (2:3-3:2) cation exchange : anion exchange is formed by mixing emulsions of the cross-linked copolymer resin beads, each of which is approximately spherical, with 0.01-1.5 μm diameter and having 0.7-1.5 ion exchange functional groups per monomer unit. When added to raw sugar solutions the resins form coherent, filtrable flocs which remove ash and colour and which may be separated by conventional means.

Continuous process for cellulose saccharification. J. A. Church, D. Wooldridge, R. L. Burroughs, A. A. Strzepek and W. J. Thompson, *assrs.* American Can Co., of Greenwich, CT, USA. **4,201,596.** January 12, 1979; May 6, 1980. – An aqueous mixture of a cellulosic material (bagasse) containing 15-45% solids by weight is introduced continously into one end of a tubular reactor, the other end of which is restricted, to provide a back-pressure of 90-400 psi. A strong mineral acid (H_2SO_4) is introduced with the cellulosic material (giving a mixture of 50-85% solids) (of pH about 1.0) to catalyse the hydrolysis, while, downstream from the feed, steam is injected to give a reaction mass comprising 10-25% solids while providing a temperature of 160°-250°C. The mixture is passed along the tube through a reaction zone where hydrolysis takes place, during a residence time of 1-10 minutes, and the products discharged. If the temperature is maintained at at least about 190°C glucose and furfural are produced; at below 180°C xylose production is favoured. The discharged products are neutralized to pH 4-7 with lime, filtered, a yeast may be introduced and the sugars fermented to alcohol.

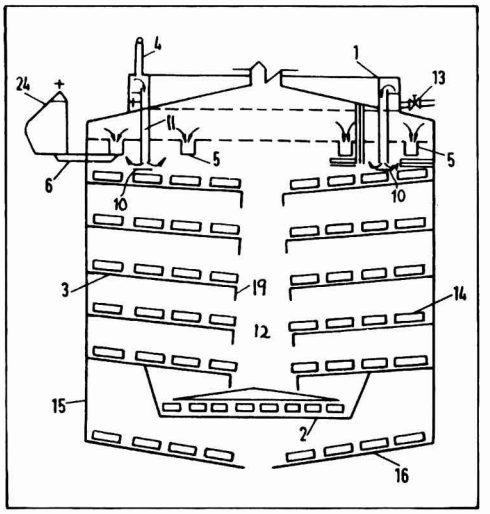
UNITED KINGDOM

Ripening of sugar cane. Shell International Research Mij. B.V., of The Hague, Holland. **1,555,770.** November 27, 1975; November 14, 1979. – See US Patent 4,056,385[1].

Producing dextrose from cellulose. Great Western Sugar Co., of Denver, CO, USA. **1,556,401.** May 25, 1978; November 21, 1979. – See US Patent 4,097,333[2].

Clarifier. Ministerio de la Industria Azucarera, of Havana, Cuba. **1,557,829.** June 30, 1976; December 12, 1979.

The clarifier is in the form of a cylindrical tank 15 of similar height and diameter, divided into compartments by slightly conical trays 3 and having a similar bottom 16. The lowest compartment is larger than those above and is for thickening of the sediment; it is provided with a planar thickening tray 2. Juice enters the annular channel above the top of the clarifier through two horizontal feed pipes each delivering a clockwise moving stream against a baffle to prevent turbulence. The inside wall of the channel is crenellated, providing overflows which feed uniformly into a ring of tubes 1 through which the turbid juice descends and is distributed by a deflecting ring 10. Gases separating from the juice feed are vented through pipe 4.



The solids settle out of the juice and are carried by scrapers 14 mounted on a rotating central shaft (not shown) to be thickened in the bottom compartment before removal. Clear juice at the top of the clarifier passes into concentric trays 5 from which collecting pipes 6 take it to the juice box 24 and so to process. Similar withdrawal points for clear juice are located in the upper periphery of each compartment, where there are also provided gas collecting ports which are joined and lead to a vent. Flanges 19 on the interior of the trays determine the level in each compartment into which juice from the central duct passes.

Beet cleaning device. A. Gent, of Spalding, Lincs., England. **1,562,737.** December 20, 1976; March 12, 1980. – Beets are delivered to one end and carried along a section (e.g. 12 feet long) of an endless slat (inclined) conveyor, the gaps between slats being small enough to retain the roots but large enough to allow passage of stone, dirt, tops, etc. Above the conveyor is another (parallel, inclined) endless belt (e.g. 10 feet long) carrying a series of suspended flexible flaps, e.g. of rubber, which are of a length such that they touch the slats and keep them clean by virtue of the fact that the upper belt is driven at only one quarter of the speed of the conveyor. The flaps are staggered across the upper belt and strike the beet roots, removing dirt, etc. Both belts are driven from a tractor and the cleaned beet are discharged for delivery to the sugar factory.

[1] *I.S.J.* 1981, **83**, 28.
[2] *ibid.*, 123.

British Society of Sugar Cane Technologists

An attendance of 35 at an inaugural meeting on October 8, 1981, convened by the Trustees of the British Section of the International Society of Sugar Cane Technologists, Mr. N. D. Sharvell and Dr. A. J. Vlitos, agreed on the formation of a new British Society of Sugar Cane Technologists. A Council was elected, comprising Dr. Michael Bennett (President), Dr. R. Alan Yates (Vice President), Mr. Norman Davies (Secretary/Treasurer) and Mr. Neville Sharvell and Mr. Alan M. James (Trustees).

The objects of the Society are consistent with those of the ISSCT and include encouragement of the interchange of technical information at regular meetings and stimulation of interest in the industry, particularly in view of the absence of cane sugar production in the UK, by providing the opportunity for spread of the knowledge and experience of British people previously and currently concerned with cane sugar production, especially among young people in the UK.

A Draft Constitution was agreed in large part, with a small number of items to be clarified by the Council for the next meeting. At present, eligibility for election to membership is UK residence of persons having an interest in the cane sugar industry, although eligibility of others such as British expatriates working in the industry is one of the matters on which guidelines are to be drawn up by the Council.

The membership subscription has been set at £5 per annum. Interested persons should seek further details from Mr. W. N. L. Davies, c/o Tate & Lyle Technical Services, Cosmos House, Bromley Common, Bromley, Kent BR2 9NA, England.

ISA member imports from non-members[1]. — All limitations on imports of sugar by member countries from non-members were lifted last year when prices were high but, with the fall of the LDP within the range of the International Sugar Agreement, they have been reimposed. At the September 9 meeting of the Executive Committee it considered imports of non-member sugar, particularly from the EEC, by India and Egypt. India has this year purchased 90,000 tonnes and Egypt has also recently taken delivery of EEC refined sugar. The Committee has excused India from the ruling, accepting its explanation that the required sugar was not available from members. Egypt has made no such request.

International Society of Sugar Cane Technologists. — In Newsletter No. 3, dated June 1981, the organizing committee of the 18th Congress have announced the tentative program for the period February 18 to 26, 1983. Members will assemble and register on the first day in Havana and on the next day the Agriculture Group will attend a Mechanization Field Day while the Factory Group will visit the "Treinta de Noviembre" sugar factory. On Sunday February 20, the Agriculture Group will visit the Jovellanos Experimental Station and typical cane fields, a cane harvester manufacturing plant and an agricultural implement complex, while the Factory Group will visit the Camilo Cienfuegos sugar factory and associated refinery and particle board plants, the Santa Cruz distillery, the Cuban Sugar Industry Research Institute (ICINAZ) and projects on pulp and paper research, fermentation and animal nutrition. The Congress will be inaugurated on Monday February 21 and continue with technical sessions through the whole of the week, followed by a closing plenary session on Saturday morning and a Farewell Banquet in the evening. Copies of the rules for preparing manuscripts and membership application forms are available from the General Secretary/Treasurer, Mr. Oscar Almazan, c/o ATAC, P.O. Box 4063, Havana, Cuba.

Fruit preservative based on sugar. — TAL Chemical Co., a Tate & Lyle subsidiary, has introduced a new product called Prolong, derived from sugar, which is used in water solution to provide an invisible, colourless, tasteless and odourless edible membrane around the fruit; this preserves it from decay, greatly increasing shelf life by slowing down the ripening process, and thus providing the opportunity of reducing the 40% wastage in the world's production of fruit before it reaches the customer. The product has undergone extensive testing and is now approved as a food additive by the EEC Commission and by the UK Ministry of Agriculture, Fisheries and Food.

Pakistan sugar imports, 1980[2]

	1980	1979	1978
		tonnes, raw value	
Argentina	13,573	0	0
Belgium	10,870	0	0
Brazil	59,383	13,641	0
China	26,412	0	0
Dubai	616	0	0
France	38,696	0	0
Holland	462	0	0
India	0	21,176	0
Kenya	14,348	0	0
Other countries	15	887	630
	164,375	35,704	630

Pakistan sugar production. — The area under cane in Pakistan for the 1980/81 season was 2.04 million acres and this produced 32.7 million tonnes of cane. Only 28% of this, amounting to 9,143,000 tonnes, was delivered to sugar factories and resulted in a production of 821,357 tonnes of white sugar; of the balance, 19,560,000 tonnes or 60% of the crop was used for the manufacture of gur and khandsari totalling 1,630,000 tonnes. With beet sugar production[3], white sugar production amounted to just 2.67% short of white sugar demand, which is equivalent to 10.19 kg per caput. With the gur and khandsari, total sweetener consumption is 29 kg per caput. Pakistan is currently self-sufficient in white sugar and it is anticipated that there may be a surplus of 50,000 tonnes by 1983. Furthermore, a plant for HFCS production from broken rice is planned to produce 45,000 tonnes per annum, with operation starting in 1982.

Possible sugar factory conversion in Puerto Rico[4]. — Concern is rising in Puerto Rico about the continued availability of molasses for manufacturing rum. About 40 million gallons of molasses are imported annually, mostly from the Dominican Republic, which may be a less dependable supplier in the future. One alternative would be to close one of Puerto Rico's seven raw sugar factories and convert it to production of high-test molasses and ethanol for gasoline blending. With Puerto Rico annually producing 54 million gallons of high-test molasses from available sugar cane, there would then be no need to import molasses. The earliest that any factory could be modified would be for the 1982 crop. Rum is an important part of the Puerto Rican economy with rum taxes representing 13% of the annual budget.

Cane smut research in India[5]. — The US Department of Agriculture's Office of International Cooperation and Development has announced that the Indian Institute of Sugarcane Research in Lucknow is to conduct a three-year study of the smut fungus in sugar cane under a grant of nearly $200,000 from the USDA. Research will be conducted simultaneously in the United States.

Fiji cane trials for alcohol production[6]. — The Fiji Sugar Corporation has started growing special varieties of sugar cane for ethanol at Navua and Nausori. Reports that the cane was being grown on land owned by Consolidated Farms Ltd. at Navua were confirmed by the general manager of FSC Projects Ltd. About 10 varieties of cane had been planted on two hectares of land there while experimental plots of cane were also being planted at Navuso, near Nausori, and further planting would begin soon at Koronivia. Experts were looking at which varieties were best for making ethanol as a fuel extender. It is understood that the government will make a decision on the setting up of an autonomous distillery and farm sites when the cane varietal experiments and land surveys have been completed.

[1] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 551, 571.
[2] *I.S.O. Stat. Bull.*, 1981, **40**, (5), 70.
[3] See *I.S.J.*, 1981, **83**, 320.
[4] *US Sugar and Sweetener Outlook & Situation*, May 1981, 13.
[5] *U.S.D.A. News*, June 8, 1981.
[6] *Fiji News*, June 3, 1981.

Yugoslavia sugar exports, 1980[1]

	1980	1979	1978
	tonnes, raw value		
Algeria	2,174	0	0
Bulgaria	0	3,658	0
France	6,239	5,435	0
Greece	0	498	0
Indonesia	11,413	0	0
Italy	2,121	849	0
Jordan	12,247	0	0
Kenya	11,413	0	0
Lebanon	10,888	1,707	0
Malaysia	0	10,870	0
Mexico	5,435	0	0
Pakistan	22	0	0
Panama	24,507	0	0
Rumania	17,751	40,522	0
Sudan	13,478	0	0
UK	10,870	0	0
United Arab Emirates	47,177	12,298	0
USSR	141,413	860	0
Other countries	639	139	235
	317,787	76,836	235

Poland capacity expansion need[2]. — Poland has 78 sugar factories, a 79th being currently under construction. Some of the existing factories are small in capacity and this, coupled with the old equipment, makes these factories very inefficient. Polish sugar industry technologists, in a report published in a Polish economic magazine, stress the fact that the four new factories planned by 1990 and expansion and rehabilitation of 10-15 existing factories will not be sufficient to cut the campaign to less than 100 days. The longer the campaign, the poorer the quality of the beets processed at the end. It is also claimed that beet varieties selected for Poland are unsuitable, having a higher fodder value but relatively low sugar content, and that sugar production is declining on a continuous basis. In the late 1940's the sugar content of beets averaged 14.8% and sugar yield 3.81 tonnes per hectare; this compares with 10.6% and 2.37 tonnes.ha^{-1} in 1980/81.

Madagascar sugar project[3]. — A sugar project in the south-west of Madagascar, built and financed by China, is expected to come on stream in 1983 with an annual production capacity of 25,000 tonnes. Industry sources, however, questioned whether the site was suitable as the planned plantation is on sandy ground needing constant irrigation in an area where water is scarce. Also the risk of plant disease is reported to be high. Factories in the north-west have been seriously affected by stoppages caused by lack of spare parts.

Queensland cane alcohol production possibility[4]. — The Queensland Government is to discuss a proposal to produce 10% of the state's power needs from sugar cane and cassava, a diversification proposal about which the sugar industry has strong reservations. The plan is being aired by the Industry Minister, at a time when growers face falling profits mainly from the lack of long-term export contracts. The General Secretary of the Queensland Cane Growers' Council said that the economics of ethanol from cane were improving but were a good way from being attractive. He said that the council was conducting research into the ramifications for growers of an ethanol industry.

Indonesia sugar production decline[5]. — Indonesian sugar production in 1980/81 fell by about 5% to 1,330,000 tonnes from 1,403,000 tonnes, raw value, in 1979/80. Reduced cane area was the main reason for the decline in production, farmers having allocated more land to rice because of the price advantage. The ex-factory price of sugar has been increased to 40,000 rupiahs per 100 kg of sugar and it is expected that the trend will be reversed with more cane available for sugar production in 1981/82. Promised smallholder incentive schemes may also bring about additional cane plantings.

Peru sugar exports, 1980[6]

	1980	1979	1978	1977
	tonnes, raw value			
Canada	0	0	0	10,688
Chile	13,522	28,863	11,989	87,706
China	0	0	0	25,948
Colombia	0	0	0	4,501
Korea, South	0	0	13,650	0
Portugal	0	0	0	26,600
USA	20,500	148,729	240,252	256,409
USSR	18,794	3,198	0	0
	52,816	180,790	265,891	411,832

Rumania sugar expansion plans. — In addition to the plans previously[7] reported further details have been published of the expansion program for the Rumanian sugar industry[8]. The processing capacity is to be doubled during the next five years. In 1985, 11 million tonnes of sugar beets are to be processed in 47 sugar factories to some 1.3 million tonnes of sugar, in a campaign lasting only 100 days, provided that the plans are accomplished. On the basis of a "special program" 31 new sugar factories of various processing capacities are to be built and put into operation by 1985. The new factories are to be located in the neighbourhood of large industrial complexes, in order to co-use the heat generation of the plants. Moreover the factories are to be situated in such a way that the transport routes for beets will not exceed 30 kilometres. This will permit processing of beets without delay and so contribute to increased sugar yields. In order to increase beet production, the sown area is to be extended from 270,000 to 350,000 hectares by 1985 and beet cultivation is to be totally mechanized. During 1975-79 the beet crop in Rumania averaged around 6 million tonnes and in 1980 only 5.6 million tonnes were processed, although the planned beet crop was 9,375,000 tonnes. Sugar production, at about 570,000 tonnes, raw value, was not sufficient to cover the domestic requirements of some 680,000 tonnes so that imports were needed. The planned increase to 1.3 million tonnes of white sugar (1.4 million tonnes, raw value) would mean that Rumania would have a surplus and could become a sugar exporter. It remains to be seen, however, to what extent the expansion plans materialize.

Sugar production in China[9]. — Official figures show that in 1980/81 total sugar production in China reached a record figure of 3.0 million tonnes or about 22.5% higher than in 1979/80. The reported increase in the beet sugar output was of the order of 73% over the previous year and in cane sugar 10.8% more than production in 1979/80.

US beet sugar factory closure[10]. — Amstar Corporation has said it will stop sugar beet processing in its plant at Salinas, California, by the summer of 1982. The move is due to the sizeable transportation costs involved in supplying the plant with sugar beet and about 500 of the 700 workers at the plant will be laid off. Amstar will continue spending to improve efficiency at its other beet processing plants.

US refiner bankruptcy. — National Sugar Refining Company having filed a petition for relief under Chapter 11 of the US Bankruptcy Act, a meeting of creditors was to be held in New York on October 15.

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1 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, S289.
2 *World Sugar J.*, 1981, **4**, (1), 35.
3 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 453.
4 *Queensland Newsletter*, July 22, 1981.
5 *World Sugar J.*, 1981, **4**, (1), 33.
6 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, S 227.
7 *I.S.J.*, 1981, **83**, 224.
8 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 468.
9 *World Sugar J.*, 1981, **4**, (2), 35.
10 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 470.

South Korea sugar imports and exports, 1980*

	1980	1979
	tonnes	
IMPORTS (raw sugar)		
Australia	305,577	181,106
China	183,357	194,884
Ethiopia	0	500
Hong Kong	1,000	0
Malaysia	0	1,600
Philippines	221,810	183,234
Thailand	66,957	81,637
Other countries	0	15,342
	778,701	658,303
EXPORTS (white sugar)		
Bangladesh	3,300	45
Hong Kong	47,915	53,397
Indonesia	141,600	55,205
Iran	12,600	0
Japan	3,000	0
Jordan	6,500	0
Kuwait	1,008	4
Mexico	6,208	0
Philippines	0	100
Saudi Arabia	13	96
Singapore	100	2,000
Thailand	10,060	0
UK	47,350	0
USA	917	1,200
Other countries	23,123	61
	303,694	112,108
Hong Kong (as raw sugar)	368	276
Total (tel quel)	304,062	112,384
Total (raw value)	330,502	122,157

* F. O. Licht, *International Sugar Rpt.*, 1981, **113**, S 265.

Cane alcohol in Paraguay[1]. — The total sugar cane area in Paraguay this year is estimated at 41,000 hectares, up 3000 ha from 1980. Total sugar cane production is estimated at 1.55 million tonnes, up from 1.5 million tonnes harvested last year. Sugar production is expected to decrease to about 85,000 tonnes, however, as more sugar cane is used for alcohol production. The government is promoting the production of alcohol as a gasoline extender and the first plant is scheduled to start production with a capacity of 120,000 litres of alcohol per day. Up to 100,000 tonnes of cane may be used for direct alcohol production. Paraguay is still likely to export 20,000 tonnes of sugar in 1981, despite the decline in production, as initial stocks are larger than normal and production exceeds domestic demand. In 1980, Paraguay exported sugar — 5800 tonnes — for the first time since 1976.

Cuba sugar cane plantings[2]. — Cuba's spring plantings of sugar cane have reached a record 399,677 hectares this year, against the previous high of 284,759 hectares in 1975. All the B 4362 cane which was hit by rust has now been replaced so that Cuba expects output to return next season to the more normal 7-8 million tonnes level of 1977/78 and 1978/79.

Ghana sugar factories closure[3]. — The two state sugar factories at Asutsuare and Komenda have ceased operations indefinitely because of a shortage of foreign exchange and spare parts. The factories belong to the state-owned Ghana Sugar Estates Ltd. which supplies different grades of sugar and alcohol to the home market. At least $3,600,000 in government aid is needed to rescue the company, which has not been awarded an import licence since 1978 when a $227,300 licence was granted. At least 100 trucks, together with tractors and other machinery, are idle owing to lack of tyres and other spare parts. The two factories are the only sugar production facilities in Ghana and in 1980/81 had been expected to produce some 8000 tonnes, raw value.

New US HCFS plant[4]. — A new HCFS plant is under construction in Memphis, Tennessee; it should be completed in 1982 and will have an annual capacity of 350,000 short tons.

Poor Trinidad sugar crop[5]. — Following heavy unseasonal rains, the 1981 sugar crop ended on June 11, earlier than planned. Up to June 9, 89,019 tonnes had been produced against a projected 151,000 tonnes and Caroni Ltd. described the harvest as "disastrous". Rainfall in April, May and June this year was three times the average recorded over an unspecified 10-year period and the company indicated that cane equivalent to over 130,000 tonnes of sugar was left in the fields.

Mexico sugar statistics‡

		1980	1979	1978
		tonnes, raw value		
Initial stocks		363,097*	356,832	233,801*
Production		2,456,616	3,095,408	3,130,682
Imports				
Brazil	75,319			
Chile	38,294			
Cuba	382,948			
EEC	18,062			
Korea, South	27,933			
USA	218,187			
		760,743	0	0
		3,580,456	3,452,240	3,364,483
Exports†		0	29,605	73,711
Consumption		3,012,624	3,059,538	2,933,940
Final stocks		567,832*	363,097*	356,832

* Calculated
† All to U.S.A.

‡ *I.S.O. Stat. Bull.*, 1981, **40**, (6), 65.

Portugal corn sweetener company[6]. — Companhia Portugesa de Amidos SARL plans to start enzymatic production of glucose this year in Sacavem; in 1982 production of HCFS is to commence. All will be consumed within the country which at present uses about 12,000 tonnes per annum of corn-based sweetners.

New Tanzania sugar factory[7]. — A new sugar factory is to be established with Indian assistance at Mtxara, in southern Tanzania. The factory will have a production capacity of 10,000 tonnes of sugar per year.

New Burma mill tandem[8]. — A contract was signed in January 1981 for delivery by Technoexport of a 1500 t.c.d. cane milling tandem which will operate in addition to the tandem supplied to the customer — Zeyawaddy Sugar Factory Ltd. — before the Second World War by Skoda Works of Czechoslovakia. The contract is worth $16 million.

HFCS sweetener program for Pakistan[9]. — After Japan and Korea, the third country in Asia to start production of HFCS in Asia will be Pakistan. First generation HFCS with a 42% fructose content will be produced from broken rice, and a $13.7 million plant is to be erected with a capacity of 45,000 tonnes per year. Production cost is estimated at below that of white sugar and, since Pakistan's soft drinks industry consumes more than 45,000 tonnes of white sugar, there should be no difficulty in disposing of the new product. The Pakistan Industrial Credit and Investment Corporation has approved financing of a plant at Sheikhpura in the Punjab for the production of liquid glucose from broken rice and trials are expected to take place some time in 1982.

Honduras sugar production rise[10]. — Sugar production in Honduras in 1980/81 is set at 212,057 tonnes, raw value, up from the 186,989 tonnes produced in 1979/80 and a new record. It is about 4% below previous estimates, owing to late rains which reduced sugar content. Production in 1981/82 is projected at 239,000 tonnes and this increase is dependent on greater productivity in fields and mills, rather than a larger cane area. Sugar exports in 1981/82 are forecast at virtually unchanged from the 12,704 tonnes for 1980/81.

Ivory Coast sugar production, 1980/81[11]. — The Ivory Coast produced 135,000 tonnes of sugar, raw value, during 1980/81, of which 60,000 tonnes are being exported. Production was slightly lower than the 144,000-tonne target envisaged at the start of the season, but well up on last year's output of 102,000 tonnes.

[1] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 384.
[2] *Public Ledger's Commodity Week*, June 20, 1981.
[3] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 408,522.
[4] *Zuckerind.*, 1981, **106**, 563.
[5] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 384.
[6] *Zuckerind.*, 1981, **106**, 561.
[7] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 367.
[8] *Czechoslovak Heavy Industry*, 1981, (7), 21.
[9] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 430.
[10] *S. African Sugar J.*, 1981, **65**, 165.
[11] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 387.

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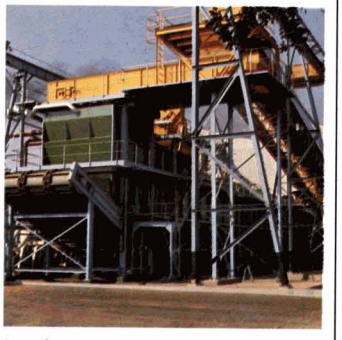

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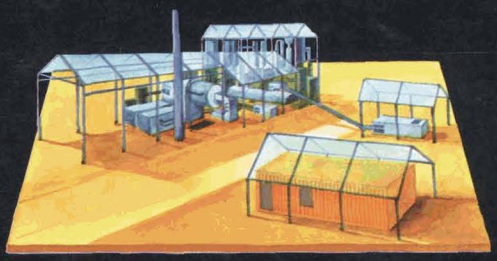

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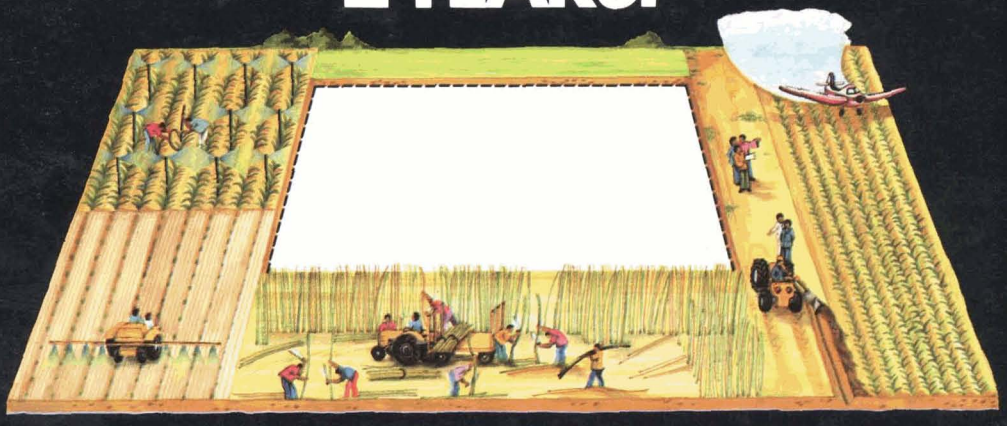

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