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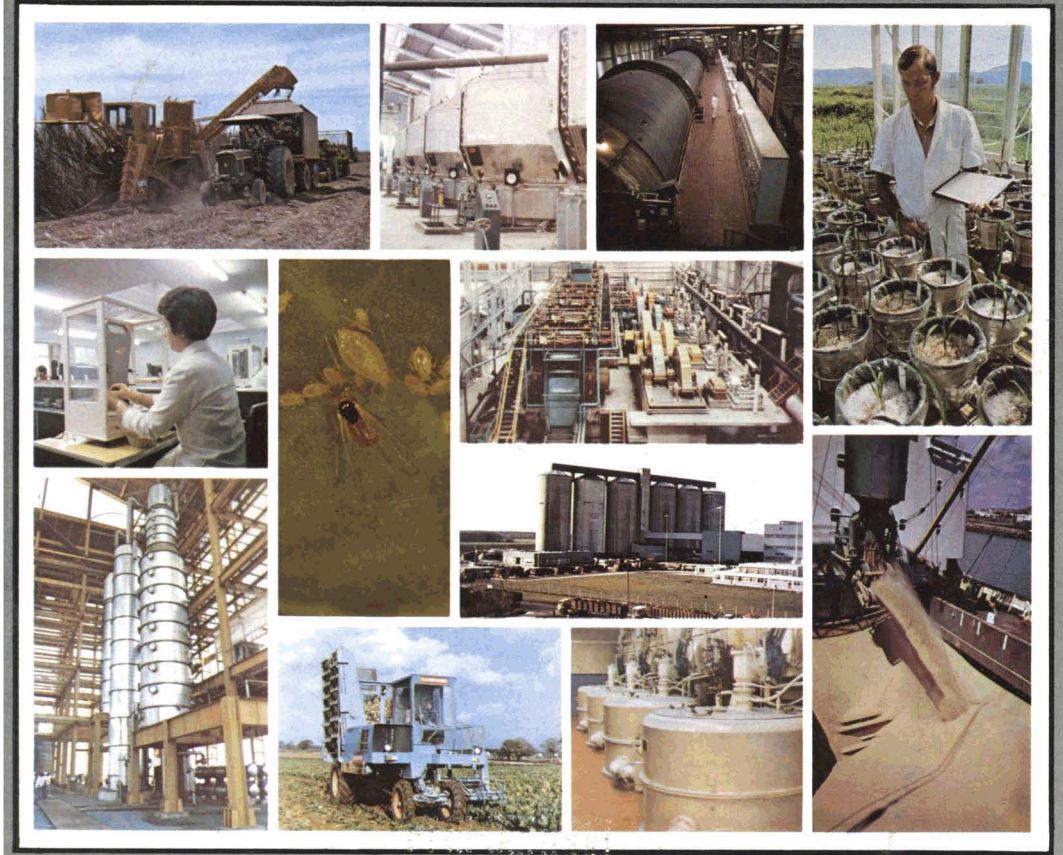

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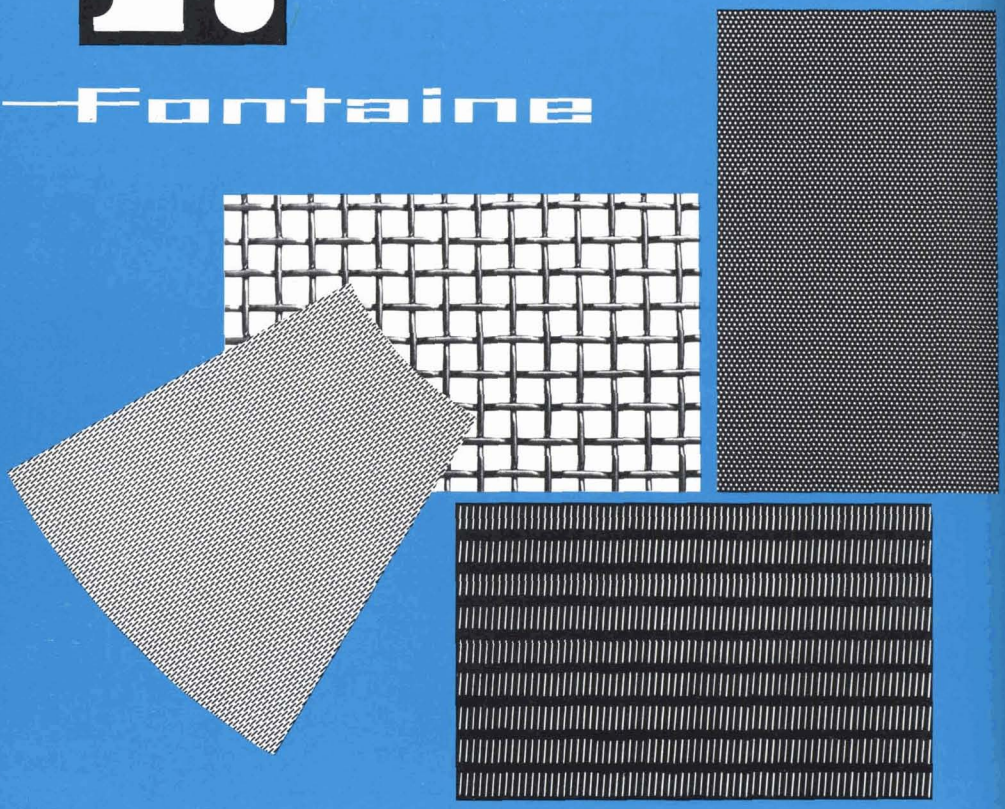

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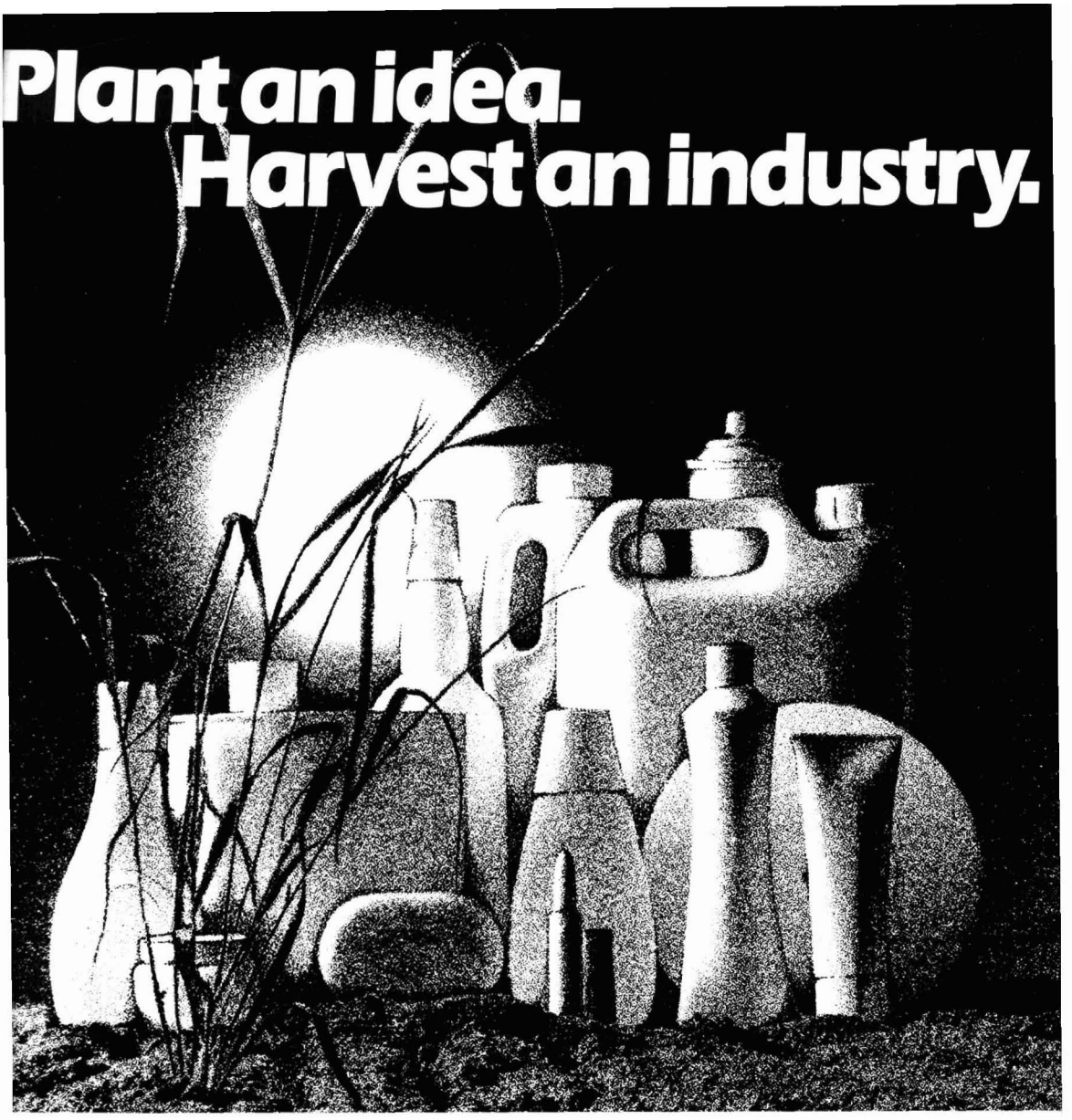

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NOTES AND COMMENTS

World sugar prices

The London Daily Price for raw sugar started the month of October 1981 at £175 per tonne c.i.f. UK and gradually slid to £158 by October 12, under the influence of the impending sugar surplus in Europe and strengthening of the pound sterling relative to other currencies. With reports of the sale of a large amount of sugar to Mexico, the price recovered to £163 but the decline then resumed and reached £152 on October 21, recovered briefly but fell again to £152 on October 27, after which, reports of Soviet interest brought another short-lived rally, and the LDP finished the month at £153 per tonne.

White sugar availability from the EEC is subjected to licence by the Commission and its commitment to the recent announcement of intention to withhold supplies has resulted in a relatively low level of export awards at weekly tenders during the month. As a consequence, the LDP(W) held up quite well during October, although it has been affected to some extent by the slide in raw sugar prices. From a level of £187 per tonne f.o.b. and stowed in approved European port, it fell to £176 by October 8 but then remained close to this level, except for a one-day drop to £169, through the remainder of the month, ending at £178 on October 30. Because of the relative changes, the premium of whites over raws, £12 on October 1, had widened to £25 per tonne by the end of the month.

The EEC and the ISA

Towards the end of October, the EEC foreign ministers gave the Commission a mandate to negotiate possible Community membership of a new International Sugar Agreement[1]. A working party of the ISO Executive Committee had been set up to consider the problems of extending the existing Agreement for up to two years as well as those of negotiating a new ISA, and an observer from the EEC, present at a meeting of the working party, delivered a prepared statement on the mandate. This was only obtained on the condition that talks should take into account the need to improve the present ISA and for EEC participation to be compatible with its own regulations.

A number of major difficulties exist: the Community would require a quota appropriate to its recent performance as an exporter, but this must also be acceptable to the other exporting members of the agreement. A BET of 4 – 5 million tonnes could be demanded, and it is interesting to note that it is quite likely that the Community might well have joined the ISA in 1977 if the much smaller BET it had been asking for then had been acceptable to other exporters.

The EEC would like to see more effective measures for controlling supplies and prices and also wishes account to be taken of HFCS and alcohol production as well as the uncontrolled flow of Cuban sugar to the Eastern bloc. Satisfaction on all these points would probably involve a new Agreement, yet the majority of current members seem to favour extension of the present ISA. A meeting of the Council, scheduled for November 19, was due to decide whether the Agreement should be extended or renegotiated.

EEC sugar stock proposals

On October 2, the French beet growers and sugar producers associations announced that they had decided to withdraw 500,000 tonnes of *C*- or non-quota white sugar from the market in 1981/82. The Italian producers are also said to have agreed to withdraw 200,000 tonnes, while the German producers will withdraw 30-40% of the *C*-sugar made in their country. Some doubt has been expressed in the trade as to these amounts since, while the associations may recommend such withdrawal to members, the fact or otherwise of such stockpiling will depend on the individual producer's willingness to store his sugar.

Perhaps in view of this, the EEC Commission has announced that it is prepared to review its program of releases so as to increase stocks of *A*- and *B*-quota sugar to more than 1.8 million tonnes by the end of 1981/82 if insufficient quantities of *C*-sugar are carried forward for 1982/83. The Commission wants to hold down exports to 4 million tonnes in 1981/82 against 4,430,000 tonnes in the previous year, while it estimates that total export availability is 5.9 million tonnes.

US Farm Bill

After passage of Farm Bills through both houses of Congress[2] it was indicated that the Reagan Administration was becoming less antagonistic to inclusion of sugar support provisions. When the Senate resumed after the summer recess, a new Farm Bill was tabled for consideration and eventually passed, in which a loan support program was included but with modifications to make the proposals less costly and so more acceptable to the Administration. The loan rate for sugar was reduced from 19.6 cents/lb in the earlier version to 18.00 cents/lb for 1982 crops, 18.50 cents/lb for 1983 crops, 19.00 for 1984 and 19.50 cents/lb for 1985 crops, all on a raw sugar basis. Although the Administration had previously indicated that it wished to see the support level at only 16.5 cents/lb, leading Republican senators claimed that the Bill as passed by the Senate had the president's support. The Bill then went to the House of Representatives for consideration but because of delays was not fully discussed before the October 9 recess.

When it came before the House, sugar loan provisions corresponding to a support price of 16.5 cents/lb were eliminated completely on a small majority vote and, as a consequence, a joint Congressional Committee had to be formed to work out a revised Bill which could be put to both houses of Congress. This Committee was reported[3] to have reintroduced the same support program as in the Senate Bill, i.e. support prices of 18-19.50 cents/lb for 1982-85.

"Whether or not the committee's proposals stick, its decision to back an expensive and protectionist sugar policy will come as a bitter disappointment to all those, both inside and outside the US, who hoped the Reagan Administration would steer through a more liberal sugar plan.

"As far as other sugar producers are concerned, especially those in Latin America and the Caribbean who rely heavily on US purchases, the dangers of the sugar program are twofold. First, by reintroducing sugar supports for American producers for the first time since 1974

[1] *Public Ledger's Commodity Week*, October 31, 1981.
[2] See *I.S.J.*, 1981, **83**, 194, 226.
[3] *Public Ledger's Commodity Week*, November 7, 1981.

the authorities will encourage domestic production (or at least will arrest any decline in output). Import requirements will thus be cut.

"But what is worse, the domestic US industry will be protected from cheap imports by heavy tariffs. At the present time the US imposes an import levy of 1.531 cents per lb on raws. Under the new plan, however, this import fee would have to be increased massively. Assuming sugar prices stay at around 12 cents per lb, origins supplying the US could be faced with an import duty of some 50%.

"High domestic sugar prices also create the risk of even further penetration of the US market by corn sweeteners, which are already growing in use at over 10% a year. The sugar program could therefore backfire by playing into the hands of the wet corn millers rather than America's hard-pressed sugar producers which it is designed to help.

"Seven Latin American and Caribbean countries, led by the Dominican Republic, have urged President Reagan to abandon the sugar loan program, but to no avail. And the State Department in Washington has also asked for the plan to be scrapped because of its potentially diastrous impact on US-Caribbean relations. But the US farm lobby has resoundingly won this battle, if not the war.

"As far as the international sugar community is concerned, charges of double standards will undoubtedly be levelled against Washington following the decision. In recent months the US has voiced opposition to the EEC's alleged dumping of sugar on world markets. But for many producers, including Australia, the decision to press ahead with the Senate's sugar plan makes the US as big a villain in the international sugar market as the EEC."

World sugar production, 1981/82

In recent weeks a number of estimates of world sugar production have been published for the period 1981/82 and, although the precise terms vary between them, they cover a considerable range. *World Sugar Journal*[4] considers that production will amount to 92,227,000 tonnes, raw value, while C. Czarnikow Ltd.[5] set it at 96,119,000 tonnes. Nearer the bottom end of the range is the GEPLACEA estimate of 93,328,000 tonnes while F. O. Licht KG[6] expect production to reach 95,122,000 tonnes. The French trade house Sucres et Denrées estimate production at 95 – 96 million tonnes, while the USDA believes output will reach 95.8 million tonnes[7].

Estimates of consumption are much less diverse, however, and are generally in the region of 91 – 91.5 million tonnes. The surplus is thus set somewhere between under 1 and up to some 5 million tonnes. Fortunately, even if the latter figure is correct, not all of this amount will be a burden on the world market. The EEC plans to segregate up to 2 million tonnes from the market, ISA provisions call for special stocks of one million tonnes established by the end of June 1982, and the Indian government has also indicated its intention to build up a buffer stock for domestic purposes. Moreover, there have been considerable reductions in commercial stocks of recent years when consumption has been greater than production. Of course, high costs of both sugar and finance have encouraged refiners to improve efficiency and the ability to make do with smaller sugar stocks than in former years. Against this, consumption has shown a greater elasticity in the face of high sugar prices over recent years than had been thought the case, and, with lower prices, it could be that demand will increase to a greater extent than currently estimated.

World sugar balance

Since its basis is not exactly the same as the recent estimate of world sugar production, the production figure used by F. O. Licht KG for his first estimate of the world sugar balance for 1981/82[8] is not exactly the same. It is, however, set at about the average of the production figures mentioned above and the balance may therefore be considered a reasonable guide to availabilities and demand in the current crop year September 1981 – August 1982.

	1981/82	1980/81	1979/80
		tonnes, raw value	
Initial stocks	24,473,000	26,265,000	31,456,000
Production	94,782,000	87,263,000	85,021,000
Imports	26,970,000	28,246,000	29,482,000
	146,225,000	141,774,000	145,968,000
Exports	26,755,000	28,623,000	29,997,000
Consumption	91,155,000	88,678,000	89,706,000
Final stocks	28,315,000	24,473,000	26,265,000

While the production increase is no less than 7½ million tonnes, the level estimated is still only about 3½ million tonnes more than production in 1977/78, and the final stocks figure for August 1982 is only 2 million tonnes higher than two years earlier.

GEPLACEA meeting

The 21 members of GEPLACEA, the Group of Latin American and Caribbean sugar producers, plus an observer from the Philippines, held a meeting in Quito, Ecuador, during October 19-22 and discussed market trends and the International Sugar Agreement. The Group expressed deep concern at the reimposition of an import fee by the United States and on the expansion of EEC sugar production and exports. They did not adopt a common attitude to the ISA but a majority of members favoured extension of the 1977 Agreement. The Group adopted a new estimate of world sugar production and consumption for 1981/82; the latter they set at 91,410,000 tonnes, raw value, while the former they set at 93,328,000 tonnes, rather less than the estimates of most other statisticians.

International Sugar Agreement

As indicated earlier[9], a number of quota shortfall notifications were made to the ISO by September 30, totalling 753,453 tonnes, raw value. The shortfalls were not reallocated and, as a consequence, the total of quotas in effect was reduced to 13,110,188 tonnes. C. Czarnikow Ltd. note[10] that Swaziland, a second half-year exporter, is the only country to have been inconvenienced by the non-reallocation of shortfalls this year. It would clearly be inappropriate for one country to be singled out in this way purely as a result of being a second half-year producer, and Swaziland has been awarded 10,000 tonnes from the Hardship Reserve to bring its export quota to 159,390 tonnes.

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4 1981, **4**, (4), 10.
5 *Sugar Review*, 1981, (1569), 183.
6 *International Sugar Rpt.*, 1981, **113**, 629-633.
7 *Public Ledger's Commodity Week*, November 7, 1981.
8 *International Sugar Rpt.*, 1981, **113**, 652-657; *Special issue*, October 15, 1981.
9 *I.S.J.*, 1981, **83**, 321.
10 *Sugar Review*, 1981, (1565), 166.

Total energy design in cane sugar factories*

By L. S. BIRKETT & R. B. GRAY
(Fletcher and Stewart Ltd., Derby, England)

Introduction

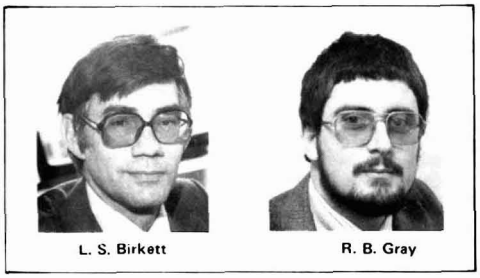
The trend up to about 20 years ago was for cane sugar factories to produce basic raw sugar for refining in separate refineries in Europe or North America. A small quantity of refined sugar was often re-imported by the cane sugar producing countries for domestic consumption. The modern situation requires cane sugar manufacturers to produce an enhanced quality raw sugar for direct consumption with a proportion or perhaps all of this sugar being refined for local bottling or canning needs, with any surplus being exported. More recently still, the increasingly viable opportunities for ethanol production from cane juice or molasses, together with traditional by-products, have attracted more attention to composite process design.

Both market forces and tradition determine a client's requirements, but increasingly it is the local balance of payments and foreign currency difficulties and not actual cost/revenue break-even points which determine the product range required by the developing country. Brazil in particular produces ethanol direct from sugar cane as a substitute for imported primary fuel. In general, the operating factors which determine the types of product manufactured are many and varied, but the overriding factor is invariably self-sufficiency in fuel and power.

The energy required to run a sugar factory originates from the burning of fuel. In this process, the heat liberated is used to convert water into steam. The traditional fuel of a cane sugar factory is the final bagasse. Normally, a conventional raw sugar factory is self-sufficient in fuel, using only the bagasse derived from the cane crushed, but for the more complicated processes required for an integral refinery, the use of bagasse itself or additional steam requirements for secondary products, would normally require the import of a supplementary fuel unless catered for in the original design. On the other hand, factories incorporating moderate process efficiencies are capable of using so little of their bagasse that the excess can become an embarrassing disposal problem.

Within the modern cane sugar factory, steam is generated at between 25 and 31 kg.cm^{-2} and 380-400°C, and first fed to cane preparation and milling machinery turbines and the factory turbo-alternator. Turbine exhaust steam, containing 70-80% of the total heat of the live steam as latent heat, is used for all process evaporation, controlled crystallization and general heating requirements. Up to 15% of the total exhaust steam requirement will be made up from reduced and desuperheated live steam. These quantities, together with other miscellaneous uses of reduced pressure process steam (4.2 kg.cm^{-2}), will constitute the boiler capacity.

It is the difference between the steam required for the main process and the total steam available from the bagasse that determines the extent to which additional by-products can be incorporated within a particular proposal. From the total energy viewpoint, the aim is to minimize or eliminate the use of supplementary fuel whilst providing the maximum scope for the production of by-products, with which this paper is concerned. The following work uses actual proposals to contrast the traditional with the modern approach for providing the most cost-effective solution to individual factory energy balance.



L. S. Birkett R. B. Gray

Four design studies

As outlined briefly above, the energy required to operate a raw sugar factory is derived from the final bagasse discharged by the cane milling tandem. With cane of approximately 14% fibre and fibre in bagasse approximately 50%, 1 tonne of cane produces 280 kg of bagasse. In general, raw sugar factories are designed to operate on 0.56 to 0.60 tonnes of steam per tonne of cane, or 56% to 60% steam on cane, so as to limit the surplus of bagasse to between 5% and 10%. Accumulation of such a surplus allows for continuous steam generation during operational downtime of the extraction process. Economies in process steam usage only become critically important at fibre in cane percentages less than 11%.

The present trend of installing more complex processing methods producing better quality sugars and more powerful sucrose extraction machinery, together with the fact that bagasse often represents commercial value as raw material for secondary products, is leading to a situation where better control of steam generation and the introduction of energy saving methods become much more important.

For ease of explanation and to keep each of the presented design studies on a comparative basis, the following process parameters are adhered to throughout this work:

Basic factory cane crushing rate: 4000 tonnes cane/day (tcd)
Crushing allowed over 23 hours: 174 tonnes cane/hour (tch)
Sucrose in cane: 12.5%

* Abridged from a paper presented to the Institution of Chemical Engineers as part of a symposium on "Total Energy Design in Process Plants". Copies of the Symposium Proceedings are available from Book Sales Dept. of the Institution, 165-171 Railway Terrace, Rugby CV21 3HQ, England, price £11.00.

Fibre in cane: 14,0%
Imbibition water (mill extraction water): 200% on fibre in cane
Filtrate returns: 15%
Mixed juice purity: 82%

The following example is representative of enquiries being received from sugar cane growing countries at the present time. The requirement is for a raw sugar factory producing approximately 425 tonnes/day high quality A–raw sugar from a cane input of 4000 tcd with the cane characteristics previously defined. The original proposal provided for a doubling-up of the capacity which, of course, although not reflected in this paper, would affect the design of certain items of equipment.

Table I. Comparison of design criteria extracted and calculated from steam and power balance calculations for a cane sugar factory/refinery

	100% Raw Factory Balance No. 1	50% Raw 50% Refined Balance No. 2	100% Refined Product Balance No. 3	100% Refined & Distillery Balance No. 4
Average factory steam demand (tonnes/hour)	94	96.6	106	111
Average factory electrical load (kW)	3400	3800	4200	4350
$\frac{\text{Exhaust make-up}}{\text{Exhaust required}} \times 100$	25	21.5	24	36
Process efficiency factor	2	5.13	6.76	6.76
$\frac{\text{Surplus bagasse}}{\text{Bagasse production}} \times 100$	19	16.9	9.0	4.8
% steam on cane	56.4	58	63.5	66.4

It is required for the basic raw sugar factory to be designed in such a fashion as to facilitate three future phases of modification. The first phase is to remelt 50% of the A–raw sugar for reprocess as 200 tonnes/day of refined white sugar and the remaining 213 tonnes/day sold as A–raw sugar. The second phase is to produce 100% refined white sugar at the rate of approximately 400 tonnes/day. The third phase is to provide steam and electrical power to a distillery producing 50,000 litres/day of anhydrous alcohol from final molasses. The design criteria for each of these phases are summarized in Table I. The corresponding steam distribution balances are included in Figures 1-4.

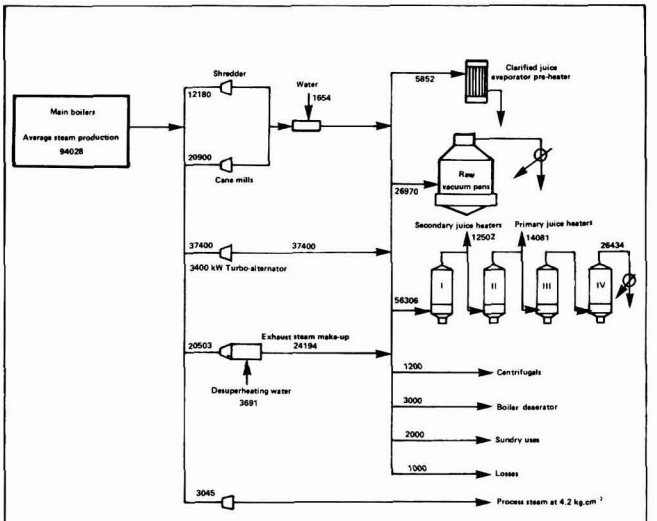


Fig. 1. Factory steam distribution based on the production of 100% high quality A–raw sugar at a cane milling rate of 174 tch

The efficient use of steam

Since similar cane preparation and milling machinery is specified for each design study of Table I, the total turbine exhaust steam increases only by that proportion of the increase in the average factory electrical load. The increase in process heating required for phase 1 and phase 2 is simply obtained by rearrangements of the exhaust steam and evaporator bled vapour users. The raw sugar factory proposed uses exhaust steam to the sugar boiling vacuum pans and the evaporator has moderate bleeding only of 2nd and 1st effect vapours to the primary and secondary juice heaters, respectively. If it is not required to supply heat energy for phase 1 and phase 2 directly from live steam through the make-up system, then evaporator vapours have to be fully employed. Consequently, both the raw sugar vacuum pans and refinery pans are heated by 1st effect vapours, and by increasing the allowable pressure drop across 1st and 2nd effects, thereby increasing the respective apparent evaporation rates, it is possible to utilize the existing equipment fully throughout each phase of modification.

Effective use of bled vapours from the evaporator improves the process steam efficiency. This process efficiency factor (F) in Table I is defined as exhaust steam to 1st effect divided by the last effect total evaporation, and shows the relative efficiency achieved in each case. The net effect of increasing turbo-alternator exhaust, to meet increased process heat requirements, produces a nearly constant make-up of live steam to the exhaust steam system which again minimizes alterations to automatic pressure reducing/desuperheating equipment installed at the first phase of operation.

The significance of the make-up figure and its absolute value in relation to optimum design is the subject of controversy, but represents the deficit of process steam required after allowing for the total desuperheated exhaust from the turbine[1]. This quantity

[1]Perk: "The generation and consumption of of steam" (Hayne & Gibson, Durban), 1973.

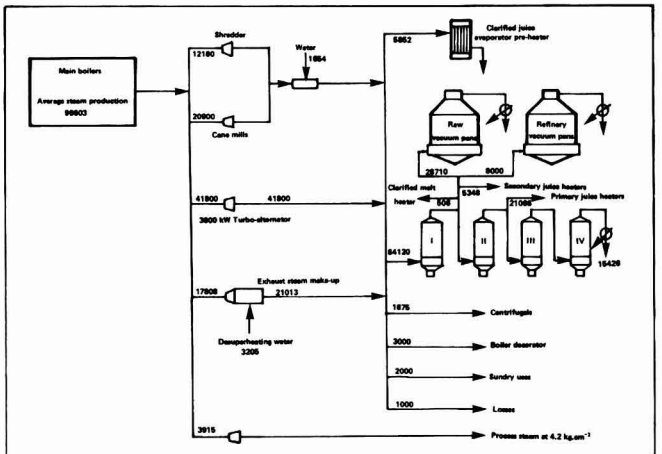


Fig. 2. Factory steam distribution based on the production of 50% high quality A—raw sugar and 50% refined sugar at a cane milling rate of 174 tch

less the associated desuperheating water is a direct draw on the h.p. boiler steam. A figure of 5-10% make-up is considered an absolute minimum and 10-25% considered a traditional safe normal to cater for the large steam fluctuations inherent in the process. With low figures of 4% or 5% the process runs the risk of direct energy loss by turbine exhaust blow-off during periodical reductions in process steam demand. On the other hand, large make-up quantities lose the benefit of obtaining mechanical work from the steam via prime movers.

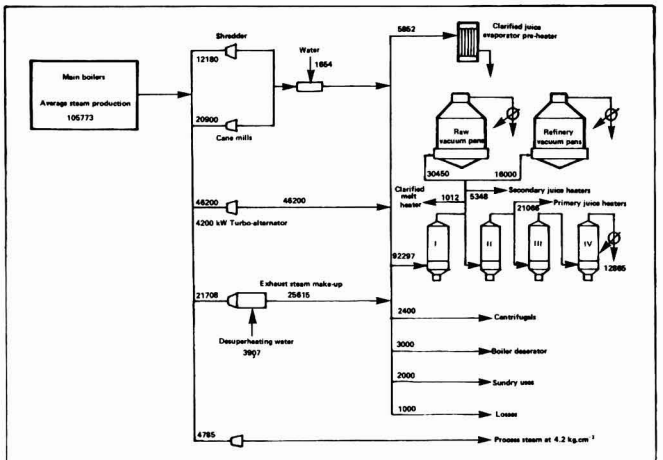


Fig. 3. Factory steam distribution based on the production of 100% refined sugar at a cane milling rate of 174 tch

If the average steam demand for the factory is divided by the average cane crushing rate, percentage steam on cane figures are obtained. The increase in processing requirements from the raw sugar factory and the phased-in refineries, coupled with the economies mentioned above, combine to produce total steam on cane figures of 56.4% and 63.5% respectively. Applying these steam figures to the corresponding cane crushing rates, gives surplus bagasse figures of 19%, 16.9% and 9.0% respectively.

In order to complete this total energy utilization package, we further reduce the 9.0% surplus bagasse for the 100% refinery to a minimum surplus of 4.8% by the addition of a molasses distillery. The extra steam produced can be supplied to the distillery at any design pressure, since it is merely pressure reduced and attemperated boiler steam. The distillery is sized at 50,000 litres/day production of anhydrous alcohol and requires approximately 5 tonnes/hr of steam and 150 kW of electrical power. Energy recovery systems from distillery waste, presently being investigated, can reduce the net energy required by a distillation process significantly, especially when external column reboilers are substituted for direct steam injection heating methods. Having now reduced the bagasse surplus to approximately 5% and accordingly fixed a boiler efficiency, the net increase in process steam does not necessitate further sugar refining process efficiencies.

Capital cost factors

One of the major restraints on the engineering of the process design is, of course, capital cost. Many proposals are, therefore, presented as a compromise between efficient total energy utilization with the associated high capital investment, and the contribution to rate of return on investment of the proposed secondary product plant. The above proposal represents such a compromise and clearly illustrates a modern approach to the initial design of a raw sugar factory. In effect the initial outlay of capital cost is reduced whilst maintaining suitability for future expansions and fully utilizing the initial raw sugar equipment.

Having expounded the virtue of compromise design, highly efficient total energy usage plants can produce very large surpluses of bagasse. In situations where bagasse has a commercial value as either a raw material itself for a secondary product or as fuel for the processing of a secondary product, increased capital expenditure can be justified. In areas where fibre contents in cane are exceptionally low, of the order of 10%, this expenditure can become a necessity. Figure 5 conveniently summarizes the total energy picture of a cane sugar factory. It clearly shows the relationship between process efficiency and the cane characteristics which, together with information on the efficiencies of energy converting equipment, constitute the cane sugar design profile.

In contrast to the raw sugar factory presented init-

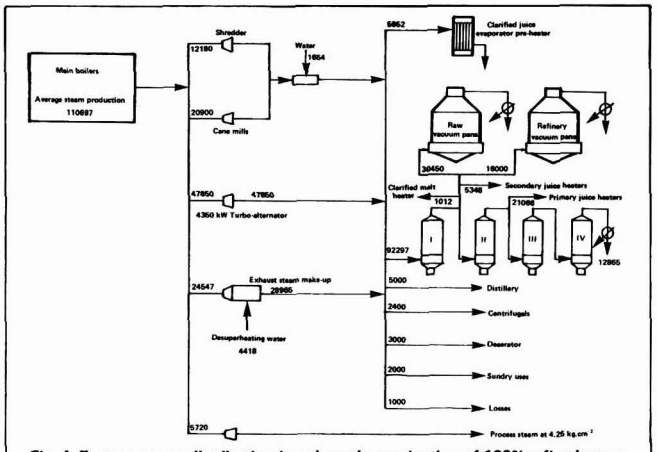


Fig. 4. Factory steam distribution based on the production of 100% refined sugar and including a molasses feed alcohol distillery at a cane milling rate of 174 tch

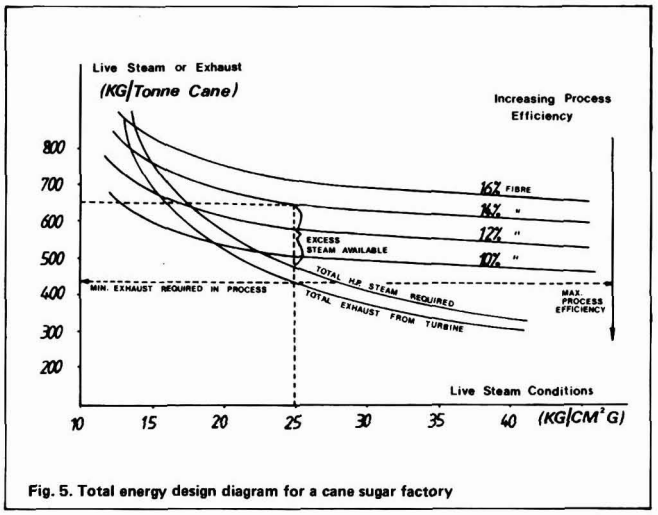


Fig. 5. Total energy design diagram for a cane sugar factory

ially, it is of interest to show the magnitude of the energy savings possible using a different design philosophy. Figure 6 summarizes a calculation for a raw sugar factory producing the same 425 tonnes/day A–raw sugar as in the case previously looked at. The cane preparation/milling power requirements and the electrical load of this factory would be similar. Consequently by making economies in the total energy usage of the process heating alone, the average steam demand of the factory can be reduced to approximately 76 tonnes/hr or 45.6% on cane. This type of economy is achieved by conventional sugar processing technology in so much as a quintuple evaporator is used and bled heavily using some 3rd effect vapours for the primary juice heating system. The process efficiency factor for this arrangement is calculated at 9.8 which compares with the previous case of 2.0.

Further process efficiencies are inhibited here because of the low make-up figure of 4%, and this figure if reduced further would have design ramifications on the vacuum pan station. Therefore, if a greater overall energy efficiency is required, one must look to increasing the efficiency of both the steam turbines and/or the steam raising plant. Marginal reductions in turbine water rates are sometimes available, but a more acceptable reduction can be obtained by replacing the single-stage steam turbines, which drive the cane preparation and milling equipment, with electric motors. The electrical power can then be generated in the higher efficiency multi-stage turbo-generator. There are practical limitations to this solution in respect of large electric motor *vs.* turbine capital and installation costs. In the sugar cane application, it is generally the case that steam turbines are more cost-effective than electric motors for powers in excess of 350 kW when power and speed control are considered.

A greater percentage increase in total energy efficiency can be gained by looking at the designed efficiency of the steam raising plant. Conventional bagasse-fired boiler plant can have gross efficiencies calculated on the gross calorific value of bagasse of between 62 and 65%[2]. These figures are based on bagasse moisture content of 50%, fibre content of 48% and residual sugar of 2%. A 65% efficiency corresponds to approximately 2.29 kg/steam per kg of bagasse. It is this rate which is used throughout the paper. More recently, boiler manufacturers have been offering units producing 2.49 kg steam per kg of bagasse or close to 70% gross efficiencies which may obviously be reflected in any surplus bagasse calculations. By way of example, the efficient raw sugar factory using a quintuple-effect evaporator produces a massive 35% surplus bagasse, or approximately 17.8 tonnes/hr. This surplus would be in the order of 40% if a high efficiency boiler was used. This surplus of 17.8 tonnes/hr of bagasse will produce the same quantity of steam as the following fossil fuels: (i) 2.65 tonnes/hr of bunker 'C' oil; (ii) 4.60 tonnes/hr of bituminous coal; or (iii) 113.0 m^3/hr of natural gas.

From a total energy point of view, this proposal for an efficient raw sugar factory looks very attractive since, with average steam demand drastically reduced and a sizeable bagasse surplus consequently produced, fuel is available for additional processes. Unfortunately, unless there is a known and, furthermore, fairly constant-demand market for the bagasse, one can be presented with embarrassing mountains of low bulk density

[2] Birkett: *Proc. B.W.I. Sugar Tech.*, 1966, 352-362.

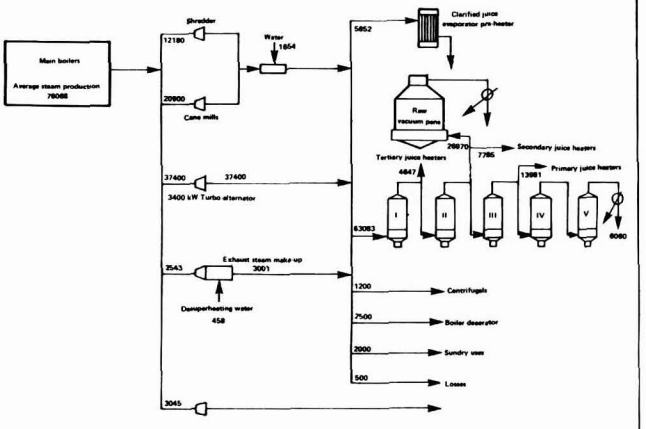


Fig. 6. Energy-efficient factory steam distribution based on the production of 100% A–raw sugar at a cane milling rate of 174 tch

(130 kg.m^{-3}) material which can be both expensive and dangerous to store for extended periods[3]. Consequently, a process designed to utilize out-of-crop the surplus bagasse produced during the cane harvesting period could involve accumulation of a very large surplus of bagasse over say a 200-day harvest. The problems of bagasse storage are not insurmountable, however, and baling can increase the bulk density to approximately 560 kg.m^{-3}. The better solution, though, is to use any surplus bagasse at near the rate of its production.

Many existing cane sugar factories operate with large surplus bagasse production, and one of the more popular ideas of the factory engineer or manager is to burn the surplus to produce steam and then generate electrical power. This can be a neat solution to the disposal of an otherwise waste material with the following qualifications. First there ought to be sufficient spare capacity in the existing bagasse-fired boilers. Second, unless there is a subsidiary requirement for process steam, the power must be generated in total condensing turbo-alternator sets which, as well as requiring further capital outlay in the form of ancillary cooling towers/ spray ponds and cooling water circulating pumps, can consume 20% of the generated power in the cooling water circuit. Third, if distribution costs are not to enter into the economic equation, then a local grid system would have to be available for the export of the power.

There have been numerous proposals prepared which cater for a multitude of by-product plants running throughout and beyond the cane harvesting period. By way of example, a recent comprehensive proposal included a 100 tonnes/day bleached bagasse pulp and paper mill requiring 9900 kW of electrical power and 60 tonnes/hr of process heating steam. Other uses of bagasse may include board, wax and cellulose extraction plants, and processing plants. By-products derived from final molasses are even more numerous than those from bagasse. In recent years interest has been shown in citric acid, yeast, potable alcohol and anhydrous ethyl alcohol plants.

The importance of alcogas production

The last two years have seen a significant rise in interest in alcogas projects using both sugar cane juice and final molasses as individual and combined feedstocks. The dramatic increase in the world oil price is the catalyst behind this upsurge. The other two factors in this economic balance are obviously the relative prices of sugar and molasses. As may be seen in Figure 7, the sugar price on the London market is highly volatile. From an average of £320/tonne in June 1980 it fell to £220/tonne in July, and then back up to £320 for the duration of August, reaching peaks of over £400/tonne raw sugar in November last year. Cane final molasses tends to be slightly more stable at approximately $116/ tonne as quoted ex-Louisiana. However, local supply agreements are often made, reducing this to as low as $28/tonne. Furthermore, many countries, including Tanzania and Sudan, have large quantities of cane molasses with few economical outlets. Tanzania in particular was reported[4] at the UNIDO Conference of 1979, to be urgently looking into the fermentation of large quantities of molasses which were simply being dumped at that time.

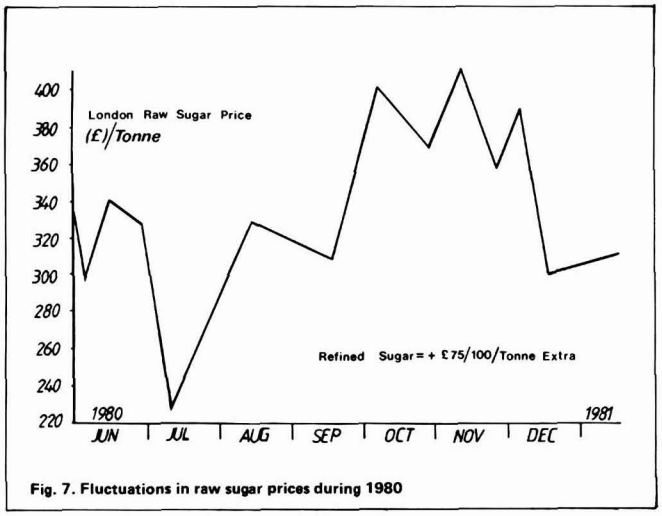


Fig. 7. Fluctuations in raw sugar prices during 1980

Brazil leads the field in alcogas production and the long-term objective of achieving a high degree of fuel self-sufficiency via alcogas has further inspired many other countries to investigate the viability very care-

[3] Atchison: *Proc. 14th Congr. ISSCT*, 1971, 1189-1201.
[4] Mungai: *I.S.J.*, 1980, **82**, 349.

fully. Certainly, in the state of São Paulo, Brazil, most of the sugar factories have integrated distilleries using molasses, producing either 96.5% v/v or anhydrous alcohol. Chenu[5] reports that the fluctuating price of sugar demands that a factory/distillery complex be capable of the co-production of varying amounts of sugar and alcohol. This split is generally achieved by the division of crystallizable sugar at a point in the cane process that suits the individual energy resource balance. Following the Brazilian lead, much effort has been concentrated in the sugar industry on improving the net energy consumption of alcohol distillation plants, and on impriving and researching fermentation technology. This work has been in an effort to engineer energy self-sufficiency packages for both the provision of distillery sections for existing cane sugar factories and for completely autonomous distilleries.

Invariably in the course of conversion of the sugar factory into a distillery, the most energy-economical division of crystallizable sugar has been found to be at the evaporator station. The evaporator usually has a reduced duty and will often be retained in the conversion. If the vacuum pans, centrifugals, sugar drying and handling equipment are retained, a reversion back to sugar production is available at the turn of a valve, with a major proportion of the capital cost required for alcohol production from cane being saved by utilizing an existing factory front end. It is in these conversions of factories that many energy saving possibilities exist. Still bound by the total energy available from bagasse, thermal vapour compression and pass-out turbines are being considered. Conversions of sugar factories tend to produce individually tailored solutions and consequently leave little scope for generalization.

Figure 8 represents a possible design for a factory/distillery which satisfies most of the requirements of a total energy design package. The plant is based on similar cane capacities and characteristics specified earlier. In addition, the following generally accepted parameters apply:

Actual milling extraction: 94%
Reducing sugar in cane: 0.75% on cane
Fermentation efficiency: 90% of GL conversion
Distillation overall recovery: 97%

The complex will produce between 318 and 350 tonnes of A–raw sugar and between 130,000 and 110,000 litres/day of anhydrous alcohol. (The variation is related to the amount of centrifugal wash sent to the distillery.) Moderate process efficiencies have achieved a bagasse surplus in the region of 23% and, as discussed earlier, would invariably produce a baling, stacking, storing and reclaiming problem if it were to be stored for the crop duration. In the light of the previous discussions, two possible solutions warrant calculation. Case 1 utilizes the surplus bagasse as it is produced by importing final molasses to be processed along with the A–molasses and A–wash at such a capacity as to leave a minimal 5% surplus bagasse. This solution, fully utilizing the net energy available, provides large capacity plant working during the crop period only.

Case 1	Production	318 tonnes/day of A-raw sugar 340,000 litres/day of anhydrous ethyl acohol
200 days	Raw material	4000 tcd { 292 tonnes/day of A-molasses 53 tonnes/day of A-wash 777 tonnes/day of imported C-molasses
Case 2	Production (in crop)	318 tonnes/day of A-raw sugar 227,000 litres/day of anhydrous ethyl alcohol
200 days	Raw material	4000 tcd { 292 tonnes/day of A-molasses 53 tonnes/day of A-wash 359 tonnes/day of imported C-molasses
100 days	Production (out of crop)	227,000 litres/day of anhydrous ethyl alcohol
	Raw material	840 tonnes/day of imported C-molasses

A better solution would be to extend the distilling plant operating period and save capital cost by reducing the plant size. Hence Case 2 is based on a 200-day cane harvesting period, and a 100-day out-of-crop period processing C–molasses only. Both these cases maximize total energy utilization and are interesting to compare.

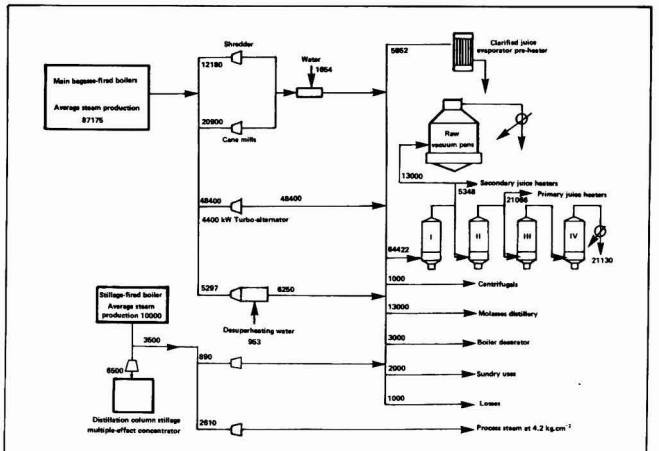


Fig. 8. Integrated distillery based on the co-production of A–raw sugar and anhydrous ethyl alcohol from a cane crushing rate of 174 tch

Discussion

Recently there has been a reduction of interest from sugar producing areas in basic raw sugar factories. A high proportion of enquiries now include provision for the production of high quality raw, plantation or local consumption white or fully refined white sugar. With each proposal presenting its unique problems and limitations, it is the objective of the sugar engineer to achieve the most cost-effective individual solution to ever increasing complexity of plant, whilst reducing the dependence upon non-renewable primary fuel resources to a minimum. This objective extends to cover second-

[5] *Proc. 16th Congr. ISSCT*, 1977, 3241-3251.

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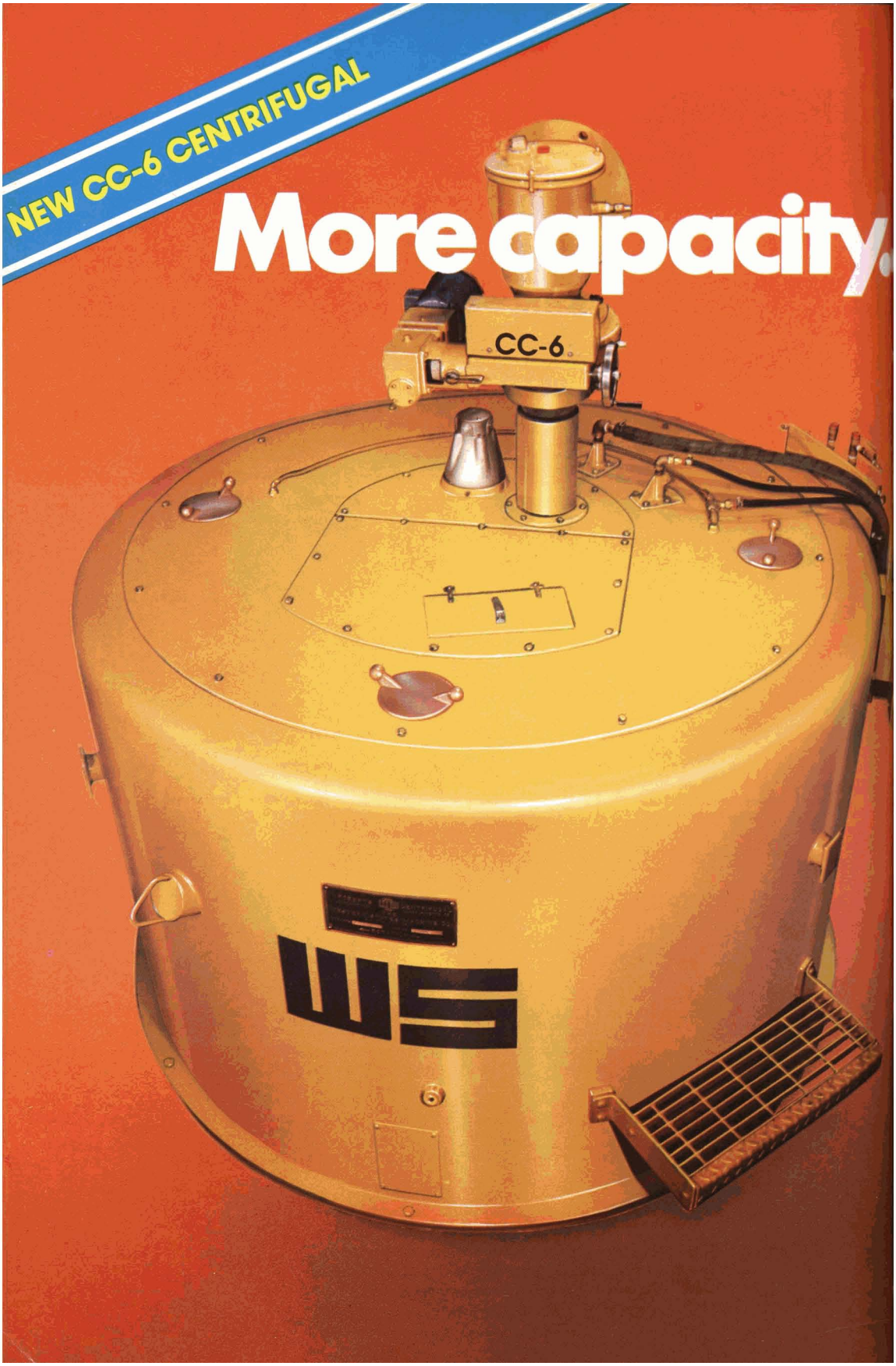

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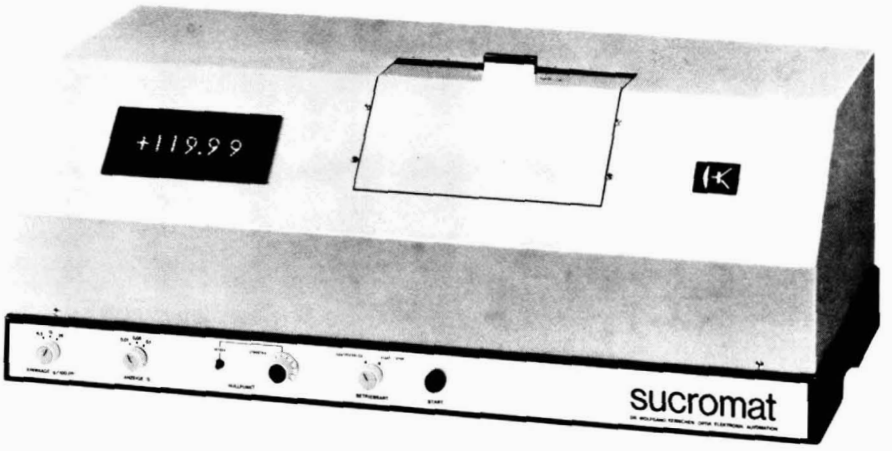

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ary product processes which, when added to the basic cane sugar process, often produces economically attractive total packages.

The factory/distillery cases presented above are just two possible solutions to one particular objective. Actual product range is more generally based on national economic development in remote areas. Despite this, efficient total energy usage is becoming more crucial. Murata[6] reports the extensive utilization of excess bagasse to generate power for local communities on an integrated import and export grid system. Reference is also made to the introduction of high pressure bagasse fired boilers (30-80 $kg.cm^{-2}$), the live steam being used to generate internal and export electrical power, turbo-alternator pass-out steam fed to more normal mill turbines, and exhaust from these being used for process heating in the normal manner. Although this arrangement is dependent on the existence of a grid system, it is certainly another route to efficient energy utilization that should be investigated further. Birkett[7] has also reported to the Tulsa section of the American Institute of Chemical Engineers, that two mills in Louisiana were seriously considering adjacent factories to make alcohol from sugar cane, cane molasses, and/or sorghum, using the excess energy for the sugar operation to fuel the plant at least part of the time.

Acknowledgements

The authors would like to express their thanks to Fletcher & Stewart Ltd. for allowing the use of various proposal work to be made public and the facilities extended during the preparation of this paper. In particular, we wish to thank Mr. R. M. J. Withers and Mr. R. G. Tomlinson for their guidance and ideas which have been incorporated in this presentation. Special thanks are also extended to all our colleagues who, knowingly or otherwise, have contributed their help without which this work would not have been possible.

Summary

With increasing interest in white sugar manufacture instead of raws, and production of alcohol, process steam requirements demand the highest efficiency of energy recovery from the basic fuel, bagasse, especially if there are proposals to achieve a surplus for conversion to board, paper or other valuable material. A number of schemes are presented in order to achieve high efficiency of energy usage, with case studies of two sugar factory/distillery combinations.

Bilan énérgétique total en sucrerie de canne

Vu l'intérêt croissant pour la production de sucre blanc au lieu de sucre brut, ainsi que pour la production d'alcool, les besoins en vapeur pour la fabrication exigent le maximum de rendement énergétique du combustible de base, la bagasse, surtout si on se propose de réaliser un excédent à convertir en panneaux, papier ou autre matériau de valeur. Un certain nombre de schémas sont proposés pour réaliser un rendement élevé dans l'emploi de l'énergie, avec des études de cas spécifiques de deux combinaisons de sucrerie-distillerie.

Gesamtenergieschema für Rohrzuckerfabriken

Die zunehmende Erzeugung von Weißzucker anstelle von Rohzucker sowie die Erzeugung von Alkohol erfordern für die Heizdampfherstellung aus Bagasse als Brennstoff den höchsten Wirkungsgrad bei der Energieumwandlung, besonders wenn es Möglichkeiten gibt, einen Bagasseüberschuß für die Herstellung von Platten, Papier oder anderen wertvollen Materialien zu verwenden. Eine Reihe von Schemata mit einem hohen Wirkungsgrad bei der Energieumwandlung werden mit Beispielen für zwei Zuckerfabrik/Brennerei-Kombinationen dargestellt.

Diseño para energía total en la fabricación de azúcar de caña

Con aumento de interés en la fabricación de azúcar blanco en lugar de azúcar crudo, y en producción de alcohol, requerimientos de vapor para el proceso necesitan la más alta eficiencia de recuperación de energía del combustible básico, es decir bagazo, sobre todo si hay propósitos para lograr un excedente para conversión en tablas, papel o otra materia de valor. Algunas esquemas se presentan para lograr un eficiencia alta de utilización de energía, con estudios de caso para dos combinaciones de ingenio azucarero con distilería.

Algeria sugar imports, 1980[8]. — Imports of sugar rose to 568,516 tonnes, raw value, in 1980 from 443,905 tonnes in the previous year. As previously, Cuba was the major supplier, with 207,131 tonnes delivered (203,088 tonnes in 1979), while other major suppliers were Brazil with 129,695 tonnes (0 in 1979) and the EEC with 107,266 tonnes (137,067 in 1979).

Zaire sugar expansion plants[9]. — Sucrerie et Raffinerie de l'Afrique Centrale (Sucraf) intends to step up cane production to reach 260,000 tonnes a year by 1987, from the 1980 level of 120,202 tonnes. Sucraf, which is partly owned by private Belgian interests and partly by the Zaire government, also plans to boost its Kiliba factory output from 1200 to 1700 tonnes a day. Refined sugar output in 1980 was 11,449 tonnes, regarded as a poor result by the company's directors, but Sucraf closed its 1980 books with profits of 774,095 Belgian francs ($19.190), bringing accumulated losses down to 171.4 million francs ($4.2 million). Factory output was low in 1980 because of the need to replace old machinery. Milling machinery has now been overhauled in Mauritius and spare parts are due to arrive from Durban. The company is investing 8 million francs ($198,360) in two cane harvesters, due to arrive for the 1981 crop which is expected to reach 140,000 tonnes. In 1980, 1824 hectares were planted to cane and Sucraf plans to increase this by 150 ha per year from 1981 to 1983 and to reclaim an additional 150 ha, bringing the total to 2400 ha in 1984. The program is being financed by a $1,100,000 loan but the company is considering increasing its capital since a major investment will be needed to raise Kiliba output as planned. The cost of mill extensions is estimated at 250 – 300 million francs ($6.2 – $7.4 million) but Sucraf first needs to modernize existing plant at a cost of around 50 million francs ($1.2 million) and also wants to install a cane washer costing 30 million francs ($743,860) to improve quality and it needs a further 5 million francs ($123,980) for workshop equipment.

Chile sugar imports, 1980[10]. — From 179,920 tonnes, raw value, in 1978 and 293,307 tonnes in 1979, sugar imports by Chile rose to 432,508 tonnes in 1980. The major suppliers were Argentina with 129,230 tonnes in 1980 (70,070 tonnes in 1979), Colombia with 107,309 tonnes (98,994 tonnes in 1979), the USA with 69,149 tonnes (0 in 1979) and Bolivia with 62,672 tonnes (46,681 tonnes in 1979). No sugar was exported in 1979, but in 1978 30,839 tonnes were exported, all to Iran, and in 1980 38,355 tonnes, all but 61 tonnes to Mexico. Production in Chile has fallen drastically in recent years from 131,338 tonnes in 1978 to an estimated 92,000 tonnes in 1979 and only an estimated 65,000 tonnes in 1980.

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6 Murata: *Sugar y Azúcar*, 1980, **75**, (12), 30-31, 34-35, 38-39.
7 *Sunday Advocate* (Baton Rouge, La.), June 1980.
8 *I.S.O. Stat. Bull.*, 1981, **40**, (7), 14.
9 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 476.
10 *I.S.O. Stat. Bull.*, 1981, **40**, (7), 25.

Soil determination in bulk shredded sugar cane

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Introduction

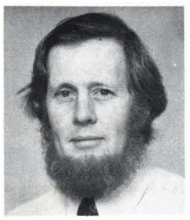
The use of mechanical cutters in modern sugar cane harvesters often introduces soil into the cane arriving at a sugar mill. This causes undesirable wear and tear in the cane shredder, the milling train, and any other parts of the sugar mill that come into contact with the soil. In addition, sugar losses in the resulting mud, and the amount of equipment needed to minimize these losses, represent further costs engendered by the presence of excessive soil. In Australian sugar factories, the extra maintenance alone costs several million dollars a year.

The present methods of determining the amount of soil in sugar cane consist either of manually examining the cane (a difficult, labour-intensive operation if precise results are desired) or of ashing well washed cane (a time-consuming operation). These methods allow only a few determinations to be made each day and hence are too slow for purposes of quality control. This article discusses a more rapid technique that uses samples taken after the cane has been shredded.

Basis of the technique

An analysis of typical soil samples taken from three cane-growing areas in Queensland (see Table I) shows that the main constituents of the soil in these areas are silicon and aluminium, which are expressed in terms of SiO_2 and Al_2O_3 respectively. However, some of the silicon and most, if not all, of the aluminium also occur in other forms such as clay minerals. With one exception, SiO_2 and Al_2O_3 together account for at least 75% of the total weight of the soil. The exception is the red volcanic soil in the northern mill district, in which the proportion of SiO_2 plus Al_2O_3 falls to 66%. Consequently, except for soils that have a high and variable iron content, a measurement of SiO_2 plus Al_2O_3 provides a reasonable estimate of the amount of soil. This is the basis of the neutron-activation technique described here.

The SiO_2 and Al_2O_3 are detected by means of the fast-neutron activation reaction $^{28}Si(n,p)^{28}Al$ and the thermal-neutron activation reaction $^{27}Al(n,\gamma)^{28}Al$. These well known reactions are widely used to determine SiO_2 and Al_2O_3 in both small and large samples (e.g., bulk iron ore[1-3]). The ^{28}Al radioisotope produced in both reactions has a half-life of 2.3 min and emits gamma radiation at 1.78 MeV during its decay. The most suitable neutron source for initiating both reactions is americium-beryllium (^{241}Am-Be), which produces neutrons with energies up to 10 MeV (the energy adequate for activating ^{28}Si). The balance between fast and thermal neutrons can be adjusted by changing the amount of hydrogen-containing material near the source (e.g., the cane sample). An increase in hydrogen thermalizes fast neutrons, thereby increasing the thermal-neutron activation of ^{27}Al and decreasing the fast-neutron activation of ^{28}Si. Consequently, by carefully selecting the mass of the cane sample, the ^{28}Al production from equal amounts of SiO_2 and Al_2O_3 can be equalized.



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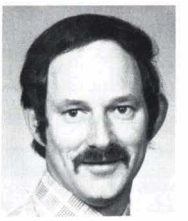

R. J. Holmes

Table I. Typical soil compositions in three cane-growing areas in Queensland

Area	Description	Constituents, % w/w SiO_2	Al_2O_3	$SiO_2+Al_2O_3$	Fe_2O_3
Northern Mill District	River flats	68.4	18.4	86.8	5.0
	Silkwood forest soil	67.9	21.4	89.3	3.1
	Schist	85.5	8.8	94.3	3.8
	Red volcanic soil	30.1	35.4	65.5	22.2
	Korrimine sand	92.9	5.0	97.9	0.7
	—	51.4	31.5	82.9	13.9
	White forest soil	91.8	3.7	95.5	1.7
Central Mill District	River flats	73.0	15.0	88.0	5.7
	Kraznozem	40.6	34.3	74.9	23.9
Southern Mill District	Grey ti-tree soil	94.1	1.7	95.8	0.4
	Black river soil	72.4	17.0	89.4	5.2
	—	95.7	2.3	98.0	0.4
	—	67.1	16.2	83.3	16.3

Irradiation and counting

In the neutron-activation technique, samples of shredded cane are placed in a brass container (31 x 41 x 16 cm deep) and irradiated for 7 min. The irradiation is performed in a concrete blockhouse with a 10-Ci ^{241}Am-Be neutron source enclosed in a cadmium sheath to absorb thermal neutrons emitted by the source. After the irradiation, a pair of horizontal rails is used to transfer the sample to a gamma-ray detector located 7 m away. The detector, which contains a cylindrical 150 x 100 mm crystal of NaI(Tl) (sodium iodide doped with thallium), is mounted in a 5-cm-thick lead shield and surrounded by concrete bricks to minimize background radiation from the neutron source. With a counting time of 5 min, the total determination time is 12 min. However, if a second sample is activated while the first is being counted, one determination can be completed every 7 min. This is much faster than the alternative methods mentioned above.

1 Borsaru & Holmes: *Analytical Chemistry*, 1976, **48**, 1699.
2 Idem: *ibid.* 1978, **50**, 296.
3 Holmes, Messenger & Miles: *Proc. Australasian Inst. Mining and Metallurgy*, 1980, (274), 17.

Pulses from the NaI(Tl) detector pass through a pre-amplifier to an amplifier and gain stabilizer. The gain stabilizer is locked on the 0.662-MeV gamma-ray peak from a small ^{137}Cs source located near the detector. The 1.78-MeV gamma-ray pulses from the ^{28}Al are selected with a single-channel analyser (window 1.60 to 1.95 MeV).

Optimum sample mass

In order to determine the optimum sample mass, 30 kg of cane was manually harvested and carefully washed to remove all traces of soil. After the clean cane was shredded, it was divided into two parts and mixed with 3% SiO_2 and 3% Al_2O_3, w/w, respectively. Various masses of each kind of cane were then activated and counted.

Fortunately, the number of ^{28}Al counts for Al_2O_3 contamination was less than that for SiO_2 contamination at small sample masses. Consequently, the Al_2O_3 response could easily be increased by increasing the sample mass to create more thermal neutrons. Fig. 1 shows that the optimum sample mass (i.e., the mass at which equal amounts of SiO_2 and Al_2O_3 produce equal numbers of ^{28}Al counts) is about 10 kg.

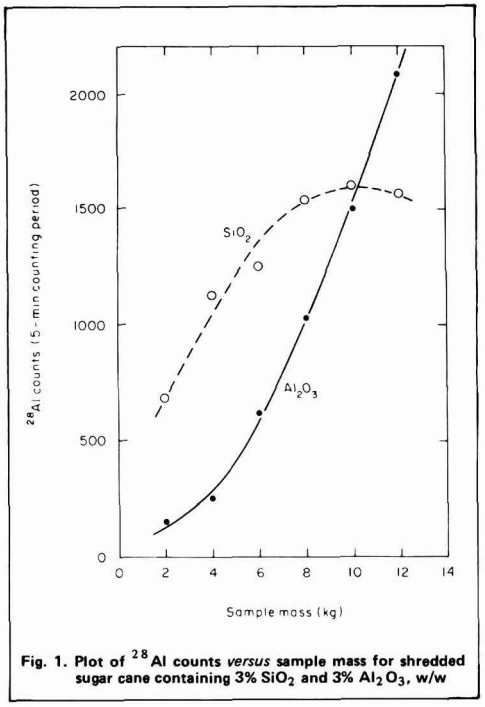

Fig. 1. Plot of ^{28}Al counts *versus* sample mass for shredded sugar cane containing 3% SiO_2 and 3% Al_2O_3, w/w

Calibration and trial

During the determination of the optimum sample mass, we found that the degree to which each sample is compacted in the brass container affects the number of ^{28}Al counts, particularly for Al_2O_3 contamination. For this reason, all samples in routine determinations must be compacted to a constant volume.

Two calibration methods are available. The first method consists of carefully mixing known amounts of dry soil with optimum masses of clean shredded cane and plotting the resulting ^{28}Al counts against the added soil (see the dotted line in Fig. 2). This is a rapid method, and it is accurate if, initially, the cane is perfectly clean and if the composition of the added soil is typical of the expected contamination.

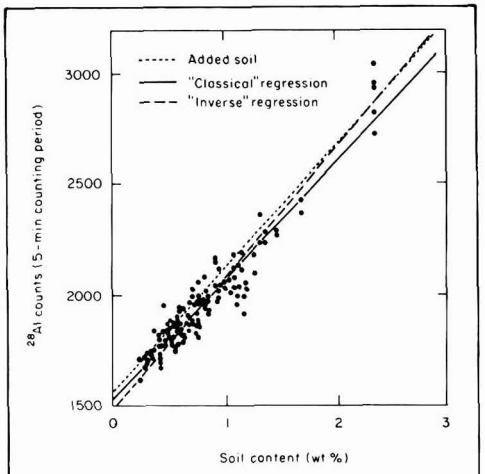

Fig. 2. Plot of ^{28}Al counts *versus* soil content for optimum masses of shredded sugar cane. The three lines represent calibrations derived with the indicated methods

• The second calibration method consists of counting at least 20 samples of prepared cane, then relating (by regression analysis) the ^{28}Al counts to accurate soil determinations obtained by ashing well washed cane. For this purpose, 69 samples of shredded cane (15 kg each) were collected from two sugar mills near Mackay. From each of the samples, a 2-kg subsample was taken for analysis by ashing.

The samples were first checked with the NaI(Tl) detector for background radiation in the ^{28}Al gamma-ray window (1.60 to 1.95 MeV). The variations detected (±5%) were attributable to binomial counting statistics, indicating that the background could be considered constant. This avoids the need to measure the background for every sample in routine determinations, thereby reducing the determination time.

The ^{28}Al counts from the samples were measured in duplicate and occasionally in triplicate. For these replicated measurements, 20 min were allowed to pass between counting and reactivation so that the ^{28}Al activity from the previous activation would decay to an undetectable level. The results are shown as solid circles in Fig. 2. No significant instrument drift was detected during the data collection period.

The data in Fig. 2 were analysed using both the "classical" and the "inverse" regression methods described by Shukla[4]. Both methods were extended to cover replicated measurements[5]. In the "classical" (or direct) method, the ^{28}Al counts are taken as the dependent variable, and the resulting calibration equation (after transposition) is

$$S = -2.85 + 1.87\gamma \qquad (1)$$

[4] *Technometrics*, 1972, **14**, 547.
[5] Lwin: Private communication.

where S is the soil content (%, w/w) and γ is the total number of ^{28}Al counts (in thousands, including the constant background). The standard errors of the intercept and the slope of this equation are both 0.05.

In the "inverse" (or indirect) method, the soil content is taken as the dependent variable, and the resulting calibration equation is

$$S = -2.54 + 1.7\gamma \quad (2)$$

The standard errors of the intercept and the slope of this equation are 0.08 and 0.04, respectively.

The accuracies of soil determinations for a new sample, as derived with the two regression methods, were compared to determine which method is more accurate. The results show that the "inverse" method is marginally better when the soil content is close to the mean value. Away from the mean, the accuracy given by the "classical" method is significantly better. Consequently, in the absence of prior information about soil content, the "classical" method is more reliable, as Shukla concluded. The standard errors of the coefficients of the above calibration equations support this conclusion. This is because the stability of the intercept is better in the "classical" method, while the stability of the slope is about the same in either case.

In addition to showing the calibration lines derived with the "classical" and "inverse" methods, Fig. 2 also shows the calibration line derived by adding soil. The equation for this line is

$$S = -2.80 + 1.80\gamma \quad (3)$$

An F test[6] showed that there is no significant difference, at the 95% confidence level, between equations (1) and (3).

With the "classical" method, the accuracy of soil determinations is 0.12% soil (one standard deviation) for a single measurement on a new sample. This figure includes an estimated error of 0.05% soil in conventional soil determinations, but even if the most favourable allowance is made for this error, the accuracy of the neutron-activation method improves only slightly to 0.11% soil. Subtracting the background from individual measurements fails to improve the accuracy.

Possible sources of error

Although no difficulties were encountered in the present work, possible interference from SiO_2 in the cane itself needs to be considered. This is not a problem if the SiO_2 content (typically <0.2%) is reasonably constant, for its presence is taken into account by the constant term in the calibration equation. However, significant deviations from the average SiO_2 content will appear as a systematic error. Systematic variations in soil composition are also a source of error. Thus, different calibration equations may be required for different varieties of cane and different types of soil, particularly if the latter has a high iron content.

Conclusion

The soil content of 10-kg samples of shredded sugar cane from regions with the same type of soil can be determined with an accuracy of 0.1% soil by means of neutron-activation analysis. The analysis time for each sample is 12 min, which is a significant improvement over present methods. This time can be reduced to 7 min if a second sample is activated while the first is being counted. The technique requires further evaluation for routine use.

Acknowledgements

The authors are grateful for the assistance given by Dr. T. Lwin of the CSIRO Division of Mathematics and Statistics, and by the staff of the Sugar Research Institute, particularly Dr. V. Mason and Mr. G. Cowan.

Summary

A neutron-activation method has been developed to determine the amount of soil in 10-kg samples of shredded sugar cane. The method consists of activating the silicon and aluminium in the soil with fast neutrons and thermal neutrons, respectively, thereby forming ^{28}Al in both cases, and then measuring the 1.78-MeV gamma radiation emitted by the ^{28}Al. With a 10-Ci ^{241}Am-Be neutron source and a 150 x 100 mm NaI(Tl) gamma-ray detector, an accuracy of 0.1% soil can be obtained for soil contents between 0.3 and 2.5% by weight.

La détermination de la terre dans la canne à sucre broyée en vrac

Une méthode d'activation aux neutrons a été élaborée pour déterminer la quantité de terre dans des échantillons de 10 kg de canne à sucre broyée. La méthode consiste dans l'activation du silicium et de l'aluminium du sol avec des neutrons rapides, respectivement thermiques, formant de ce fait du ^{28}Al dans les deux cas, et en mesurant ensuite la radiation gamma de 1,78 MeV émise par le ^{28}Al. Avec une source de neutrons 10-Ci-^{241}Am-Be et un détecteur de rayons gamma de 150 x 100 mm NaI (Tl), une précision de 0,1% de terre peut être obtenue pour des teneurs en terre comprises entre 0,3 et 2,5% en poids.

Erdanhangbestimmung in losem geshreddertem Zuckerrohr

Eine Neutronenaktivierungsmethode wurde zur Bestimmung des Erdanhangs in 10 kg-Proben von geshreddertem Zuckerrohr entwickelt. Die Methode verwendet die Aktivierung des Siliziums im Erdanhang mit schnellen und die des Aluminiums mit thermischen Neutronen. Dabei bildet sich in beiden Fällen ^{28}Al. Sodann wird die 1,78-MeV-Gamma-Strahlung gemessen, die von ^{28}Al ausgeht. Mit einer 10-Ci-^{241}Am-Be-Neutronenquelle und einem 150 x 100 mm NaI (Tl)-Gamma-Strahlen-Detektor kann eine Genauigkeit von 0,1% Erde bei 0,3-2,5% Erdanhang erhalten werden.

Determinación de suelo en caña de azúcar desintegrada a granel

Un método que emplea activación con neutrones se ha desarrollado para medir la cantidad de suelo en muestras de 10 kg de caña de azúcar desintegrada. El método consiste de activación del silicio y aluminio en el suelo con neutrones rápidos y neutrones térmicos, respectivamente, formando por ésta ^{28}Al en ambos casos, y entonces, medición de la radiación-gamma de 1.78 MeV emitido por el ^{28}Al. Con ^{241}Am-Be de 10-Ci como fuente de neutrones y un detector de rayos-gamma de NaI(Tl) de 150 x 100 mm, una precisión de 0,1% de suelo puede obtenerse para contenidos de suelo entre 0,3 y 2,5% por peso.

[6] Rao: "Advanced Statistical Methods in Biometric Research," (Wiley, New York), 1952.

SUGAR CANE AGRONOMY

Studies on chemical weed control for sugar cane intercropping in Taiwan. S. Y. Peng and L. T. Twu. *Rpt. Taiwan Sugar Research Inst.,* 1980, (88), 1-18 *(Chinese).* – Weed control measures for an intercropping system need to allow for the fact that, while cane is tolerant of herbicides, the intercrops are more susceptible. By first applying a broadcast pre-emergence herbicide (Linuon) at 1 $kg.ha^{-1}$ on a peanut-cane intercropped field, followed by a second application by band spraying on the cane furrows, the yield of peanuts at three sites was 18-30% higher than in hand-weeded plots, while 98-100% control of weeds was achieved. Similar treatment of cane and corn or peanut intercrops using Cyanazine at 1.5 $kg.ha^{-1}$ a.i. gave 28% higher corn yield and 23.6-55.6% higher peanut yield by comparison with hand weeding, with comparable weed control. Use of Isouron and DPX 410 (a mixture of Velpar and Diuron) in a single 1.5 $kg.ha^{-1}$ a.i. application to peanut-cane intercrops gave a 50-100% increase in peanut yield, while with corn:cane they gave a yield no less than in hand-weeded fields. Better weed control was obtained with these new herbicides than with Diuron alone. A soil conservation agent, Curasol AH, at 0.5% was mixed with Outfox or Devrinol herbicides applied at 4 $kg.ha^{-1}$ a.i. or Linuron at 2 $kg.ha^{-1}$ a.i. and preserved the original form of the soil ridges by preventing leaching and erosion; with peanut intercrops, the yield was raised by up to 100% and weed control efficiency was up to 80%, while plots without Curasol AH were affected by breakdown of ridges and poor drainage.

The characteristics of water consumption in sugar cane. III. Studies on evapotranspiration in autumn-planted cane under an automatic mobile shelter. Y. T. Chang, S. J. Yang and P. L. Wang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (88), 35-41 *(Chinese).* A record is presented on lysimeter experiments to determine actual evapotranspiration in each month of autumn-planted cane during the 1979/80 crop. The pattern of change in evapotranspiration at different growth stages is indicated in graph form. Total water consumption during the whole growth stage was measured as 1200 mm and the average Class A pan ratio determined as 0.73. The correlation between actual evapotranspiration and pan evaporation showed significant differences, while the water consumption of different varieties showed significant differences also. Water consumption in medium and fine-textured soil was significantly different, but not between sandy loam and loam.

Yield and nitrogen uptake of sugar cane varieties at graded levels of nitrogen. C. V. Raghavaiah and P. P. Singh. *Indian Sugar,* 1980, **30**, 13-17. – Nitrogen was applied with other basal fertilizers to cane plots and the total uptake measured by weighing the cane stalks, trash and green tops and drying and analysing samples. Control plots had no N fertilizer applied. Three varieties were studied and showed different uptakes. The stalks accounted for 62.1-77.2% of the total uptake. The return on investment in N fertilizer is calculated from the difference in the fertilized and unfertilized plots.

Yield of sugar cane and sugar as influenced by application of by-product gypsum to Baldwin silty clay loam. L. E. Golden. *Sugar Bull.,* 1980, **58**, (18), 11-14. Application of gypsum at 1 short ton per acre as a S source to the title soil did not affect plant cane yield but gave a significant response in 1st, 2nd and 3rd ratoons totalling 14.53 tons per acre. Means of obtaining waste gysum in Louisiana and of applying it to the soil are described briefly.

Comparative study of the forms and doses of nitrogen in the cultivation of sugar cane (first and second ratoons). O. Brinholi. J. A. Furlani, E. Soares and G. Serra. *Brasil Açuc.,* 1980, **95**, 208-216 *(Portuguese).* – Comparative trials with three rates of N fertilizer in the form of ammonium nitrate applied to the cane row and as anhydrous ammonia injected into the soil showed that the former gave a greater increase in cane yield by comparison with the control. The sugar content of the cane was greater in the case of ammonia fertilization, however, so that, in terms of sugar per ha, the advantage of ammonium nitrate was less significant.

Effect of 2-chloroethyl phosphonic acid and its mixture with urea on the induction of tillering in ratooning of sugar cane (*Saccharum* spp.) variety CB 41-14. A. A. Lucchesi, O. P. Godoy, A. C. Florencio and V. B. de Araujo. *Brasil Açuc.,* 1980, **95**, 232-236 *(Portuguese).* – Ethrel at 1, 2 and 3 $litres.ha^{-1}$ and at half these rates, mixed with 20 kg urea per ha, was applied to 1st ratoon cane, 30 days after harvesting of the plant crop, and the numbers of tillers counted at approx. monthly intervals during 11 months. The treatments increased the number of tillers, relative to the untreated control, and also the cane yield. Application as a mixture with urea permitted an equal benefit from half the amount of Ethrel.

Mineral fertilization (N-P-K) in plant cane in the states of Rio de Janeiro and Minas Gerais (Mata Zone). D. F. de Azevedo, A. A. Robaina and M. S. Manhães. *Brasil Açuc.,* 1980, **95**, 347-356 *(Portuguese).* – Factorial trials were carried out using nil and two levels each of N, P and K, applied to two varieties of cane grown in eight types of soil from the two title states. At harvest after 16 months it was found that N fertilization did not influence cane yield on any soil; only the table-land and red-yellow latosol soils reacted positively to the addition of P and K; the Truog extractor did not adequately show the availability of soil phosphate for cane; N fertilization induced a fall in pol % cane which was statistically significant in some cases; and, of the nutrients studied, only K had a positive influence on pol % cane.

Isouron and Velpar in a new criterion for field evaluation of herbicides. S. Y. Peng. *Taiwan Sugar,* 1980, **27**, 94-99. – After initial sets of trials in 1976/77 and 1977/78 for screening of 11 pre-and post-emergence herbicides, experiments were made with Bladex, Isouron and DPX 410 (a 13.2%:46.8% formulation of Velpar and Diuron) in 1978/79 and with Isouron and DPX 410 in 1979/80. All three herbicides gave good weed control when applied as pre-emergence treatments in 1978/79, with little damage to intercropped peanuts or to newly transplanted cane seedlings. Weed control was, in fact, better with intercropping, and competition from the

peanuts was considered a factor in reduced weed growth. Diuron as the check caused severe intercrop reduction by its low selectivity; none of the treatments affected cane growth or yield, however. The 1979/80 trials were in various regions of Taiwan and showed that Isouron and DPX 410 gave satisfactory weed control with no damage to peanuts or cane seedlings except at Kaohsiung, where application was delayed and nutgrass weeds had already had a chance to emerge profusely. The two herbicides are therefore recommended generally for pre-emergence weed control throughout the island.

Planting procedures and materials for improving germination and tillering of sugar cane in the rain-fed areas of Natal. E. N. Dicks. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 109-111. – By means of field experiments, planting by machine in moist soil was found to increase germination, tillering and stalk elongation compared with drawing furrows and planting by hand some hours later when the soil had dried. Further delay in hand planting after opening the furrows reduced germination and subsequent tillering. With planting in dry soil, germination, tillering and stalk elongation were increased by planting with 40 tonnes.ha^{-1} of filter cake in the furrow or application of 2-3 litres of water per m of row onto the setts before covering. A liquid copolymer sprayed over the row after covering marginally increased shoot population and stalk elongation in two of the four experiments.

Results of a soil salinity survey on the Umfolozi flats. M. A. Johnston. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 112-114. – An examination was made to assess the danger of soil salinity affecting the title cane lands. The water table is high and underlying sediments, being of marine origin, are high in salts. Soil salinity was shown to be minor, however, and this is thought to be due to high rainfall in the area. Where it did occur was on heavy alluvial and organic soils. The water table during the survey was invariably between 0.2 and 0.4 m below the surface. The electrical conductivity of soil from which the water had drained was less than half that of ground water.

"Operation Low Top" – a planned project in the Umvoti area. Q. V. Mann. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 118-120. – Overproduction, cane restrictions, the fuel crisis and other factors led to formulation of a plan to persuade growers in a single extension area to top their cane lower and more accurately. Node-by-node cane analysis had shown that a substantial increase in sucrose % cane could be achieved by this means, and an account is given of the steps taken to publicize the plan and to educate the growers and harvesting staff. They were successful, and at Noodsberg mill sucrose % cane was raised by 0.81% and at the Union Cooperative mill by 1.25%.

Effects of moisture regime, amount of nitrogen applied and variety on the ripening response of sugar cane to Glyphosates. M. S. J. Clowes and N. G. Inman-Bamber. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 127-133. – Results from 30 trials showed that adequate moisture was required at the time of spraying and between spraying and harvesting to produce good responses to Glyphosate ripeners (Roundup or MON 8000 used at about 0.4 kg.ha^{-1} a.i.). At least 5 hr should elapse between spraying and heavy rainfall or irrigation, however, while different varieties react in different manner. The level of N did not affect ripener response but did affect both cane yield and quality. Current South African recommendations on level and timing of fertilizer application appear adequate to ensure good response to Glyphosate. Varieties N 52/219 and N 8 appear more susceptible than others to early chlorosis or stunting in the following ratoon crop, but the full effects on ratoon regrowth will not be known until after harvest.

Results from Glyphosate used as a ripener at Felixton. A. N. Mills. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 134-139. – Comparison of a large number of treated and untreated cane fields on a farm near Felixton indicated a substantial improvement in cane quality, particularly at the beginning and end of the milling season. There was no evidence to suggest that yields of either the treated crop or the following ratoon crop were reduced by application of Glyphosate (MON 8000 and Roundup). Over-application could, however, damage the following crop. Other benefits from the use of Glyphosate included a better burn, more efficient cane topping, fewer tops and less trash in delivered cane, reduced fibre % cane and higher payloads.

The efficacy of Roundup for killing sugar cane. P. E. T. Turner. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 140-145. – Roundup is registered in South Africa as a non-residual herbicide for killing sugar cane when seeking to establish a new crop quickly, employing the minimum tillage technique. Experiments have been made to study factors influencing its action, and these are reported. Of the different rates tested, 10 litres.ha^{-1} consistently produced the best kill, while band sprays were superior to overall sprays where coverage was adequate. Low volume applications were marginally superior to high volume applications. Disturbance of the cane one day after treatment only affected the kill very slightly under favourable conditions, while dew had no effect. Varieties differed in their susceptibility, but at 11.2 l.ha^{-1} all those tested were adequately killed. The rate of kill was unacceptable in all experiments where cane was sprayed in winter. Cane growing on light soils was more susceptible to treatment than cane growing on heavy soils. The stage of cane growth had a marked effect on the kill achieved, best results being given by treatment when the height of the leaf canopy was between 0.4 and 0.75 m.

Growth stimulation from Ethrel and the effects of gibberellic acid when applied to sugar cane. M. S. J. Clowes. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 146-150. – Ethrel was applied to mature cane about a year old and was found to cause additional stalk elongation in N:Co 293, N 55/805 and N:Co 310, which resulted in a greater stalk mass but a reduction in sucrose % cane. N:Co 376, currently the most widely grown variety in South Africa, did not respond to treatment with Ethrel. The importance of maturity testing of cane in the rain-fed regions before application of Ethrel is emphasized. Application of gibberellic acid as a 10% formulation, Pro-Gibb Plus, in two stages each of 690 g.ha^{-1}, stimulated growth only with N:Co 293 cane, whereas N:Co 376 did not respond even when irrigation water was applied.

Nitrogen fixation association with sugar cane. B. S. Purchase. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 173-176. – Nitrogen fixation associated

with cane was monitored using acetylene reduction and bacteriological techniques. Soil cores and trash from cane fields showed acetylene-reducing activity, but this was usually low in association with sandy soils. High activity in soil cores was correlated with the wet weight of roots present. Nitrogen-fixing bacteria resembling *Azospirillum* spp. were cultured from surface-sterilized roots of a number of cane varieties, of which N 7 was particularly well infected. Tenuous calculations based on acetylene reduction results and root weights suggest that cane growing on certain soils at the Mount Edgecombe Experiment Station might derive about 25 $kg.ha^{-1}$ of nitrogen per annum by fixation.

Preliminary observations on the rooting habit of some sugar cane varieties in South Africa. V. W. Spaull. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 177-180. – Setts from 12 cane varieties were planted and the development of roots examined at 2, 6, 10 and 14 weeks. The number and mass of sett roots generally increased up to 10 weeks and then declined; the increase continued to 14 weeks, however, with N:Co 382 and N 6. Shoot root production began after 2 weeks and increased with time, but there were wide differences between number and mass with different varieties. Varieties that generally grow well on soils subject to moisture deficiency tended to have longer roots than others. The variety N 8, which has shown some degree of tolerance of nematodes in field trials, did not develop more or longer roots or greater root mass than some other less tolerant varieties.

Land use planning for sugar cane. G. G. Platford and L. P. Nel. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.,* 1980, 184-188. – The steps taken in land use planning are explained, using some completed farm plans as examples. Field layout before and after planning are compared in terms of possible machine efficiencies. Soil protection and agronomic advantages are discussed. An attempt is made to estimate the cost of the operations involved in order to highlight the advantages of a new layout. The problems of implementing a new plant and methods used to establish a work program for five years or more are given.

Treatment of secondary sewage effluent for use in drip irrigation. B. Gillespie and G. Tasato. *Rpts. Hawaiian Sugar Tech.,* 1979, 57-61. – Effluent from local sewage treatment plants can be used for furrow irrigation; however, since, in the near future, the majority of cane land in Hawaii will be irrigated by the drip method, such effluent will need to be treated to render it suitable for use. Trials showed tht the use of a rotary, self-cleaning 200-mesh screen followed by passage through a filter containing No.20 silica sand at 20 gpm per ft^2 of sand area was effective in producing a liquid which could be distributed through drip irrigation tubing. Chlorination was employed once a day to provide a residual 20 ppm. For commercial use, three alternatives are discussed: direct pumping to the distribution system, use of a small reservoir, and use of a larger reservoir system; the cost and disadvantages of each are discussed as well as other possible problems.

Salinity and sodicity problems of Hawaiian sugar cane. R. P. Bosshart. *Rpts. Hawaiian Sugar Tech.,* 1979, 62-71. – Surveys have shown that 35% of the irrigated cane area in Hawaii is subject, to some extent, to saline irrigation water. It is the soil salinity which affects the cane and produces symptoms such as shortened internodes, erect and edge-fired leaves, etc. Ten steps which may be taken to manage soil salinity are specified and discussed. When irrigation water is relatively high in Na and low in Ca and Mg, the cation exchange sites on the soil become charged with Na ions and the soil is described as sodic. The harmful effects of high sodicity are described as is its control. Changes in soil sodicity observed at HC & S Co. and at Pioneer Mill Co. are recorded.

Review of work with MON 8000, Embark and Ethrel. A. Teshima. *Rpts. Hawaiian Sugar Tech.,* 1979, 72-75. In field trials in Hawaii, MON 8000 proved superior in ripening activity to Polaris. Applied at 0.5 or 0.7 $lb.acre^{-1}$ it raised the pol % cane figure by different amounts, depending on variety and time from treatment. The optimum rate and interval before harvest remains to be determined. At rates above 0.4 $lb.acre^{-1}$ MON 8000 decreased the number of tillers and stalk height in the ratoon crop. However, these effects were alleviated with time, the differences between treated and untreated cane being smaller at 7 months. Results with Embark were disappointing, little improvement occurring at the rates tested; although greater benefit might have resulted from higher application rates, these would not have been economical. Ethrel was found in two series of tests to increase stalk elongation significantly, and a future test is to be made on combining Ethrel with MON 8000 to lengthen the cane while also ripening it.

Progress report on MON 8000 block tests. N. Nomura. *Rpts. Hawaiian Sugar Tech.,* 1979, 76-78. – MON 8000 (Polado) has been tested in field blocks against Polaris, with untreated cane as control. Twelve varieties were included in the program, but most trials were with H 59-3775. The results indicate that the material is an effective ripener, giving values which are better than those given by Polaris but at lower rates. It can ripen any of the Hawaiian varieties currently established, provided work is done to determine the optimum application rate and interval before harvest.

Model ripening with Glyphosate in young sugar cane plants. A. Maretzki and A. de la Cruz. *Rpts. Hawaiian Sugar Tech.,* 1979, 79-82. – Greenhouse experiments have shown that simultaneous application of Glyphosate and alkali metal ions such as Na^+, K^+ or Li^+ to the leaf canopy of cane plants increases sucrose accumulation and decreases reducing sugars in young internodes which are actively storing sugars. Once precise conditions for increased ripening response by salt additions have been determined, these will be further tested in field plots.

Insecticides for control of ant damage to drip tubes. A. K. Ota and V. C. S. Chang. *Rpts. Hawaiian Sugar Tech.,* 1979, 87-91. – Use of Mirex bait is no longer permitted in Hawaii, and Heptachlor is currently used where needed to control ant damage to drip irrigation tubes. Trials have been conducted with an ant bait (217,300) of American Cyanamid Co.; it has shown promise, but further testing is needed to determine the proper timing, dosages and frequency of application.

Farm planning from above. A. I. Linedale. *Cane Growers' Quarterly Bull.,* 1980, **44**, 25-27. – By means of aerial photography it is possible to plan cane fields and farm layout so as to provide drainage systems, row lengths, etc. for optimum crop production.

SUGAR CANE MECHANIZATION

Trends in cane transport from harvester to factory. C. R. Murry and R. D. Peirce. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 27-35. — A typical Australian sugar factory crushes over 9000 tonnes of cane per day which is received from growers at a number of delivery points and is transported to the factory by narrow gauge railway. The history of the development of the rail equipment and infield transport, etc. is reviewed and a description given of studies on track/train dynamics. It is suggested that the design of the track structure may no longer be adequate, rail car maintenance problems are excessive, and it may not be possible to keep the cost of maintenance under control. The present roll-on-roll-off system of infield handling of cane may no longer be effective, and there may be advantages in increasing the scale and sophistication of the equipment used both in the field and on the railways. Larger rail cars may be advisable but, since the engineering research and development required to produce a near-optimum design would take at least three years and about 12 man-years of work, such a project should be undertaken well in advance of the time needed for such equipment to go into service.

Mechanization and its effect on tramline maintenance. R. Mitchell and B. J. Cooke. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 97-100. — An illustrated account is given of mechanical equipment introduced by Proserpine sugar factory for maintenance of its light railway track on which cane is transported to the mill. This includes a compressor, a pneumatically operated and a petrol-driven borer, spiking hammer, impact wrench, tie tampers, large compressors and additional air tools, rail saws, rail drills, a track jack, a lifting tamping machine, a ballast regulator and a 26-tonne ballast hopper. Labour cost reduction is calculated as 23%.

Electric traction applied to cane railways. W. McWhinney. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 107-114. In order to improve fuel efficiency in cane haulage there are a number of alternatives. Rail is more economical in fuel than road transport while, of the different types of design for locomotives (bagasse, fluidized bed, fireless locomotives using steam accumulators and electric traction), only the last would not require major re-design of existing equipment. A reticulated system would entail high capital costs for power distribution, and case studies are therefore presented for a battery system and a hybrid system. It is concluded that, while both capital and operating costs are currently greater than for a conventional diesel-hydraulic locomotive, a battery system would become more attractive as oil fuel cost rises and availability decreases.

Multiple unit locomotive operation for cane railways. R. A. James, D. A. Finlay and T. B. O'Donohue. *Proc. Australian Soc. Sugar Cane Tech.*, 1980, 115-117. — Because of limited hauling power, particularly on gradients, the replacement of smaller 0-6-0 locomotives by larger units has been considered. Trials are described, however, in which two such locomotives were coupled together and operated by a single driver; they proved capable of meeting requirements as a hauling unit and of substitution for a larger unit if necessary.

The mechanical harvesting of green cane. S. W. D. Baxter. *Sugar y Azúcar*, 1980, **75**, (7), 43, 46-47. — Problems encountered in green cane harvesting are discussed, and the advantages and disadvantages compared with harvesting of burnt cane. Despite the shortcomings of green cane harvesting, the author is of the opinion that it will increase, particularly where trash blanket retention has a beneficial effect on cane yield. The commercial sugar content of green cane has been found to be marginally higher than in burnt cane.

The operation of combines for the harvesting of cane. U. Peralta, G. Frias and A. Gasparov. *ATAC*, 1979, **38**, (2), 42-48 *(Spanish)*. — With mechanical harvesting, there is a loss of cane in the field of 5-15% while, at the same time, the cane delivered to the cart contains 5-15% trash. The effects of successive reductions in these figures are calculated and tabulated, and extended to industry-wide operation in Cuba.

The new Cuban KTP-2 combine passes operational trials successfully. J. Vázquez. *ATAC*, 1979, **38**, (3), 4-10 *(Spanish)*. — A new self-propelled chopped-cane harvester has been tested in Cuba. By comparison with the earlier KTP-1 model, it is intended to attain the same harvesting rate (115-138 tonnes per hr) in green cane as the earlier model with burnt cane. The cleaning is by induction instead of a forced-draught fan and gives better results with smaller losses, while a second induction cleaning chamber is located at the end of the cane conveyor. The chopper gearing is provided with oil baths and the drum has been redesigned to give better cutting. The cabin is completely enclosed and ventilated. The conveyors have been designed with roller chains to reduce mechanical failures. The drive is hydrostatic instead of mechanical, and a modern efficient topper is fitted.

Compaction of soil in mechanized cane harvesting. M. Dominguez, M. Fonseca, A. Abdukadirov and R. Ramirez. *ATAC*, 1979, **38**, (3), 57-64 *(Spanish)*. Soil compaction was measured in terms of soil density at soil depths of 0-10, 10-20 and 20-30 cm after passage of a KTP-1 cane harvester. The compactibility of the soils was also related to the moisture content before and after passage of the harvester. It was concluded that, to avoid the apparent density of the soil exceeding a critical level (1.5-1.7 $g.cm^{-3}$), the harvester should be employed when the soil moisture is 18-20%. Further work is required on a production basis as against the field-laboratory studies reported.

The effect of load and tractor size on tractor trailer fuel consumption. T. J. Murray, T. M. C. Boevey and E. Meyer. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.*, 1980, 26-31. — In South Africa, 74% of the cane crop is moved by road transport, and tests have been made to determine the effects of load size and tractor size on fuel consumption and productivity of transport units. Results indicate that fuel consumption could decrease at the rate of 1.08 litres per 100 tonne-km per tonne of increase in payload for 50-kW tractors, while fuel consumption could increase by 0.17 litres per 100 tonne-km for each kW increase in tractor size.

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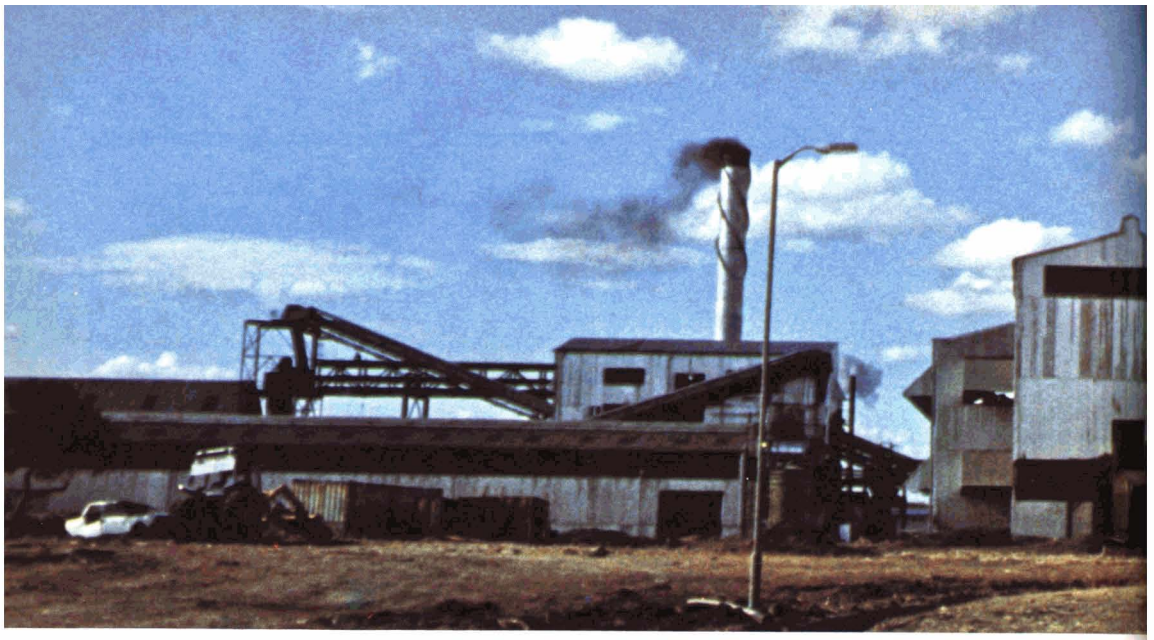
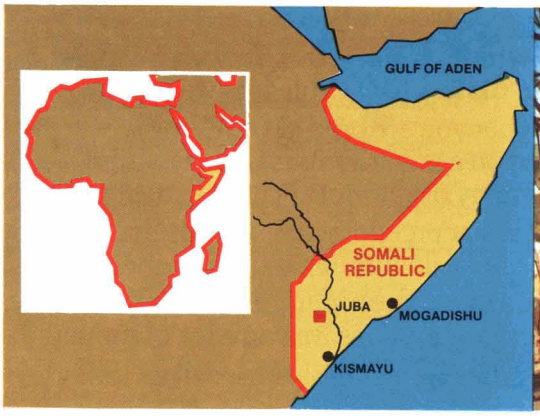


FS IN SOMALIA

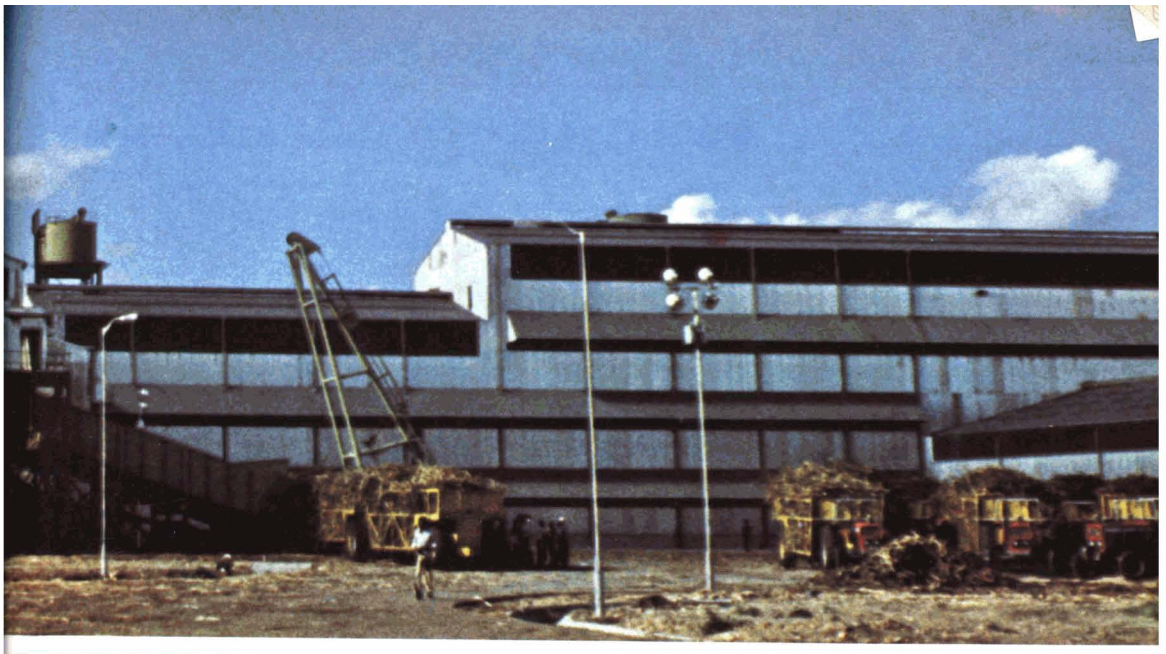


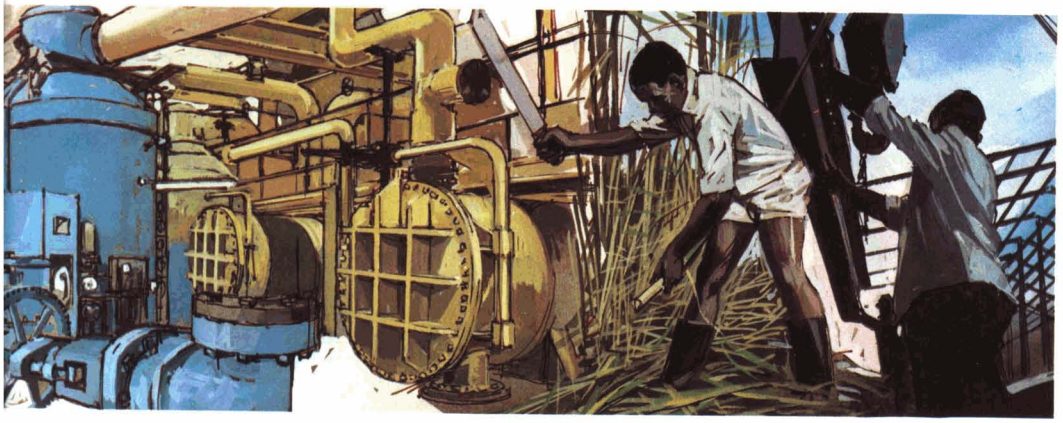
Covering an area of some 170,000 sq.km with an estimated population of 800,000, the Juba Valley in Southern Somalia is a Government designated area for the exploitation of raw materials aimed at reducing imports, increasing exports, improving the balance of payments and creating job opportunities.

Particular emphasis has been placed on increasing sugar production, and to this end the Juba Sugar Project (JSP) was formed as an autonomous agency in 1977 following two years of feasibility, planning and design studies, and field trials by Booker Agriculture International, a sister company of FS within the Booker McConnell Group.

A site was chosen on the west bank of the Juba river, 105 km north west of the port of Kismayo and comprised the development of 8,000 hectares of irrigated cane, the erection of a 3,360 MTCD factory and the construction of estate buildings, housing, roads and associated infrastructure.

The factory, designed and supplied by FS, is capable of processing 3,360 MTCD producing raw sugar by the lime defacation process with inbuilt provision for future expansion to 5,280 MCTD with optional conversion to produce 50% raw and 50% refined sugar output if required.





In addition the design embodies the facility to add a distillery at some future date to process all the final molasses produced.

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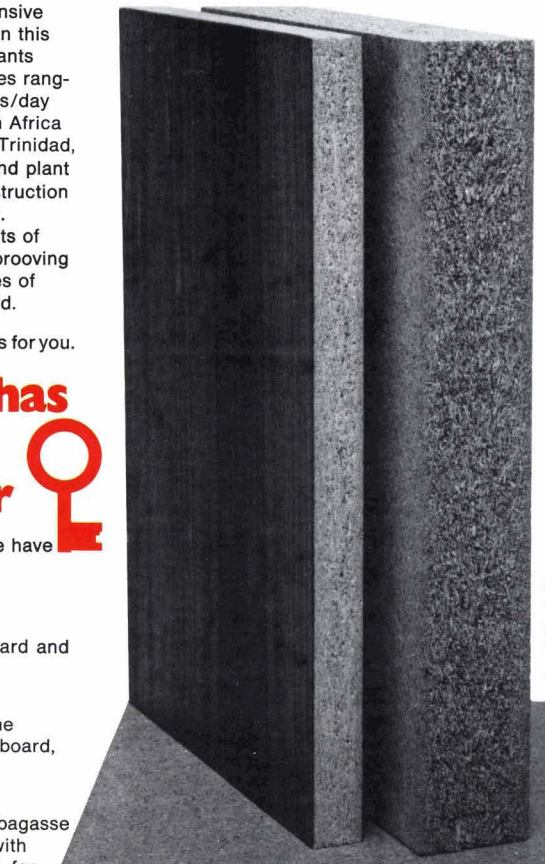

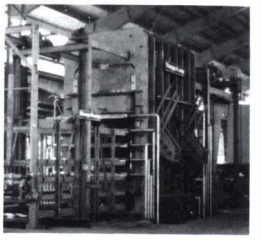

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CANE PESTS AND DISEASES

On the fauna of white grubs inhabiting sugar cane fields in Okinawa. N. Nagamine. *Bull. Okinawa Agric. Expt. Sta.,* 1980, (5), 53-64 *(Japanese).* – Of the 19 species of white grub identified in Okinawa, *Anomala albopilosa* (Rutelidae) was the most important and abundant, while one cetoniid, three other rutelidae and two melolonthidae *(Tricholontha papagena* and *Melolontha masafumii)* species were also important locally. The seven melolonthidae, including the two above, were recorded as cane pests for the first time. Since the life cycles of the different species of white grub differ widely, timing of insecticide application for their control should be adjusted accordingly. The range and abundance of white grubs was usually rich in sandy loam and red soil areas, where more than two species are likely to occur in the same field.

Sugar cane white leaf disease in Taiwan. C. T. Chen. *Taiwan Sugar,* 1980, **27,** 56-61. – A detailed survey of the literature on the history, symptoms, causal agent, transmission, host range, economic importance and control of the title disease is presented, with 49 references.

Lorsban tested to control wireworms. Anon. *Cane Growers' Quarterly Bull.,* 1980, **43,** 96. – Trials of Lorsban, a formulation of Chlorpyrifos, used as a mixture containing 0.1% a.i. in fertilizer applied at planting, showed that it did not provide adequate protection against wireworms.

Resurgence of Fiji disease in southern Queensland. J. Wright. *Cane Growers' Quarterly Bull.,* 1980, **43,** 103-105. – The Maryborough district was free of Fiji disease for about 27 years, but the disease was found in 1976 and has subsequently increased in spite of roguing measures, and is probably carried by leafhoppers. Control measures introduced include quarantine of cane farms where the disease is present, use of planting material restricted to cane growing 400 m from diseased blocks, except in the case of the resistant variety Q 103, requirement to plough-out the highly susceptible varieties Q 70 and Q 71, and reduced planting of the susceptible variety, N:Co 310. Trials with other resistant varieties are being carried out.

Viability of sugar cane smut spores in a Florida organic soil at three moisture levels. H. J. Andreis. *Sugar J.,* 1980, **42,** (12), 21-22. – A supply of a common organic soil was collected from a field in Florida where no smut had been observed in cane crops. It was dried and mixed in a proportion of 40:1 by weight with spores obtained from the whips of a smut-infected cane crop, to give approximately 800 million spores per g of soil. Portions of the mixture were treated with 16.5, 60.9 and 129.9% of water, and a control soil used where no spores were used but 16.5% of water was added. The soils were held 52 weeks at about 25.5°C, the moisture content, spore germination and infectivity being checked at intervals. Single-eye seed pieces from healthy cane were soaked in tap water for 1 hour and then inoculated by dipping the ends in the mixtures and rubbing a paste of the latter across the bud. They were then covered with a sterilized organic soil, incubated in a greenhouse and planted out in the field at 18-24 inches high. The numbers of infected stools were counted from each infectivity trial. Germination of spores was highest in the soil mixture to which 16.5% water had been added, and a few spores per plate still germinated even after 52 weeks' storage. The same stage was reached after 8 weeks where the water addition was 60.9% and after one week where the water addition was 129.9%. Thus, in dry soil, smut spores would still remain viable up to a year, whereas very few would remain viable in wet soils after a week. Consequently, flooding a field or ploughing to expose the spores to moist soil would reduce viability. Under normal climatic conditions in Florida there should be no build-up of spores.

How to control sugar cane diseases. Anon. *Maharashtra Sugar,* 1980, **5,** (6), 55, 57. – Descriptions are given of smut, grassy shoot and ratoon stunting disease, with control measures in each case.

Cane diseases in Réunion. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (Syndicat des Fabricants de Sucre, Réunion), 1979, 26-28 *(French).* – Although smut (caused by *Scitaminea ustilago)* is under control in Réunion as a result of growing resistant varieties, very severe outbreaks have occurred in regional tests involving certain local hybrids or foreign varieties. R 570, a variety grown on a large scale in Réunion, has proved susceptible to pokkah boeng (caused by *Gibberella moniliforme);* this was demonstrated under conditions of heavy rainfall, and particularly applies to young cane of 5-7 months. R 526 is also a susceptible variety but to a lesser extent than R 570. Until recently, rust (caused by *Puccinia melanocephala* and *P. erianthi)* has been of minor importance on the island, but is spreading. Highly susceptible and susceptible varieties are listed; susceptibility in seedlings can be inherited from either male or female parent. Yellow spot (caused by *Cercospora koepkei)* occurs only to a slight extent, and most outbreaks have been in trial plots. A slight attack of mottle stripe (caused by *Xanthomonas rubrisubalbicans)* has been recorded.

Losses from the recurrence of yellow spot epiphytotics in Mauritius. C. Ricaud, J. C. Autrey and S. Sullivan. *Sugar y Azúcar,* 1980, **75,** (7), 28-29, 34-35, 38-39. – A survey of yellow spot incidence at six different locations (including two at different altitudes at Combo) in 1977 and 1978 showed that yellow spot caused pol losses which ranged from 6.7% to 19.4% in S 17 cane (the % reduction in pol being based on subtraction of pol in untreated cane from pol in Benomyl-treated cane). The areas under S 17 cane where infection exceeded 15% (the level beyond which losses were considered of economic importance) were determined. (See also Ricaud *et al.: I.S.J.,* 1981, **83,** 271.)

Nematodes, nematicides and sugar cane: questions and answers. Anon. *S. African Sugar J.,* 1980, **64,** 201, 205. A 2-day course was held on agricultural chemicals by the SASA Experiment Station on a number of occasions. Panel discussions provided an opportunity for participants to ask questions and make comments; some questions regarding nematodes and nematicides occurred several times, and are presented (together with answers given by a nematologist) in the form of an article.

An Eldana borer incident on the Natal South Coast. Anon. *S. African Sugar J.,* 1980, **64,** 207. – Cane of N 11 variety growing adjacent to *Cyperus immensus* heavily infested with *Eldana saccharina* was found to be slightly damaged by the pest. The sedge grows by a water course running through the valley in which the cane grows. N 52/219 cane growing on the other side of the water course was unaffected, as was N 11 seed cane growing in the field from which the infested cane was obtained; hence, the attack is attributed to the proximity of the sedge.

Screening of promising genotypes of sugar cane against smut *(Ustilago scitaminea* **Sydow.) in east U.P.** K. P. Verma and R. K. Shukla. *Indian Sugar,* 1980, **29,** 711-713. – The reactions of promising cane genotypes to smut, which is increasing at a considerable rate in U.P., were determined in screening trials in 1976-79. Of the 38 varieties, only 10 proved resistant, 10 were moderately resistant and the rest moderately susceptible or susceptible. Even moderately susceptible varieties having improved characteristics are recommended for general cultivation provided proper phytosanitary measures are adopted.

Root and basal stem rots of sugar cane: a new disease caused by *Xylaria* **sp.** W. H. Hsieh. *Rpt. Taiwan Sugar Research Inst.,* 1980, (87), 15-25. – In November 1976 an unusual wilt was observed in almost-mature cane growing in Taiwan; the root and basal stem tissues were affected by rotting, a black zone line was often found on the basal stem surface, and upright stomata bearing abundant conidia were produced on the surface of the diseased stems during the spring rainy season. Isolations consistently yielded *Xylaria* sp. (possibly *X. hypoxylon),* a fungus which readily developed stomata on potato-dextrose agar, and, in inoculation tests, caused symptoms similar to those observed in the fields.

Efficacy of Vacor bait for the control of sugar cane field rats. P. Y. Wang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (87), 27-38 *(Chinese).* – Laboratory experiments revealed that 0.25-2.0% Vacor baits were highly toxic to five species of field rats, first day mortality reaching 80-90% with 1-4.7 g fed to *Bandicota nemorivaga* and 1-3.4 g fed to *Rattus losea.* Vacor baits at concentrations of 0.5-1.0% were found to be appropriate for field application and could be applied at the rate of 1 $kg.ha^{-1}$. The efficacy of Vacor baits for field rat control was comparable to that of zinc phosphide bait. Although it is a selective rodenticide and less toxic to other animals, field application should be made under technical guidance.

Studies on the biology and feeding potential of *Stichotis madagassa* **Weise (Coccinellidae:Coleoptera), an exotic predator on the scale insect of sugar cane,** *Melanaspis glomerata* **Green.** T. A. V. S. Raghunath and B. H. K. Rao. *Maharashtra Sugar,* 1980, **5,** (8), 17-20. – Laboratory study of the biology of the title beetle, a predator of the scale insect, which is a serious pest in Andhra Pradesh, showed that average pre-oviposition, egg, larval and pupal periods were 7.5, 4.0, 12.7 and 5.5 days, respectively. The total life cycle from egg to adult lasted 22.2 days. Longevity and fecundity were 35 days and 40 eggs for the females, and their feeding potential indicated that the *S. madagassa* grub ate 16.2 scales on average, while an adult beetle consumed 31.6 scales on average per day.

Testing sugar cane varieties for smut resistance in North India. M. R. Gupta. *Maharashtra Sugar,* 1980, **5,** (8), 25-28. – An account is given of trials in which 15 cane varieties were inoculated by dusting with smut spores and the incidence of infection determined as a measure of resistance. Of the 15, only one (Co 1148) was classified as resistant, with zero infection, while four were moderately resistant, four moderately susceptible and the remainder susceptible.

Sugar cane mosaic in Taiwan. II. Physical properties, seed transmission and host range of the causal agent. C. T. Chen. *Rpt. Taiwan Sugar Research Inst.,* 1980, (88), 43-53 *(Chinese).* – Differences between the physical properties of the strains of sugar cane mosaic virus (SCMV) in Taiwan were not significant; the dilution end-point ranged from 10^{-3} to 10^{-5}, thermal inactivation point was 55-57°C, longevity at 27°C *in vitro* was 17-24 hr and at 4°C one week. When diseased sugar cane leaves were stored at 4°C, the Badila strain (SCMV-D) lost its infectivity after one month while the other three strains could infect sorghum seedlings after 3 months. Juice from the mature stem of infected cane was unable to infect the sorghum indicator, but leaves, root and young stem were infective. Alternative hosts to sugar cane included corn, rice, sorghum and nine species of wild grasses, all of which could be infected with SCMV-D by the air-brush method. The susceptibility of 16 commercial cane varieties to SCMV-D was different from the susceptibility to the other three strains, F 170 being highly susceptible, F 163 and F 168 susceptible, F 178 moderately resistant and the remainder (F 146, F 157, F 158, F 160, F165, F 171 – F 177) resistant. None of the four strains of SCMV in Taiwan was transmitted through corn or sorghum seeds.

A study on the method of screening sugar cane varieties for resistance to leaf scorch. Z. N. Wang and C. S. Lee. *Rpt. Taiwan Sugar Research Inst.,* 1980, (88), 55-63. Sugar cane varieties were subjected to artificial inoculation in the greenhouse and natural infection in the field, the former by pipetting concentrated suspension of *Stagonospora sacchari* conidia into spindles or spraying of the suspension (2×10^5 spores per ml) on the plant. Incidence of leaf scorch after inoculation was determined and very consistent results obtained for susceptibility or resistance measurements by both methods. Consequently, artificial inoculation in the greenhouse is proved to be a feasible and convenient technique for evaluation of varietal resistance to the disease.

CANE BREEDING AND VARIETIES

Effect of ventilation on germination and vigour of sugar cane caryopses. J. Bleicher and H. Tokeshi. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. Caryopses of five cane varieties were cleaned with a seed blower to remove physical impurities using a ventilation pressure between 0 and 9.9 $mg.cm^{-2}$. Germination percentage, vigour and impurities elimination increased with increasing ventilation pressure but the differences in the first two were not significant between 9.6 $mg.cm^{-2}$ and higher pressures.

Studies on flowering of sugar cane in the south of Hainan, China. K. Y. Wong. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — Comparison of flowering of sugar cane at two locations in Hainan, using 200 cane varieties, showed that floral initiation was poorer at the drier site where humidity was lower. Pollen fertility and seed setting at the two locations were not different, however.

Breeding and testing sugar cane varieties at Central Romana. R. E. Perdoma, G. Arceneaux, J. F. van Breeman, J. O. Despradel and J. D. Ayats. *Sugar J.,* 1980, **42,** (9), 18-22. — Information is given on the cane breeding work conducted at Central Romana in the Dominican Republic. The program has been in operation for over 22 years. Two varieties have been released for commercial growing: CR 6101, which occupies 18% of the 69,000 ha of cane land, and CR 67400, occupying 13% of the cane area; the former variety is grown largely on soils of intermediate productivity, while the latter cane has given best results on the more productive soils, giving an average sugar yield of 12.44% from 45,000 tonnes. Mention is made of testing for rust resistance, and of the method applied to estimating sugar yield on the basis of crusher juice analysis.

Selection for quality with refractometric Brix in sugar cane. J. A. Mariotti, J. Scandaliaris and C. A. Abregú. *Bol. Estac. Exp. Agro-Indust. Obispo Colombres,* 1979, (131), 11 pp (*Spanish*). — Two consecutive series of trials were used to compare the effects of selection or no in stage I by refractometric Brix. For a better comparison of clones in stage II they were differentiated by quality characteristics and agronomic type; tests for independence were made between and within series by the chi-square method. The results clearly indicate independence of these criteria within series but not between series. The first implies lack of apparent association between quality and agronomic type, while the second indicates the effectiveness of selection for Brix in stage I. Selection for Brix permits doubling of the frequency and so the probability of identifying superior clones in stage II, by comparison with the usual methods. Based on the combined progeny of variety L 60-25, it was possible to estimate a realized degree of genetic determination for refractometric Brix through observed advances in sugar rendement % in stage II. The value of 0.42 obtained compares well with earlier estimates for pol % juice between stages I and II.

Population characteristics of eight quantitative characters in the *Saccharum officinarum* L. germplasm. N. V. Nair, K. G. Somarajan and N. Balasundaram. *Indian Sugar,* 1979, **29,** 577-581. — In an experiment using a randomized block design with three replications, 126 varieties were evaluated for number of millable canes per row, cane thickness, single cane weight, number of internodes, length of cane, juice sugar content, yield of cane per row and commercial cane sugar per row. A study of the frequency distribution of these properties showed that only single cane weight and cane length did not have continuous and normal distributions.

De-fuzzing sugar cane seed with a small seed scarifier. R. D. Breaux. *Proc. Amer. Soc. Sugar Cane Tech.,* 1977, 23. When seed viability is <50 per g, a thick mat of fuzz must be sown in order to give an adequate plant population per flat in the greenhouse. However, seedlings have great difficulty germinating in and growing through a thick mat of fuzz, control of fungi and bacteria is difficult, and many seedlings die when the mat dries between waterings. A small seed scarifier used at Houma, Louisiana, removed the callus hairs from the cane spikelets faster and more easily than any other previously reported method. The de-fuzzed seed of six crosses of low viability produced 40% more seedlings than untreated fuzz sown in thick mats.

Basic sugar cane breeding in subtropical Louisiana. P. H. Dunckelman and S. Nagatomi. *Proc. Amer. Soc. Sugar Cane Tech.,* 1977, 43-46. — The progress of the basic breeding program at Houma is reported. By manipulating basic and established cane breeding stocks under natural and artificial environments, it was possible to make crosses that would otherwise have been impossible. Outdoor racks, a photoperiod house and a breeding greenhouse were used to obtain a suitable environment for flowering, crossing and seed production. During 1976-77 seventy-three biparental crosses were made for the purpose of combining the economic features of the commercial breeding stock with the hardiness and disease resistance of *Saccharum spontaneum* spp., the vigour of *S. robustum* spp. and the large size and high juice content of *S. officinarum* spp.

The heritability of lodging in sugar cane. P. M. Lyrene. *Proc. Amer. Soc. Sugar Cane Tech.,* 1977, 87-91. — The heritability of lodging was studied in 40 populations of cane stools, comprising 10 commercial varieties, 25 F_1 seedlings produced by crossing five of the commercial varieties with the other five, and 5 S_1 populations obtained by selfing paternal parents. A randomized block experiment with one plot of each population in each of six blocks was used, with each plot consisting of about 17 plants spaced 1 m apart in a single row. Each plant was given a rating ranging from 1 (fully erect) to 10 (fully prostrate). Lodging was much more severe in F_1 and S_1 populations than in parental clones. Lodging tendency was transferred from parents to progeny, the correlation between mid-parent and F_1 lodging being 0.59. General combining ability effects for lodging were highly significant, but the estimate for specific combining ability was zero. F_1 populations with high numbers of stalks per stool lodged more severely than those with fewer stalks, but lodging was not correlated with stalk diameter or length. Extent of lodging had high heritability, as did stalk number per stool, stalk diameter and flowering per cent. Stalk length had low heritability, and the heritability of Brix was intermediate. It was concluded that selection of upright parents should increase F_1 seedling erectness. In selection for erectness, uprooting should be considered a more serious defect than stalk bending.

BEET PESTS AND DISEASES

Polyvalent machines for liquid treatments in beet cultivation. G. Baraldi. *Ind. Sacc. Ital.,* 1979, **72,** 89-96 *(Italian).* — An account is given of machines for the distribution of chemicals to beet crops and the precision of application discussed.

Yellows control. L. van Steyvoort. *Le Betteravier,* 1980, **14,** (141), 11 *(French).* — Some advice is given on chemical control of aphids acting as virus yellows vectors. It is stated that, while no resistance has been observed to carbamates, aphids have shown a little resistance to phosphoric esters (e.g. Meta *iso*-systox and Mesodrin), especially when the dosage rate is low.

The biotest technique for beet nematode determination. P. Behringer. *Die Zuckerrübe,* 1980, **29,** (3), 21-22 *(German).* — Four transparent triangular pots held together by two rubber bands to form a single unit are filled with test soil and seeded with winter rape which is identical to sugar beet in its susceptibility to nematodes but roots better and yet does not have such a fibrous system as beet in early stages of growth. The contents are then covered with neutral culture soil, and fungicide applied every 10 days. After 7-8 weeks' growth under controlled conditions, the pots are examined for cysts, and the details of the degree of incidence reported to the grower from whose fields the test soil was taken. Up to 5000 pots can be filled by one person in a single day. Even with low nematode incidence, up to 15% yield loss can be expected; preferably 3-4 years should be allowed to elapse before beet is grown.

Sugar beet pests. Anon. *Die Zuckerrübe,* 1980, **29,** (3), 24 *(German).* — A list is given of beet pests with possible means of control.

Sugar beet yellows — a permanent annoyance. —. Rieckmann. *Die Zuckerrübe,* 1980, **29,** (3), 42, 44-46 *(German).* — The question of yellows virus transmission is discussed, and lists are given of host plants that allow the virus to over-winter. The feeding habits of aphids and the means by which they transfer the virus and simultaneously cause other problems to the beet through excretion of "honey dew" are described.

Protection of sugar beet from disease and pests. M. Kubacka-Szmidtgal. *Gaz. Cukr.,* 1980, **88,** (5), 131-133 *(Polish).* — Recommendations are given on chemical control of a number of beet diseases and pests that occur in Poland.

Beet fly in sugar beet fields. E. Szafarek. *Gaz. Cukr.,* 1980, **88,** (5), 133-134 *(Polish).* — Widespread infestation of beet fields in Poland with beet fly larvae in 1979 caused considerable losses in root and leaf weight and in sugar content. Beets were unaffected where Furadan 5G granules had been applied at sowing. The best means of control in infested fields was a 0.15% solution of Nuvacron 40 sprayed under the leaves.

Control of the major pests of sugar beet. M. Ionescu. *Prod. Veg., Cereale si Plante Tehn.,* 1980, **32,** (4), 36-39 *(Rumanian).* — Trials on control of major beet pests in Rumania, including *Bothynoderes punctiventris* (beet weevil), *Scotia* spp. and *Mamestra brassicae* (cabbage moth), are reported. Various chemicals were tested at several dosage rates; they included Furadan 5, Disulfoton 5, Lindatox 20 and Carbetox 40. All treatments gave considerable increase in root yield by comparison with untreated controls.

A study of methods for control of sugar beet seedling pests. M. Kubacka-Szmidtgal. *Gaz. Cukr.,* 1980, **88,** (5), 137 *(Polish).* — Results obtained with a number of granular insecticides, both contact type and systemic, applied to the soil at sowing, are reported. Dosage rate and the effectiveness of each chemical (very good, good or moderate) against named pests are tabulated.

Effect of artificial defoliation on root and sucrose yield of sugar beet. K. N. Singh, G. C. Sachan and R. C. Chhibber. *Indian Sugar,* 1980, **29,** 715-718. Removal of 25%, 50%, 75% and 100% of the leaves from beets, 120 days after drilling, to simulate the effects of leaf-eating pests caused a drop in root and sugar yield, the effect increasing with % defoliation. Leaf removal 144 days after drilling had less effect than the earlier defoliation, but there was still a drop in root yield by comparison with normal beet, except with 25% defoliation (when the root yield was higher than that of the control). With regard to sugar yield, the results for defoliation after 144 days were better than for the earlier defoliation except with the 25% leaf removal. Where defoliation was carried out both 120 and 144 days after drilling, root and sugar yield suffered more than with the single defoliation. In all cases, the sugar content was lower than in the control. Natural infestation by lepidopterous pests gave lower root yields than with defoliation, lower sugar yields than with 25% or 50% defoliation, but higher sugar contents in all cases.

Present-day possibilities of insecticidal treatment of sugar beet seed. W. R. Schäufele and C. Winner. *Zuckerind.,* 1980, **105,** 751-755 *(German).* — Trials were conducted on three insecticides used for pelleted seed treatment as alternatives to Heptachlor, which has been removed from the officially recommended list in West Germany. Results obtained with Bendiocarb, Carbofuran and Mercaptodimethur showed that all were effective in reducing the incidence of specific pests and gave as good emergence as without treatment, and in many cases better emergence. The question of which of the three insecticides to use is left to the individual farmer.

Investigations on spread and harmful effect of sugar beet powdery mildew *(Erysiphe betae)* in Germany, Austria and Turkey. W. Ahrens and H. C. Weltzien. *Zuckerind.,* 1980, **105,** 916-925 *(German).* — A survey is presented of the literature on field trials involving various fungicides applied to beet for powdery mildew control, and results of tests carried out in Austria, Turkey and West Germany are reported. The effect of the disease on sugar yield is clearly indicated, and the point is made that the extent to which yield is reduced is such that the disease should not be regarded as economically unimportant. The reaction of a number of beet varieties to the disease is also discussed.

CANE SUGAR MANUFACTURE

A quantitative determination of the flow and frictional properties of raw sugar. D. F. Bagster. *Proc. Australian Soc. Sugar Cane Tech.,* 1980, 221-225. – A preliminary study has been made on some samples of raw sugars with a view to establishing what have now become the standard design parameters for a bulk solid. The Jenike Flow Factor Tester was used with the view that quantitative designs of sugar handling facilities should be based on the now well-established solids flow techniques. Little if any gain in strength was found for raw sugar during extended storage, at least over a six weeks' period; however, when caking of raw sugar was simulated, an enormous increase in strength resulted, indicating that the ingress of air or the presence of thermal gradients in a raw sugar mass must be carefully avoided.

Odour control in the treatment of sugar cane waste with hydrogen peroxide. P. Pubbakasikor and N. C. Burbank. *Proc. Ind. Waste Conf.,* 1976, **31,** 77-83; through *S.I.A.,* 1980, **42,** Abs. 80-872. – Possible methods of removing the odour from hydroseparator effluent in Hawaii before land disposal were tested. The effluent contained 2650 mg BOD and 10,000 mg suspended solids per litre. Treatment with activated sludge or a cationic coagulant removal suspended solids and odour; treatment with 125 mg H_2O_2/ litre removed odour and decreased the BOD to < 100 mg.l^{-1}.

Process steam economy – a study from a different angle. S. K. Ghosh and A. J. Ray. *Maharashtra Sugar,* 1980, **5,** (7), 9, 11-12, 14, 16-18, 20-21. – Rather than examine the total heat consumption in each process station, the authors investigate sources of heat loss and show, where possible, how such losses can be reduced.

A modified Graver clarifier. K. S. R. Rao, K. Venkataratnam and O. B. Reddy. *Maharashtra Sugar,* 1980, **5,** (7), 23-26, 28, 30-32. – Details are given of a modified Graver clarifier based on the more recent concepts in clarifier design, including flow of an ascending stream of juice through a falling curtain of mud. Performance data indicate the improvement in performance compared with the unmodified model, including production of a clear juice of sufficient quality as to permit manufacture of larger-grained sugar of colour grade 30.

Factors influencing milling efficiency – scope and measures for their improvement. B. L. Mittal. *Maharashtra Sugar,* 1980, **5,** (7), 33-34, 36-39. – The two criteria of milling efficiency are juice extraction and cane crushing capacity. Factors which affect one or both of these are listed with a brief discussion on each, viz. degree of cane preparation, specific pressure applied, roller speed, bagacillo treatment (return or separate processing in a screw press or roller press), imbibition, etc.

Review of performance of sugar factories in 1978. J. T. d'Espaignet. *Rev. Agric. Sucr. Maurice,* 1979, **58,** 180-184. – Notes are provided on the cane sugar season in Mauritius in 1978 with the overall statistics and reference to specific installations and problems at individual sugar factories.

Evolution of sugar cane milling capacity in the whole country. F. A. Fogliata and M. O. Haro. *La Ind. Azuc.,* 1980, **86,** 2-4 *(Spanish).* – From a total daily effective capacity of 102,040 tonnes in 1972/76, the average for 1977/79 reached 112,784 tonnes (although the figures for 1978 and 1979 were in fact lower than in 1977). The effective time during the season has improved during the period from an average of 78.958% in 1972/76 to 82.088% in 1977/79. There is thus scope for increased output from existing Argentinan sugar factories.

Some facts about the exhaustion of final molasses and its economic evaluation. E. David. *ATAC,* 1979, **38,** (2), 11-13 *(Spanish).* – Any occasion when the purity of final molasses is greater than it need be results in a financial loss which can be quantified. It is pointed out, however, that a correct assessment needs the use of true purity rather than apparent purity because of the errors that can arise when pol is measured and not sucrose. Exhaustion depends on adequate equipment and residence time in crystallizers, and it is suggested that, where the crystallizer capacity is insufficient for good exhaustion, the use of a higher boiling temperature may help. The boiling house includes not only pans and crystallizers but syrup feed tanks, etc., and careless operation of any part can increase losses. The final boiling is the end of the exhaustion and the earlier strikes should be made with care, since a lower feed purity for the final boiling assists exhaustion. Full seeding is not a simple concept and requires great care in application. All pan feed material should be at a well controlled supersaturation level and at the same temperature as the massecuite. The residence time and temperature in crystallizers should be calculated to optimize exhaustion, and any unit out of operation for a mechanical defect will be a source of loss. If massecuite viscosity must be reduced, it should be done with diluted final molasses, not water. Pan operation should be with the aid of instrumentation based on refractometry, conductimetry, B.P.E. or other valid principle. Visual examination of the crystals using a microscope is a sure way of assessing the pan work, and an experienced eye can see things that are not shown by chemical analysis.

Influence of cane quality and the type of sugar on recovery. E. Cardet. *ATAC,* 1979, **38,** (2), 14-19 *(Spanish).* – The effects of cane quality (pol:fibre ratio) on extraction and retention are quantified, as is the effect of the pol of sugar produced on recovery. Comparison between factories is unfair where some are obliged to start their season early and to crush immature cane, and also to those which have to produce very high pol sugar for particular customers. For purposes of comparison, a corrected recovery should be calculated on a basis of a standard cane quality and standard sugar.

Influence of bagacillo in filter cake on the filtration process. J. Marinello and L. Berriz. *ATAC.* 1979, **38,** (2), 56-64 *(Spanish).* – Increase in the bagacillo content in filter cake is of advantage up to a limit, found by the authors in experiments to be about 2.3%, above which the specific resistance of the cake is not reduced further,

while the volume is increased. A level of 2.4% is the upper limit for increased return of turbid filtrate to the clarifiers, and reduced flow rate as well as filtrate clarity.

Bagasse and fuel economy. E. David. *ATAC,* 1979, **38,** (3), 11-13 *(Spanish).* — Bagasse has been used for a century or more as fuel in sugar factories, although some with antiquated equipment still need to employ supplementary fuel, generally oil or wood. The methods of improving efficiency to avoid this are well known. and the need for energy economy compels the application of these methods. An important factor, however, is the nature of the raw material entering the factory, since the amount of energy required to produce a given quantity of sugar depends on the quality and ripeness of the cane, while the amount of bagasse depends on the fibre content.

Continuous crystallization of *B*-massecuite. F. Reyes and O. Quiñones. *ATAC,* 1979, **38,** (3), 19-21 *(Spanish).* Good results having been obtained with continuous crystallization of final massecuite, a similar system was tested with *B*-massecuite. Four crystallizers were operated in series. The tests started in 1976 and purity drops for this year and 1977 were 16.24 and 15.76, against 14.48 in 1973, 16.00 in 1974 and 15.95 in 1975. The operating conditions in 1978 were such that the purity drop of 14.21 is not considered representative of the system. The continuous operation gave the opportunity for a higher throughput, however, and further trials will be conducted.

Evaporator cleaning. T. Hechavarría and R. Rodríguez. *ATAC,* 1979, **38,** (3), 28-32 *(Spanish).* — Because of a shortage of HCl, a new method of cleaning was employed for the evaporator at Central Loynaz Hechevarría, involving boiling with caustic soda, application of 5 psi steam direct to the dry calandria, examination and, if the scale was not sufficiently removed, boiling with caustic soda again, and then boiling with acid. No extra time was necessary and no extra NaOH was used, but acid usage fell from 14,880 kg in 1977 to 9325 kg in 1978.

Influence of mixed juice quality on oil consumption. P. Perez, O. Quiñones and R. Espinosa. *ATAC,* 1979, **38,** (3), 44-48 *(Spanish).* — At the authors' factory, mixed juice quality is low and supplementary fuel has been found necessary, the amount being greater, in general, when the purity was lower. The need to take measures in the field and factory to raise the quality of the cane is emphasized.

Optimum water requirements in centrifugals. P. K. Singh. *Indian Sugar,* 1980, **29,** 697-699. — A material balance is used as basis for a system of equations from which to calculate the optimum water requirements in centrifugals. The system is developed for a given 3-massecuite scheme, and Brix values and purities are tabulated.

Effect of temperature on absorption on calcium phosphates. J. Jover P., R. Fajardo G. and L. D. Bobrovnik. *Centro Azúcar,* 1978, **5,** (2), 31-40 *(Spanish).* — During the cane juice clarification process, colouring matter is adsorbed onto a calcium phosphate precipitated in the juice. Studies were made of the adsorption of a standard synthetic colorant on a commercially available calcium phosphate and another synthesized in the laboratory. Adsorption isotherms were prepared for temperatures of 40°, 50°, 60° and 70°C and were found to correspond to a modified form of the Freundlich adsorption equation. In general, adsorption on both phosphates decreased with higher temperature.

Study of the adsorption on different adsorbents of natural substances of high molecular weight present in cane juice. M. Darias P., M. C. Ruíz G. and L. D. Bobrovnik. *Centro Azúcar,* 1978, **5,** (2), 41-52 *(Spanish).* — The capability of zeolite, hydroxy-apatite and kieselguhr to remove high-M.W. impurities from cane juice was assessed by adding small amounts of these adsorbents to solutions of egg albumin, dextran and a mixture of egg albumin and apple pectin, all brought to pH values in the range 3-9, at room temperature and also at 95°C. After shaking for 45 minutes and filtering carefully, the protein and polysaccharide contents of the filtrates were measured to determine the extent of adsorption. The results are presented in graph form and discussed. Kieselguhr proved better than the other two materials. Protein adsorption reached a maximum at pH 4, owing to precipitation at the isoelectric point. The pectin reduced adsorption of the protein and caused the adsorption maximum to shift to other pH values. Dextran behaved irregularly and differently for each adsorbent and at the different temperatures. Adsorption of the different substances analysed depended fundamentally on the nature of the substance and the adsorbent.

Dynamics of the substances colloidally dispersed in the sugar manufacturing process on the semi-industrial scale. M. Darias P., N. Fleites E. and L. D. Bobrovnik. *Centro Azúcar,* 1978, **5,** (2), 53-65 *(Spanish).* — Crusher juice, mixed juice, clear juice, syrup, *A*- and *B*-sugar and *A*-, *B*- and *C*-molasses produced in a pilot plant at the Central University of Villa Clara were analysed for the colloid content, polysaccharides and proteins as well as the monosaccharides and amino-acids produced on hydrolysis of the colloidal fractions. The results are presented in the form of graphs which show the variations in the substances analysed during processing of cane. By means of analyses of material from cane which had remained in the field after cutting, the increase in polysaccharides during the interval between cutting and crushing is demonstrated.

Effect of simulated recirculation during the clarification of cane juice. R. Fajardo G., S. Cepero G., J. M. Meana and L. D. Bobrovnik. *Centro Azúcar,* 1978, **5,** (2), 67-73 *(Spánish).* — The effects on clarification of returning filtrate to mixed juice has been studied. pH, colloids, colour and reducing sugars remained within acceptable limits, but the settling rate of limed juice was reduced.

A new system of obtaining nuclei for crystallization. L. Carrazana R. and A. P. Koziavkin. *Centro Azúcar,* 1978, **5,** (2), 75-87 *(Spanish).* — Uneven rates of growth have been observed with sugar crystal nuclei obtained in a ternary system sugar:water:alcohol, and a modification, whereby a fourth material, glycerine, is included, has been studied and found to provide a seeding medium stable for more than 20 days. The physico-chemical properties of such quaternary systems are discussed and indicated in graphs.

Continuous boiling: a bibliographical study. R. Alemán G. and A. Cabrera P. *Centro Azúcar,* 1978, **5,** (2), 89-104 *(Spanish).* — An illustrated survey of the literature is presented, with 52 references.

BEET SUGAR MANUFACTURE

Extraction of beet juice after various periods of storage in a pile. C. A. Accorsi, F. Zama, G. Vaccari and G. Mantovani. *Ind. Sacc. Ital.*, 1980, **73**, 42-47 (Italian). A pile of sugar beets was built at a sugar factory and stored for three weeks, part of the pile being removed and processed in a pilot-scale diffuser (of about 250 $kg.hr^{-1}$ capacity) over a period of ten hours at the start of the experiment and at weekly intervals. Analyses were made of the cossettes, juice and pulp produced at each stage, and a record indicated in graph form of the minimum and maximum atmospheric temperatures and daily rainfall; the average temperatures in the pile is also recorded, and increased from just over 20° to about 26°C during the three weeks. There was a fall in absolute Ca and Mg contents of the cossettes and pulp during the period, as well as expressed as a proportion of insoluble ash. The juice pH fell from 6 to 5.2, while the apparent purity fell from 88 to 75. The reducing sugars % Brix increased from 0.9 to 3.35, however, and, when a pol correction was applied, the fall in purity was smaller, from 88 to 83. Of the organic acids, lactic and pyrrolidone carboxylic acids increased markedly, malic acid increased slightly (as did phosphoric acid), while citric acid fell slightly and oxalic acid fell slightly during the first two weeks and then markedly in the third. Total Kjeldahl nitrogen increased from 0.657 to 0.812 g % Brix, but ammoniacal and amide N fell from 0.189 to 0.145.

Investigations on the suitability of new types of filter cloth for the sugar industry. J. Haszczynska. *Gaz. Cukr.*, 1980, **88**, (5), 138-139 *(Polish)*. — An outline is given of the methods used to evaluate filter cloths and of the criteria used in determining their suitability under both laboratory and factory conditions.

Investigation of energy consumption in the sugar industry. Z. Kuncewicz. *Gaz. Cukr.*, 1980, **88**, (5), 139-140 *(Polish)*. — The aims and approaches of research on energy consumption being conducted by the central sugar institute in Poland are set out, and certain of the findings discussed. For prediction of energy consumption by the year 2000, two variants are examined: where sugar yield is 11.5% on beet and where it is increased to at least 14% on beet. In the former case, energy consumption is calculated as approx. 6300 Mcal per tonne of white sugar, while a 1000 Mcal/tonne drop is estimated for the latter case. By the year 2000, at a total production of 2,400,000 tonnes of white sugar, it is therefore calculated that 400,000 tonnes of coal could be saved by raising beet quality and hence sugar yield to the higher value above.

Joint treatment of sugar factory effluent and municipal sewage. B. Zalicka and B. Polec. *Gaz. Cukr.*, 1980, **88**, (5), 140 *(Polish)*. — Tests have shown that treatment of a mixture of sugar factory effluent and municipal sewage does not present any difficulties and can, under favourable conditions, reduce the BOD_5 by 99% to below 10 $mg.l^{-1}$. Where the sugar factory effluent has a COD content of > 4000 $mg.dm^{-3}$ it should be treated separately by the conventional two-phase system (anaerobic and aerobic treatment) and the municipal sewage fed directly to the aeration tank without prior anaerobic fermentation. Where the sugar factory effluent is of lower COD content, say of the order of 2000 $mg.dm^{-3}$, it can be mixed with the municipal sewage before aerobic treatment, although care is necessary in the mixing. Apart from the reduction in BOD_5 and COD, the scheme also permits a reduction in the level of coliform bacteria.

The effect of Sterinol on flume waste water and a process for its treatment. B. Polec. *Gaz. Cukr.*, 1980, **88**, (5), 140-141 *(Polish)*. — Tests showed that addition of Sterinol disinfectant to flume water at the rate of 4 kg per 1000 tonnes of processed beet (assuming a water usage of 100-500% on beet) produced biological stability. Laboratory experiments demonstrated that at 0.001-0.02 $g.dm^{-3}$ Sterinol did not inhibit anaerobic processes occuring during ponding, and at 0.001-1 $g.dm^{-3}$ had no adverse effect on bacterial dehydrogenase activity. Toxicity of flume water was eliminated by treatment with the disinfectant (as demonstrated after 3 months' ponding), while the concentration of Sterinol lethal to fish (50% mortality among test fish after 48 hr) was 0.91 cm^3 per dm^3 water.

Use of the IRIS automatic control system for continuous diffusers. G. Windal and D. Maes. *Sucr. Franç.*, 1980, **121**, 149-152 *(French)*. — Automatic control of the water:cossettes ratio in a continuous diffuser was tested where a continuous refractometer mounted on a De Smet diffuser transmitted Brix measurements to an electronic ratio calculator which also received signals from the cossettes feed conveyor; a controller receives the signal and actuates water feed and juice draw-off valves so as to adjust the ratio to a target value. Results of tests have proved highly satisfactory, with a very good precision in the lower Brix range of 5-6° (out of a total range of 0-55°Bx). The sensor has shown itself to be resistant to temperatures as high as 70-80°C, while the refractometer readings have shown good agreement with those on a laboratory instrument. Installation of the system on a DDS diffuser is less simple, while a system for a RT diffuser remains to be tested. The economic advantages of the system are considered.

Comparison of methods of 2nd remelt liquor demineralization. H. Zaorska. *Gaz. Cukr.*, 1980, **88**, (6), 121-123 *(Polish)*. — Three methods of demineralizing 2nd sugar remelt liquor were compared: (1) ion exchange on the H^+ and OH^- cycles, (2) electrodialysis, and (3) ion exchange on the ammonium and carbonate cycles. Although all three methods met the requirements of removing at least 75% ionic non-sugars from the 60°Bx liquor, method (1) caused a certain fall in pH and a slight rise in the invert content, despite maintenance of a low temperature (approx. 10°C). Some 20% of the initial ash content remained in the syrup, while regeneration with HCl and NaOH resulted in a highly polluted effluent. Whereas electrodialysis gave much better results than method (1), there was a fall in pH below 7.0 and a consequent rise in invert sugar, although the major snag was the high cost of the ion exchange membranes. Method (3) gave the best results, removing more than 90% of the ionic non-sugars and permitting production

of a high-purity liquid sugar. Operation of the system in a closed circuit avoided production of effluent.

Simulation of a multiple-effect evaporator using the CSMP system. K. Urbaniec and M. Szczeniowski. *Zuckerind.*, 1980, **105**, 628-631 *(German).* — A simulation program for a quintuple-effect evaporator is described, and possible applications of the model are indicated.

Factory tests on a scheme for juice purification by defecation before 2nd carbonatation. Yu. F. Tsyukalo, I. S. Cherkas, K. P. Zakharov, V. Z. Semenenko, N. I. Zharinov and A. P. Lapin. *Sakhar. Prom.*, 1980, (7), 10-12 *(Russian).* — By liming 1st carbonatation juice with 0.42% CaO on beet before 2nd carbonatation but using the same total amount of lime as in conventional treatment (consumption in pre- and main liming being reduced and no lime added to 2nd carbonatation), 2nd carbonatation and thick juice purity rose and reducing sugar, lime salts and colour were reduced, so that molasses sugar was decreased and sugar yield raised.

Preliming by recycling partly saturated defecation juice. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Sakhar. Prom.*, 1980, (7), 13-15 *(Russian).* — Tests showed that recycling unfiltered juice from the first section of the carbonatation vessel (after only 30-40% saturation of the lime) to preliming was more effective, in terms of juice colour, albumins, acid anions and purity rise, than recycling the same quantity of juice after complete saturation.

The effect of flocculants on 2nd carbonatation juice quality. I. G. Bazhal, I. A. Oleinik, E. N. Shirokikh, R. M. Polishchuk, S. D. Sobko, V. S. Bondarenko and N. I. Nespryad'ko. *Sakhar. Prom.*, 1980, (7), 16-18 *(Russian).* — Tests with a number of flocculants indicated that they caused considerable increase in the settling rate and a corresponding fall in the filtration coefficient, thereby cutting juice residence time in clarifiers sufficiently to permit use of rapid clarifiers. In investigations on flocculant effect on juice thermal stability, 1st carbonatation juice was subjected to 2nd carbonatation with and without pre-addition of an optimum quantity of flocculant. Results showed that use of flocculant increased purity by 0.8 unit, reduced lime salts and reducing sugars contents and decreased colour as well as the sucrose degradation rate constant by 3-9% in the temperature range 80-120°C.

Liquid jet sulphiters for juice and syrup at sugar factories of 6000 tonnes of beet daily slice. S. A. Zozulya *et al. Sakhar. Prom.*, 1980, (7), 19-22 *(Russian).* — Details are given of a juice and a syrup sulphiter experimental model in which the juice/syrup is forced into the branch feed line as a high-pressure jet and mixes with a stream of SO_2 gas fed at right-angles to the liquid flow. Tests have shown that the degree of gas utilization was very high at a juice throughput of 34 $kg.hr^{-1}$ and a syrup throughput of 10 $kg.hr^{-1}$.

Investigation of the natural loss in raw sugar during intra-factory transport and storage. V. A. Pronina and E. M. Belen'kaya. *Sakhar. Prom.*, 1980, (7), 33-34 *(Russian).* — An investigation was conducted into the transport and storage losses occurring in Soviet sugar factories processing cane raw sugar. According to the time of year and whether the sugar is stored in bulk or bagged, 0.09% by weight is the maximum permissible loss in handling and transport and 0.05% by weight in storage.

Device for juice and syrup sulphitation with liquid sulphur dioxide. Yu. G. Goncharov *et al. Sakhar. Prom.*, 1980, (8), 25-28 *(Russian).* — The performances of various types of sulphitation vessel are discussed, and details given of an experimental model in the form of an inverted U-shaped pipeline. Juice, fed from the bottom of one leg of the vessel, comes into contact with a stream of liquid SO_2 fed via an evaporator and bubbler at right-angles to the juice flow. The juice and SO_2 then flow into an expanded absorption chamber, after which the juice flow rate is accelerated by means of a diaphragm; mixing, already increased by the change in velocity, is then further enchanced by profiled baffles placed across the flow path, after which the juice flows via the top curved sections into the down pipe. At an hourly throughput of 97 m^3 of syrup, colour reduction in September was from 40° to 24.9°St, and in November from 75.8° to 40.7°St.

The use of a tungsten electrode for pH measurement. Z. S. Voloshin, A. V. Pogrebnyak and M. R. Shemberko. *Sakhar. Prom.*, 1980, (8), 34-37 *(Russian).* — Laboratory and factory tests on a tungsten electrode are reported. In continuous control of 1st and 2nd carbonatation juice pH, comparison was made with results obtained using sensors provided with glass electrodes, which showed that the system employing the tungsten electrode maintained pH constant within ± 0.1 unit at constant temperature; however, changes in temperature had a marked effect on precision.

Performance of the sectioned flume-wash water settling tanks at Ust'-Labinskaya sugar factory. N. K. Polishchuk. *Sakhar. Prom.*, 1980, (8), 41-42 *(Russian).* — Changes made to the settling tank design are described, including raising the height of the walls of the 18 compartments so as to permit a higher level of water and hence faster particle settling, installation of mud rakes in each section so that any one could be removed for cleaning when necessary, changes to the design of the rakes, and modifications to the maintenance platforms and walkways.

Pressing of beet pulp. Anon. *Stord Bartz Rev.*, 1980, **6**, 20-23. — The press water from a pulp press includes fines or suspended solids, and the press water may be recirculated to diffusion with or without preliminary screening to remove these fines. If they are not removed, they recirculate through the diffuser, adding to the retention time, whereas if separated they can be either added to the pulp press feed or can be pressed separately. Recirculation to the pulp press feed is calculated, from measurements made at one factory, to reduce the press capacity by 5% and, because of disintegration, it will have a harmful effect on the pressed pulp.

Processing stored beets. G. W. Cossairt. *Sugar J.*, 1980, **43**, (2), 11-16. — The processing of frozen and non-frozen beets separately in a diffuser produces thermal shocks at the time of change, while change from healthy to deteriorated beets similarly results in an almost instantaneous slowdown in the filtration system, high syrup colour and increased fuel usage. The impact is softened by a storage recovery system which permits blending of beets in different states to allow smoothed-out changes in quality.

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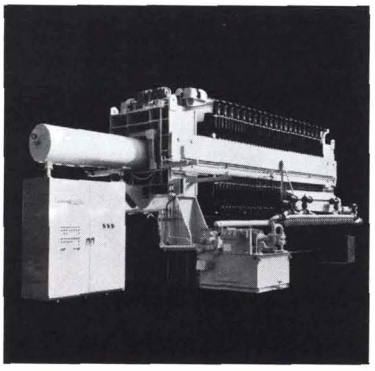

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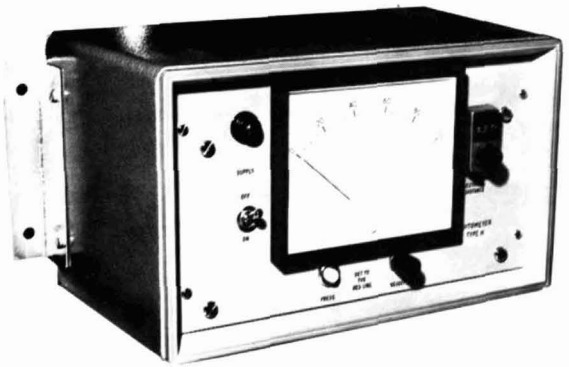

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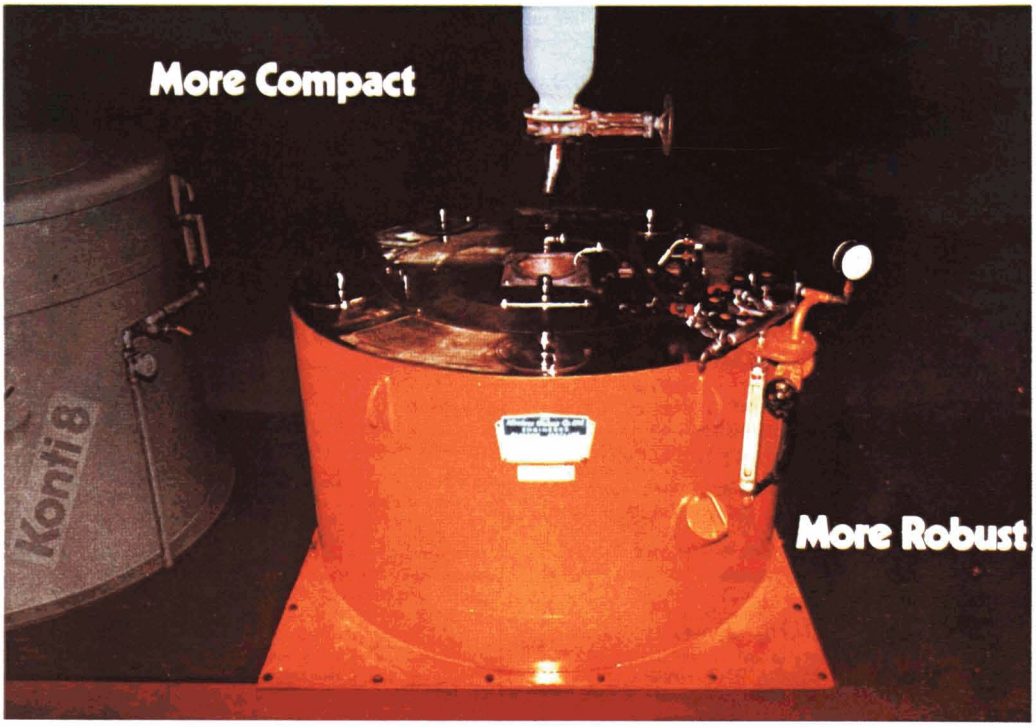

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SUGAR REFINING

Acrylic anion resin as gross decolorizer in cane sugar refining. O. I. Cheong and H. Mussebah. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — The use of acrylic anion exchange resin as gross decolorizer in the carbonatation refinery was more advantageous than the classical carbon-styrene anion exchange resin polishing system. Even with heavy colour loading, the acrylic anion exchange resins had an economical life of 450 cycles, representing about 14,000 tonnes of refined sugar produced per m^3 of resin.

Processing of raw sugar to refined white sugar at Labinskii sugar factory. M. I. Daishev *et al. Sakhar. Prom.,* 1980, (3), 21-24 *(Russian).* — Details are given of a 4-massecuite boiling scheme which excludes both reboiling of run-offs and carbonatation of remelt made up with 2nd massecuite run-off.

The effects of the ash content percentage in raw sugar on the refining process. J. V. López-Oña and G. S. Baumert. *La Ind. Azuc.,* 1979, **86,** 268-270 *(Spanish).* — See *I.S.J.,* 1981, **83,** 248.

The Victorias Milling Company refinery decolorization plant. C. H. Tupas and M. A. Garcia. *Sugar y Azúcar,* 1980, **75,** (5), 51, 54, 58. — Details are given of the VMC granular activated carbon pulse-bed system used for liquor decolorization in place of a previous bone char system. Factors considered in the choice of system are discussed. Experience over a period of 15 years has shown that the carbon process has brought many economic benefits, reduced manpower and maintenance requirements and ensured continued high sugar quality, while being operationally flexible.

The state of and basic means of improving the equipment and technology of refined sugar manufacture. S. A. Brenman. *Sakhar. Prom.,* 1980, (5), 23-26 *(Russian).* The present level of refining technology in the USSR is examined, and ways of improving both the processing techniques and the equipment used are discussed.

Experience in the use of disc filters for mechanical filtration of refinery syrups. N. S. Tishchenko. *Sakhar. Prom.,* 1980, (5), 26-28 *(Russian).* — In 1976 Cherkassy refinery received a large amount of low-quality raw sugar having a mechanical impurity content of about 0.5%, so that each day some 3 tonnes of foreign bodies entered the refinery, and much of this enveloped the granules of active carbon, considerably lowering its efficiency. The system used to remove the impurities was inadequate, so that some found its way into the end-product. The difficulties were overcome by installing a battery of disc filters, with Perlite precoat, before the active carbon station. Details are given of the procedure used to filter the syrup. Automatic maintenance of the working pressure in the filters would improve their operation.

Use of AV-17-2P ion exchange resin at Tula sugar refinery. V. N. Dneprovskii. *Sakhar. Prom.,* 1980, (5), 29-31 *(Russian).* — Because of various problems associated with its use, AV-16GS anion exchange resin was replaced with AV-17-2P highly basic anion exchanger of the polystyrene type. Details are given of initial tests in which, however, the efficiency of the resin in reducing the colour of syrup from approx. 10°St to approx. 6°St was lower than that of the resin it replaced, while the interval between regenerations was shorter.

Reception, storage and processing of liquid sugar at Krasnozvezdinskii sugar refinery. A. G. Antonenko. *Sakhar. Prom.,* 1980, (5), 31-33 *(Russian).* — The system for reception, storage and processing of liquid sugar sent to the title refinery from a number of sugar factories for processing to crystal sugar is described. On discharge from the rail tankers, the liquid sugar of 64-67°Bx is treated with formalin. Almost no changes have been found in purity, pH or reducing sugars content after 4½ months' storage. Problems have been encountered with reception and handling in winter, so that it is recommended that the sugar should be in transit no more than 3 days. From storage it passes by gravity to the minglers where it is mixed with crystal sugar in an optimum ratio of 65:35, after which it is processed as normally in a refinery.

The technological scheme for cane raw sugar processing at Odessa sugar refinery. N. T. Tzerezovskii. *Sakhar. Prom.,* 1980, (6), 29-30 *(Russian).* — An outline is given of the refining processes used for cane raw sugar at Odessa refinery, where a 4-massecuite boiling scheme is used.

The conception of a single-liquor scheme with production of 3 types of crystal in white sugar factories with and without processing of raw sugar from other sources. J. Burianek. *Listy Cukr.,* 1980, **96,** 132-141 *(Czech).* A boiling scheme which produces one white sugar and two grades of refined sugar is described; it is designed to reduce the amount of massecuite boiled and hence steam consumption. The white sugar massecuite is boiled on 2nd refinery run-off plus some thick juice adequate to give a target purity. Some of the run-off from this massecuite (typically of 89 purity) is used as feed for low-grade massecuite, while the remainder is used to provide an intermediate massecuite which is boiled to provide the main footing for the low-grade massecuite. The intermediate massecuite is boiled on affination syrup (obtained from intermediate sugar and thick juice), thick juice alone, or low-grade sugar melted in thick juice. The affined sugar is melted and filtered to provide footing for the 1st refinery massecuite, the run-off being used for the 2nd refinery massecuite.

Behaviour of an activated carbon-ion exchange resin system for decolorization of sugar liquors. A. Curbelo S. *Centro Azúcar,* 1979, **6,** (2), 1-7 *(Spanish).* — Initial experiments have been made on a semi-pilot scale for treatment of sugar liquor whereby it is stirred and heated with a quantity of active carbon, filtered and percolated through a column of strong-base anion exchange resin to remove colour in two stages. The system avoids waste of colour-adsorbing capacity of carbon and it is possible to calculate the contributions of the two stages which minimize cost.

Revere liquid sugar refinery in Chicago. R. W. Timmer. *Sugar J.,* 1980, **43,** (1), 12-13. — See *I.S.J.,* 1980, **82,** 167-169.

LABORATORY STUDIES

Studies on acid formation and acid elimination in technical sugar juices. II. Effects of process parameters. E. Reinefeld, K. M. Bliesener and P. Kowitz-Freynhagen. *Zuckerind.*, 1980, **105**, 563-574 *(German)*. – In investigations, laboratory purification parameters (time, temperature, quantity of lime, addition of oxygen) were varied and the effect of after-liming also determined. It was found, as in earlier studies, that glutamine cyclization was very much slower than invert sugar degradation, so that it was not completed. Blowing of oxygen into the juices during main liming reduced the colour by some 53% (although other studies have shown that oxygenation can also have the reverse effect on colour). After-liming caused more extensive glutamine cyclization as well as greater separation of malic and citric acids, although a marked increase in acids occurred as a result of invert sugar degradation. These effects mark the difference between the Braunschweig purification system and the conventional system. At pH 11, simultaneous carbonatation gave thermolabile juices which were of higher colour content but contained lower quantities of the acids formed by invert sugar degradation and cyclization. The lime salts content was thus markedly lower, while the juice had inadequate alkalinity reserves. Samples of juices and molasses from two factories using the two different purification methods were analysed by gas chromatography, and the results related to the differences between the two methods.

A definitive method for true purity of molasses. J. F. T. Oldfield, M. Shore, R. Parslow and E. L. Williams. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 25 pp. – The proposed method involves determination of sucrose by gas-liquid chromatography and total dissolved solids by the Karl Fischer method. It has been compared with standard methods employed in British sugar factory laboratories; these have shown considerable differences which are mainly attributable to differences in the estimation of molasses dissolved solids rather than sucrose content. In contrast to normal process molasses, the apparent sucrose content of Quentin molasses, measured by polarimetry, was significantly higher than determined by GLC, and dissolved solids measurement by refractometry was also higher than measured by the Karl Fischer method. Fortuitously, the excess values of the two combined to give a purity figure similar to that obtained using the GLC/Karl Fischer procedure.

A laboratory apparatus for vacuum extraction. S. Zagrodzki. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 12 pp. – The apparatus described is designed for extraction of juice from about 1 kg of cossettes under thermostatic conditions and under vacuum. The cossettes are held in a vessel with a sieve bottom, and a cooling element above condenses vapour produced by the action of a steam jacket so that the condensate falls onto the cossettes, draining through the container below which serves as a source for the vapour. Extraction can be carried out at between 70 and 80°C and is followed by measurement of the conductivity of the juice. The apparatus may be used in assessment of beet quality and in beet breeding stations.

Determination of the technical value of sugar beets at the tare laboratory. G. Rens. *Paper presented to the 25th Tech. Conf., British Sugar Corp. Ltd.*, 1980, 22 pp. During the 1960's and first half of the 1970's the quality of the beet delivered to Belgian sugar factories declined markedly, coincident with the growth of mechanical harvesting. In 1977 it was decided to make a detailed survey of the quality of individual beet samples at Tienen, and this has continued for three campaigns. The number of samples analysed totalled 64,800 in 1977, 67,400 in 1978 and 70,700 in 1979, and measurements were made of pol, K, Na and N, and white sugar yield calculated from the formula of Reinefeld *et al.*[1]. The calculations were made for individual growers and by areas; in some areas, soil quality affected the results but, in addition, local cultural practices influenced beet quality, e.g. a pig-farming area where a large amount of liquid manure was applied to the fields and caused excessive N content. The actual value of sugar loss to molasses proved consistently to be higher than that calculated, and the equation was consequently modified to increase the effect attributed to Na + K. By informing the individual grower of the lower quality of his beets in relation to the average, a certain amount of improvement has been achieved.

Systematic liquid chromatographic separation of poly-, oligo- and mono-saccharides. D. Noel, T. Hanai and M. D'Amboise. *J. Liq. Chromatogr.*, 1979, **2**, (9), 1325-1336; through *Anal. Abs.*, 1980, **38**, 633. – Poly-, oligo- and monosaccharides were analysed on columns of Toyo Soda Starch Gel TSKLS 170P5, Chromosorb LC 9 and Hitachi 301N, with use of water, a linear gradient of acetonitrile (70 to 62.5%) in water, and 4:1 acetonitrile:water as eluents, respectively. Sugars were detected in the eluate either by differential refractometry or by reaction with 2% tetrazolium blue solution in 1:1 aq. ethanol and spectrophotometry at 530 nm. For monosaccharides, the limit of detection was 10 ng.

High pressure liquid chromatography for the analysis of sugar cane saccharides. J. Wong-Chong and F. A. Martin. *Sugar y Azúcar*, 1980, **75**, (6), 40, 44, 48, 50-51, 58. See *I.S.J.*, 1980, **82**, 141-146.

The conductivity of lime in sugar solutions and formation of saccharates. E. Sarka. *Listy Cukr.*, 1980, **96**, 141-144 and inside back cover *(Czech)*. – Conductivity data are given for model solutions of sucrose, of varying concentrations, to which $Ca(OH)_2$ had been added. Conclusions are drawn on the equilibrium between free (active), bound and total concentrations of lime and sucrose. The ratio of lime to sucrose was found empirically to be 1:0.7. For a sucrose concentration of up to approx. 20%, the ratio between total and free lime was calculated as $4.9\ S^{0.7} + 1$, where S is the total molar concentration of sucrose, the value of the exponent increasing with sucrose concentration up to 50%. Since the ratio of lime to monosaccharate would be expected to be 1:1 and for di-and trisaccharates 1:2 and 1:3, respectively, the difference between the empirically

[1] *Zucker*, 1974, **27**, 2.

found exponent and the calculated values must be due, it is concluded, to the formation of macroions such as $(Ca\ sucrose)^{+}$ and $(Ca_2\ sucrose)^{+++}$.

The determination of sodium and potassium in final molasses. R. Caro, E. Rubio, Z. Hernández and M. Morales. *ATAC,* 1979, **38,** (3), 38-43 *(Spanish).* Three methods were compared: ashing, dilution and addition of standard amounts of Na and K, and wet ashing with perchloric and nitric acid. The second proved much quicker than the conventional ashing and more precise than both the other methods.

Constituent amino-acids of the colloidal fraction of different products of the sugar process. M. Darias, M. Quincoces, G. Fernández, C. E. Hernández and D. Moreira. *ATAC,* 1979, **38,** (3), 51-56 *(Spanish).* The colloidal fractions of molasses and raw sugar were separated by gel filtration across Sephadex G-50 and then submitted to hydrolysis with an equal volume of 12N HCl at 100°C for 24 hours, after which the amino-acids present were determined by paper chromatography against a standard mixture of 17 known amino-acids. The acids found were the same as those identified by Parish[1] in cane juice protein. Fewer amino-acids were found in sugar, buth this is believed to be due to low concentrations. A second series of analyses were made using crusher juice, mixed juice, clear juice and syrup; the amino-acids found were the same in all cases, except that methionine was not found in syrup.

Study on the deterioration of sugar. III. M. Muro, C. Silverio and I. Machado. *Centro Azúcar,* 1978, **5,** (2), 1-6 *(Spanish).* — Raw sugar of standard pol (97.5-98) was stored in bulk and changes measured at intervals during a period of 7 months, using temperatures of 30° and 40°C and maintaining an atmospheric R.H. of 60-70%. Deterioration was independent of microbial activity. The pH fell with time from 6.20-6.45 to 4.9-5.5; colour increased at 30°C from 24.8 to 40 IC units and at 40°C from 27.0 to 75 units; this latter rise could be halved by washing the sugar in the centrifugals with a solution of Na_2SO_3. Microbial counts did not increase during storage but varied in an unsystematic manner. The authors propose that sugar be stored in bulk should be cooled to 30°C to slow down deterioration and permit longer storage.

Infra-red absorption spectra of some colorants present in sugar industry products. L. P. Kotelnikova and L. D. Bobrovnik. *Centro Azúcar,* 1978, **5,** (3), 1-6 *(Spanish).* — Infra-red spectra for melanoidins and products of the alkaline degradation of reducing sugars are reproduced and discussed, and conclusions drawn as to the structure of the products formed.

Variation of pH of sugared products. C. Silverio, I. Machado, G. Cardoso and M. Muro. *Centro Azúcar,* 1978, **5,** (3), 49-56 *(Spanish).* — Solutions of 60-90 purity and of initial pH 5.0-8.0 were heated for 50 days at 37°, 50°, 60°, 70° and 80°C, and the pH values measured. The changes in pH are discussed and mathematical equations developed for their calculation.

Study of the reaction of nitration of the hydrolytic lignin from sugar cane bagasse. F. Argilagos V. and E. Pastrana G. *Revista ICIDCA,* 1978, **12,** (3), 3-10 *(Spanish).* — Reaction of lignin with concentrated HNO_3 produces intense red solution from which can be isolated, *inter alia,* salts of nitrogenated polycarboxylic quinonic acids which are of value as fertilizers. A study has been made of the reaction and, owing to the violent evolution of gaseous oxides of nitrogen, a cascade type of reactor is considered the most suitable. Trials have been made using such a reactor and conditions sought which give the highest yield.

Microbial and proton-catalysed sucrose degradation in continuous cultivation of thermophilic bacilli. A. Dziengel and W. Mauch. *Zuckerind.,* 1980, **105,** 620-628 *(German).* — Seven strains of *Bacillus stearothermophilus* and isolates from beet diffusers were subjected to continuous anaerobic fermentation in a medium containing 1% sucrose, which underwent 32-92% degradation, with 70-88% conversion to lactate. In only two cases was there any relationship between bacterial cell growth and energy recovery. All the strains studied split sucrose by means of α-glucosidase; extra-cellular formation of invert sugar was a result of direct bacterial secretion. A combined polarimetric-enzymatic procedure for determination of sucrose hydrolysate formed during batch fermentation gave values which were much lower than those given by the continuous process; use of an approximation formula developed by Vukov[2] permittted sufficiently precise calculation of the continuous process results.

Rapid determination of chemical oxygen demand (COD). J. Condé, J. Bartós and A. Reyes. *Revista ICIDCA,* 1978, **12,** (3), 21-31 *(Spanish).* — In order to deal with a large number of waste water samples, a rapid method has been developed for COD determination. A 1 ml sample or aliquot is pipetted into an Erlenmeyer flask, followed by 1 ml of 0.25N $K_2Cr_2O_7$, 0.04 g $HgSO_4$ and some pieces of pumice previously heated at 600°C for one hour. To this is added concentrated H_2SO_4 containing Ag_2SO_4 (10 $mg.ml^{-1}$) and the mixture well mixed before heating under reflux on a sand bath for 12-15 min. The mixture is then removed, diluted with distilled water to 10 ml and the excess dichromate titrated with 0.05N ferrous ammonium sulphate using 1-2 drops of ferroin as indicator. A blank determination is carried out at the same time and the COD calculated from the difference in excess dichromate volumes. The method was tested with COD levels from 100 to 100,000 $\mu g.ml^{-1}$ and found to give good reproducibility and precision by comparison with the standard method.

Automatic beet sampler and equipment for sugar content determination — latest from DDR. L. Kolovrat. *Listy Cukr.,* 1980, **96,** 161-165 *(Czech).* — Details are given of an East German Sangerhausen electro-pneumatic sampler, the probe of which penetrates to the floor of the beet transport and removes a 35-kg sample. It can take samples from up to 50 loads per hour. Associated tare house equipment is also described.

Determination of permanent hardness in boiler water. G. Ruzickova and J. Havir. *Listy Cukr.,* 1980, **96,** 189-190 *(Czech).* — Details are given of a method for determining the permanent hardness (magnesium and calcium sulphate) in boiler water by titration with a chelating agent using Eriochrome Black T as indicator. Where the test sample is too highly coloured for determination of the end-point, it must first be acidified and filtered.

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[1] *Proc. 12th Congr. ISSCT,* 1965, 1857-1864.

[2] *I.S.J.,* 1965, 67, 172-175.

BY-PRODUCTS

Operation of a pressed pulp drum dryer using a process computer. P. Mosel, E. Feuerstein, P. Peters and G. Scholze. *Zuckerind.*, 1980, **105**, 554-561 *(German).* See *I.S.J.*, 1981, **83**, 347.

Sugar by-products in animal feed: their potential and limitations. J. Deville. *Rev. Agric. Sucr. Maurice*, 1979, **58**, 185-198. – A review is presented of the feeding of sugar cane by-products to animals, with 49 references to the literature. The main problems arise from the low contents of protein and glucose precursors and, in the case of bagasse and cane tops, from a high fibre content. The need for adequate supplementation and pretreatment has been indicated, and suggestions are made for local production of supplements – acacia, cassava and sweet potatoes.

Investigations on the utilization of mud from sugar factories as a medium for the growth and development of bacteria to be injected in oil deposits. I. Lazar. *Stud. Cercet. Biolog., Ser. Biolog. Veg.*, 1979, **31**, (2), 123-128; through *Abs. Roman. Sci. Tech. Lit.*, 1980, **16**, (1), Abs. XVI, 196. – Compared with other types of mud, sugar factory mud was found, after several months of storage, to be the richest source of bacteria as well as a substrate for bacterial growth stimulation.

Economic aspects for alcohol production from sugar cane. W. S. Patout. *Sugar J.*, 1980, **42**, (12), 9-10. The value of alcohol produced from cane is lower, even with remission of taxes, than the corresponding amounts of sugar and molasses which can be produced from the same tonnage, and it is consequently uneconomical to produce it as a fuel extender. Special conditions will have to be provided by the US government to permit its production as a means of ensuring independence from foreign oil suppliers, but, even so, the amount likely to be produced is less than the 10% which may be used as a fuel mixture requiring no major changes in engine design. The difficulties in disposal of distillery wastes are discussed.

Application of a chromatographic molasses desugarization process in a beet sugar factory. H. J. Hongisto and P. Laakso. *Sugar J.*, 1980, **42**, (12), 17-20. – A description is given of the Finnsugar-Pfeifer & Langen process for recovery of sugar from beet molasses and its application in more sugar factories advocated. In the USA, the often high Ca content requires preliminary treatment with Na_2CO_3 or softening by ion exchange, to bring the Ca + Mg level to no higher than 0.1% on dry solids. Handling of the product fraction and economical use of the residual molasses solution are described.

Pressed pulp – an energy-rich fodder. W. C. von Kessel. *Die Zuckerrübe*, 1980, **29**, (4), 25-26 *(German).* – The value of beet pulp silage as animal fodder is discussed, and details are given of its typical composition, which is compared with that of other forms of silage. The economics involved are set out.

Storage of pressed pulp. J. Blöcker. *Die Zuckerrübe*, 1980, **29**, (4), 28-30 *(German).* – Advice is given on beet pulp ensilage, and on protection of concrete bases used for silage storage against the acids formed by fermentation.

Effect of clarification of saccharine materials on the manufacture of citric acid by a fermentation process. P. K. Agrawal, C. S. Bhatt and L. Viswanathan. *Maharashtra Sugar*, 1980, **5**, (7), 45-46, 48-50, 52-58. See *I.S.J.*, 1981, **83**, 217.

Study of the continuous cultivation of micro-organisms for the production of biomass using sugar cane final molasses. P. Hernández S., I. Morrell F. and N. Reyter A. *Centro Azúcar*, 1978, **5**, (3), 99-109 *(Spanish).* – In order to acquire knowledge of continuous fermentation, series of batch fermentations using *Torulopsis utilis* were made and the results adapted by methods of other authors. The temperature of 30°C was found to be more suitable than 40°C, and under equal circumstances a substrate concentration of 40 $mg.cm^{-3}$ did not seriously affect results. The yield was better at the highest pH of the range studied (3.7-5.2), and for values near the maximum specific growth rate a tendency to instability was observed in the system which required a high supply of oxygen and affected the yield.

Study on the industrial scale of the variables which affect the physico-mechanical properties of refined pulp. A. Ribot E., E. González S. and I. Vega R. *Centro Azúcar*, 1979, 6, (1), 95-100 *(Spanish).* – A description is given of the methodology of experiments to determine the effects of a number of factors (organic matter content, pressure, Kappa number, pH, wear of the discs, feed consistency) on the refined pulp characteristics (ring crush test, internal tearing resistance, bursting strength, tensile breaking strength and Cóncora medium test). The Plackett-Burman method was used to develop equations relating these characters and will contribute to optimization of the pulp refining process.

Efficiency and distribution of energy consumed by a single disc (bagasse pulp) refiner. A. Ribot E., E. González S. and I. Vega R. *Centro Azúcar*, 1979, **6**, (2), 71-75 *(Spanish).* – The energy consumed by a single disc refiner is quantified in relation to the temperature difference of the pulp at the inlet and exit and to the current usage of the motor under load and no-load conditions. The efficiency is compared with disc erosion and a linear relationship found to exist between them.

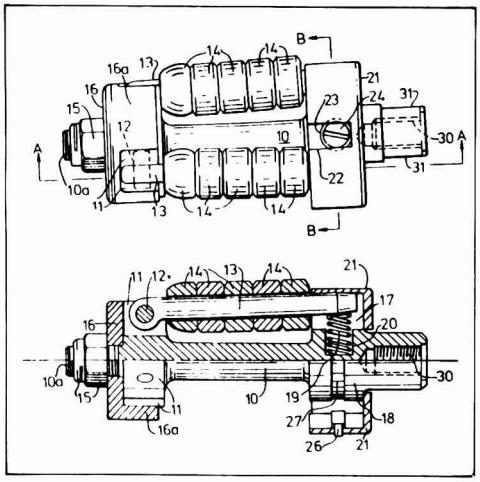
Some energy themes of the pulp and paper industry. O. L. García H. *Rev. ICIDCA*, 1978, **12**, (3), 11-20 *(Spanish).* – The Cuban pulp and paper industry consumes large amounts of energy for which either imported oil or bagasse is used as fuel; in the latter case, this means a reduced availability of bagasse as the raw material. Improvement of thermal and energy efficiency in the plant is therefore required and an analysis is made of proposals for this, including generation of high-pressure steam and production of by-product electricity. Chemical and mechanical pumping methods are compared from an energy standpoint and the complications involved indicated. Another alternative is the use of a gas turbine; this provides considerable savings in oil consumption, but investment cost is high.

PATENTS

UNITED KINGDOM

Tube cleaning tool. Rotatools (UK) Ltd., of Liverpool, England. **1,563,087.** May 18, 1978; March 19, 1980.

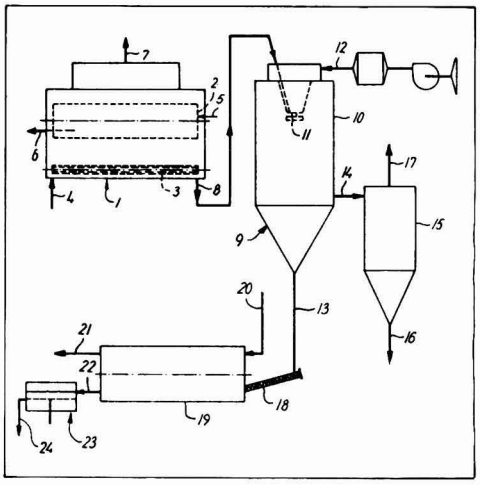
The tool, suitable for cleaning the scale from inside sugar factory tubes such as those of boilers, evaporators, juice heaters, etc., comprises a shaft 10 with, at the end which is forward in use, three pairs of uniformly spaced radial lugs 11 with, between each pair, a releasable pin 12 about which pivots a spindle 13. An end plate 16 with skirts 16a covers the forward end of the tool, maintaining pins 12 in position, and this is held in place by means of lock-nut 15 on the threaded end 10a of shaft 10.



The spindles carry a number of abrading elements 14 having grooved or roughened surfaces, depending on the scale to be removed, while the rear end is held outwardly by radiallly located springs 19 against the inner surface of a cover 21. Between the radial bores 20 holding these screens the shaft is provided with a groove 27 into which engages a stud 26 on the inside of cover 21. This cover is also provided with a slot 22; when this slot is aligned with a radial bore 20 the corresponding spindle 13 is able to pivot outwardly for replacement of elements 14. At this position the stud 26 is opposite a break in the groove 27 and the cover can be removed and reassembled. When it is wished to prevent the cover from rotating sideways, a lock-screw 23 is unscrewed from a threaded radial bore in the shaft 10. The innermost part of the screw head is wider than slot 22 so that the screw cannot be completely withdrawn and lost. The outermost part 24 of the head unscrews into the slot, however, and so prevents its rotation and also, by means of the stud 26 and groove 27, holds the cover onto the shaft. The bore 30 in the end of shaft 10 is internally threaded for connexion to a rotary drive for operation and the shaft is provided with flats 31 to assist this connexion.

Spray drying of a sugar solution. A/S Niro Atomizer, of Soborg, Denmark. **1,564,770.** October 25, 1977; April 16, 1980.

A vacuum evaporator 1 comprises a slowly rotating corrugated cylinder 2 with, below it, a rapidly spinning rotor 3 which splashes liquid onto the cylinder. Sugar solution, at a suitable concentration, is fed into one end of evaporator 1 through line 4 and splashed onto the surface of cylinder 2 which is internally heated with steam admitted through line 5, condensate being removed through line 6. Vapour from the sugar solution is exhausted through line 7 and may be used as a source of heat. Sugar crystallizes as a consequence of this evaporation and forms a suspension the concentration of which rises in the direction of flow towards the outlet line 8.



The suspension passes through line 8 to a spray dryer 9 which comprises a drying chamber in container 10 provided with a rotary atomizer wheel 11. Filtered and heated drying gas is supplied to the spray chamber by way of line 12 and converts the sugar suspension to a consistency resembling wet snow. This is removed through outlet 13 while the spent air leaves the dryer 9 through outlet 14 and enters cyclone 15 where entrained sugar is separated and discharged through outlet 16 and the air exhausted through line 17. The sugar suspension from outlet 13 is transferred by a worm or belt conveyor 18 into drum dryer 19 and conditioned by air at room temperature admitted through inlet 20 and discharged through outlet 21. After a residence time of 10-30 minutes the sugar discharged through line 22 is almost completely dry and the final traces of moisture are removed by passage through a "vibro-fluidizer" 23 having two zones fed with heated and unheated air, the final sugar being discharged through line 24.

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).

International Sweetener and Alcohol legislation conference

The Conference on International Policy and Legislation on Sweeteners and Alcohol sponsored by *World Sugar Journal* and Paine Webber Jackson & Curtis Inc. was held at the Sheraton Bal Harbour hotel in Florida during October 15-17. Some 200 participated, gathering during Ocober 14 and being entertained to a reception by the sponsors that evening.

Mr. William P. Cleaver, Consultant to Golodetz & Co. Inc. of New York, was Chairman and welcomed participants on the following morning. He introduced Sir Ernest Jones-Parry, retired Executive Director of the International Sugar Organization, who provided the keynote speech, describing the history of the various agreements to try to regulate the world sugar market since 1861 and discussing the success of post-war ISA's with special mention of the importance of recent developments in the USA and the EEC and the importance of the North-South Summit meetings to be held in Mexico later in October.

Mr. Jose Lago, Assistant Secretary for Marketing and Statistics of GEPLACEA, then spoke on the importance of sugar to developing nations as a provider of employment, food and foreign exchange. He referred to the formation of GEPLACEA in November 1974, its current composition (21 members and one observer, the Philippines), and discussed its objectives and the services it provides for members in respect of information, direct aid, training facilities, etc.

Mr. Magne Osteras, Counsellor to the Agriculture Division of the General Agreement on Tariffs and Trade, described the conciliation of disputes between members and gave a detailed account of the current status of that between Australia and Brazil on the one hand and the EEC on the other concerning export subsidies and the rapid rise in the EEC's share of world sugar exports.

UNCTAD's role in commodity agreements in general and the ISA in particular were discussed by Mr. L. Hulugalle, Chief of the Agricultural Commodities Branch of UNCTAD. He referred to the proposed setting-up of two funds, one for a contribution (not necessarily 100%) to the cost of stocking and the other for the development of commodity utilization. He stressed the importance of a continuing, effective ISA which would need the inclusion of the EEC, provided with a realistic quota, and indicated the need to reduce protectionism in various importing countries. UNCTAD considers that the stocks provisions in the 1977 ISA are inadequate, being much less than those established under other international commodity agreements, i.e. for cocoa, rubber, tin, etc.

Mr. Fred Carlson of Merrill Lynch presented a market analyst's view of legislation on sweeteners in the USA. Congress has yet to agree a sugar loan support program but the higher it was set, the greater would be the penetration of the sweetener market by HFCS; this would harm domestic producers, with reduction of beet sugar manufacture. Even with a support price of 18 cents/lb this would only provide a stay of execution for the beet sugar industry where the cost of manufacture averages 24.3 cents. That for raw cane sugar averages 25 cents but processing costs 17 cents in Louisiana as against some 9 cents in Florida, so that Mr. Carlson foresaw a greater decline in the former. With a support price of 16 cents he expected a loss of 500,000 tonnes in annual US production but this would not affect the world market appreciably. He attacked EEC sugar policy as irresponsible and more likely than anything the US might do to result in unrest in Latin America.

Mr. Simon Harris of S & W Berisford Ltd. spoke on legislation and the world sugar market, with special attention to the EEC sugar policy. His paper was based on a study for the FAO and was in the form of a comparison of support measures. That of the EEC was very much the greatest, being twice that of Japan which was itself greater than that of the USA and this greater than that of Canada. Partial rebuttal of criticism of EEC sugar policy was provided by Mr. Henri Cayre, President of the Joint Working Party on Sugar in Brussels and Director-General of the French Confederation of Beet Growers. He presented a review of the history of EEC sugar policy development and its internal effects. He declared that EEC countries did not believe that export quotas were adequate and that control should be provided at the production stage, that a new agreement was necessary and that it should take into consideration the production of both corn sweeteners and alcohol.

The final paper of the day was by Mr. Lucien Renier of Jean Lion & Cie. S.A., who gave an amusing account of the difficulties of trading white sugar under the rules of the EEC.

On the following morning, the impact of US legislation on the sweetener industry was discussed by Mr. William A. Cromarty, of Connell Rice & Sugar Co., while Ms. Rollinde Prager, Adviser to the US Trade Representative in the Executive Office of the President, discussed US and EEC sugar legislation and the ISA. Policy and legislation for production of sugar and alcohol in Brazil were described by Mr. Omar Montalegre of the Brazilian Institute of Sugar and Alcohol.

At luncheon, Mr. Kika de la Garza, Chairman of the Agriculture Committee of the House of Representatives (which had the day before adopted an amendment to the Farm Bill eliminating sugar price support measures) spoke of the need for the USA to protect its domestic sugar industry in which 100,000 people are employed.

The remainder of the day was free but the conference resumed on the following morning, when completely opposed views on the international effects of domestic legislation on sweeteners were presented by Mr. David Carter, President of the US Beet Sugar Association, who argued for a domestic program to ensure survival of the beet sugar industry, and by Mr. Nicholas Kominus, President of the US Cane Refiners Association, who argued that, with a shrinking sweetener market, into which HFCS was making large inroads, it was unwise to support domestic production so that offshore suppliers, many of them developing countries, would bear the brunt of the reduced market for raw sugar, damaging their economies with consequent political danger, and reducing their ability to buy goods from the USA.

This was echoed by Mr. Nicholas Rivero, Commodity Group Chief for the Organization of American States, who discussed regulation of sugar exports and free competition, the latter existing for only a small proportion of world sugar trade.

The need for an International Sugar Agreement in stabilizing the world sugar market was discussed by Mr. William K. Miller, Executive Director of the ISO; he reviewed the achievements of the present Agreement, pointing out that its effect had been to moderate excesses rather than maintain control. He compared the effects of 1980 and 1974 and concluded that, in real terms, there had been benefit even if the Agreement had

been inadequate. If the ISA were to be extended for two years, as is provided for, a number of aspects could be improved by action of the Council without the need for parliamentary ratification by members, including setting of realistic BET's for 1983 and 1984 and accession of non-members, such as the EEC, and measures to improve confidence in special stocks. A new Agreement would leave the field free for any new ideas but time is limited for their introduction. The main requirements would be more complete membership, including the EEC and non-member importers, and more effective price control by stocks and quotas, with trigger points further apart. Mr. Miller did not believe inclusion of HFCS in a new ISA was practical, but it and also alcohol manufacture should be borne in mind.

Mr. Michael Attfield of Tate & Lyle Ltd. considered that the overturn of an ISA by the market was not a calamity but an indication of a need for change to take account of new conditions. These currently include the trend to replacement of single cargo imports by larger purchases, often by governments, and the increased importance of whites relative to raws. The hedging capability of the Paris market is, in his opinion, inadequate and results in a greater premium/discount risk over raws than that of change in price. The increase in HFCS usage in the USA, Canada and Japan was less of a trend than a violent change and it would be preferable if there were some means of bringing its production under legislative control as with beet and cane sugar.

The final paper of the conference was given by Mr. Nixar G. Osman, Editor of *World Sugar Journal*, who spoke on an ideal International Sugar Agreement. He considered that production quotas rather than export quotas were desirable but were not acceptable at the moment. Adequate special stocks should be a part of an ideal agreement and he proposed the establishment of intervention stocks to be purchased at the minimum of the ISA price range when the market price went below. These stocks would be released when the price rose above the ISA minimum (or even maximum, when a shortage was indicated). Such a stock could be self-financing, although an initial fund might be needed to establish them.

With this the conference ended and participants returned home. It is believed that a printed *Proceedings* of the conference will be available by the end of the year and may be ordered through our Book Dept. at a price of $100 or £55.

Second Inter-American Sugar Cane Seminar, 1981. — The Second Inter-American Sugar Cane Seminar, on insect and rodent pests of sugar cane, was held during October 6-8, 1981 at Florida International University, Miami, with more than 200 participants from 21 different countries of the Western Hemisphere, including the three US Mainland cane areas. President of the Seminar was Mr. Diego R. Suárez, also President of Inter-American Transport Equipment Company, co-sponsor with the City of Miami of the event. Chairman of the Organizing Committee was Dr. Alfonso L. Fors. The Technical Sessions featured sucessive discussions on specific pests by panels of experts under a Moderator, and included the sugar cane froghopper (*Aeneolamia* spp.), the West Indian cane fly (*Saccharosydne saccharivora*), white grubs of sugar cane (*Phyllophaga* spp. and other genera and species), the Dominican leaf worm (*Calisto pulchella*), the sugar. cane root stalk borer weevil (*Diaprepes abbreviatus*), the giant cane borer (*Castnia licoides*), stalk borers in general, sugar cane nematodes, the rice borer (*Acigona loftini*), rodents, and the sugar cane insects of Guatemala. Abundant discussion took place after presentation of the papers which were in either Spanish or English, with simultaneous translation facilities provided. During the Closing Act, a special Plaque of Recognition was given to Mr. Ralph Mathes, retired entomologist from the US Department of Agriculture, who for more than 30 years was actively involved in the study of insects specifically associated with sugar cane. On October 9 the visitors were taken for a Field Tour around the Lake Okeechobee area, stopping at the USDA Sugarcane Field Station in Canal Point where the different activities were explained by staff members. Visitors also had the opportunity to see the damage caused to millable cane in fields where there was some infestation by the white grub, *Ligyrus subtropicus*. They then visited the A.R.E.C. at Belle Glade, an Educational and Research Centre of the University of Florida, where they were welcomed by the Director who briefly explained the activities of the Centre. Information on the 1981 and future Seminars may be obtained from Dr. A. L. Fors. c/o Inter-American Transport Equipment Company, 3690 N.W. 62nd Street, Miami, FL 33147, U. S. A.

Verenigde HVA Maatschappijen N.V. report, 1980. — The Group is concentrating on agro-industrial projects, where its expertise lies, and has engaged in remunerative consultancy work, especially in the sugar industry. It is active in Bangladesh, the Congo, Ivory Coast and Madagascar, as well as Tanzania and the Sudan. Contracting work has not been so satisfactory and resulted in a loss; the profits from the Zuenoula project in the Ivory Coast were smaller than anticipated, and the costs of studies, preparation and acquisition in respect of new contracts have had to be borne while income will not be forthcoming until the contracts are completed. No recompense has yet been received for the former subsidiaries in Ethiopia and, while the three estates continue to show handsome production figures, no dividend has been received on the minority shareholding remaining to HVA.

Sugar Industry Technologists Inc. — A preliminary notice has been issued on the 41st Annual Meeting of SIT which will take place in Atlanta, Georgia. Details of the technical program scheduled for Monday and Tuesday May 3-4 will be announced later but members will see a large beverage syrup manufacturing plant and a new technical centre and pilot engineering plant on May 5-6. The meeting will be centred at the Omni Hotel in Atlanta, and information and a reservation card may be obtained from Mr. George W. Muller, Jr., Executive Director, Sugar Industry Technologists Inc., P.O. Box DD, Oak Harbor, WA 98277, USA.

Sugar Research Institute Annual Review, 1980-1981. In addition to providing information on the member mills, Board of Directors, history and staff of the Institute, a summary is presented on the work carried out on sugar technology projects to aid the Australian sugar industry. These include studies on microprocessor control of a cane milling tandem, mass losses of sugar and water from cane during fires, locomotive gearbox design and drawgear evaluation, development of computer simulation models for assessment of the effects of changes in evaporator stations, fly-ash separation in a small SRI clarifier, examination at individual mills of the amount and nature of dirt in cane, automation of cane transport scheduling, investigation of battery electric locomotives for cane haulage, factory trials with a 250 tonnes.hr^{-1} bagasse diffuser, studies of track train dynamics and rolling stock maintenance, measurement of sugar reflectance, design of continuous low-grade boiling pans, grain establishment and antifoam evaluation in batch pans, construction of computer models for process stages in sugar manufacture, comparison of juice heating methods, assessment of spheroidal graphite cast iron mill roller shells, pelleting of bagasse, minimizing of boiler tube erosion, and monitoring of mill tailbar torque.

Süddeutsche Zucker-AG 1980/81 report. — Südzucker achieved the targets it had set itself for the business year 1980/81. Sales increased by almost 12% to DM 1300 million. Weather conditions at the beginning of sowing were at first favourable but were later adversely affected by frost, snow, and a long period of rain. A total of 103,000 hectares was sown (102,500 ha in 1979/80) and, after a cool and wet summer, the sugar content was only 16.68% (17.69%), reducing sugar yield to 7.2 (8.1) tonnes.ha^{-1}. An unusually early frost began on November 1 and two changes from warm weather to frost made it difficult to avoid losses during the last stages of the campaign. The average slice of the seven factories increased to 62,100 tonnes (61,700) and in a campaign of 84 days (87 in 1979/80), 744,000 tonnes (827,000 tonnes) of sugar was produced from 5,150,000 (5,360,000) tonnes of beets. Capital expenditure increased to DM 87 million (DM 64 million), with emphasis on equipment for the saving of energy and environmental protection. The beet area for 1981 was increased to 116,800 ha, i.e. by some 13%.

BREVITIES

CSR Ltd. 1981 report. — The profit of the Sugar Division after tax in 1980/81 was 80% higher than the previous year, mainly owing to higher earnings from sugar milling because of higher export prices and increased production in the 1980 season. The seven CSR sugar factories crushed 6.2 million tonnes of cane (5.6 million tonnes in the 1979 season) to produce 845,500 tonnes of raw sugar (770,300 tonnes). Capital expenditure was $A 9.6 million ($10.0 million in 1979/80) and a new boiler at Kalamia was commissioned as the last major item in a $A 127-million five-year program to upgrade the factories. Crushing capacity is now being increased further in preparation for the larger cane supply to come from the additional cane area authorized by the Central Cane Prices Board. Refined sugar sales were 697,000 tonnes, 4000 tonnes less than in 1979/80, while 23,000 tonnes were exported. Sales by the New Zealand Sugar Co. Ltd., a CSR subsidiary, were 148,000 tonnes, 18,000 tonnes below the previous year when sales were inflated by speculative purchases in anticipation of imminent price rises. During 1980 long term contracts were signed with China, South Korea, Malaysia, Singapore and New Zealand, covering the supply of about 1 million tonnes a year and extending between 3 and 5 years.

New Pakistan sugar factory. — The Shah Murad Sugar Mills Ltd. factory at Jhok Shareef in the Thatta district of Sind Province is the 35th unit in the country and went into trial production on October 6, 1981. The factory, which is in the private sector, has an installed capacity of 2000 tonnes of cane per day and, over a normal 150-day season, is expected to produce 25,000 tonnes of direct consumption white sugar. Cane is prepared by knives and a shredder and crushed in a tandem of 5-roller Goninan mills of 34 x 66 in roller dimensions.

Taiwan sugar production, 1980/81[1]. — Sugar production in Taiwan during the 1980/81 season, which ended on June 30, totalled 727,000 tonnes, tel quel, some 100,000 tonnes less than was produced the year before. The decline was primarily due to lower cane plantings because of low domestic sugar prices as well as to severe damage to plantations caused by typhoons in 1980. The Taiwan Sugar Corporation owns half of the 100,000 hectares of cane land while the remainder belongs to private farmers who can switch to more profitable crops if they choose and so affect the total crop and sugar output. Of the 1980/81 production, 291,000 tonnes of sugar will be for export and the rest for domestic consumption.

Turn-key distillery for Paraguay. — The Stroessner distillery, supplied to the Government of Paraguay by the Dedini Group of Brazil, is believed to be the first international contract for a turn-key autonomous distillery. The facility has a production capacity of 120,000 litres per day and includes cane reception, milling plant, process equipment and steam and power generation plant by M. Dedini S.A. Metalúrgica, and pre-treatment, fermentation, distillation and storage equipment from Codistil.

International Colloquium on World Sweetener Policy. — The Sugar Users Group, an organization of trade associations representing industries which are major consumers of sugar and sweeteners, is to hold its second colloquium to discuss a wide range of issues related to the use and availability and cost of sweeteners and US sweetener policy. A similar meeting took place in Phoenix, Arizona, in February 1981 and the second will be held at Innisbrook, Tarpon Springs, Florida during February 7-10, 1982. More details are available from the Group at 910 Seventeenth Street N.W., Washington, DC 20006, USA.

Mali sugar project[2]. — A loan agreement covering 500 million Mali francs ($1,250,000) has recently been signed for the financing of a study of a sugar project at Bankouma in the Bamako area of Mali for an annual production of 30/50,000 tonnes.

Mexico sugar production and outlook[3]. — Mainly because of heavy rains, sugar production in Mexico in 1980/81 did not exceed 2,371,000 tonnes, tel quel, 231,000 tonnes less than was produced in 1979/80. The rains since March have, however, improved prospects for the 1981/82 crop, and the cane crop is unofficially estimated at 34-35 million tonnes and sugar production at 2.9 million tonnes, tel quel. Increased production would reduce the country's import needs which in 1980/81 are officially estimated at between 350,000 and 500,000 tonnes, while private estimates are in the neighbourhood of 600,000 tonnes.

Mauritius drought damage to the cane crop[4]. — Harvesting of the 1981 cane crop started on June 10, and all the island's factories were in operation by the end of July. A severe drought prevailed during the growing season and parts of the island were seriously affected. Data in respect of field and factory results from all over Mauritius now indicate that the crop will not exceed 600,000 tonnes, tel quel, or 637,000 tonnes, raw value. Although considerably below the normal crop level of more than 700,000 tonnes, raw value, the 1981 forecast is very much better than the disastrous crop of 1980 which produced only 504,214 tonnes, raw value.

Czech sugar factories for Burma[5]. — Czechoslovakia has sold two sugar factories to Burma with daily cane crushing capacities of 3000 and 1500 tonnes, in a deal worth $16 million.

Tongaat Sugar Ltd. Report, 1981. — The 1980/81 season was one of the worst affected by drought and the factory crushed 1,246,006 tons against 1,911,460 tons in 1979/80. Overall recovery was also reduced to 86.10% compared with 87.02% in the previous year; in the circumstances, this is considered satisfactory, however. A very disturbing feature of the crop was the significant increase in Eldana borer damage, and all attempts by the Mount Edgecombe Experiment Station to find control methods have so far proved disappointing. The sugar belt received little rain during the critical growth period from end-February to mid-May and subsequent good rains will do little to make up the lost growth.

Venezuela crop damage[6]. — Torrential rains have severely damaged the cane crop in Venezuela and the sugar production estimate for 1980/81 has been revised downward by 17% to 250,000 tonnes, raw value. Imports of at least 430,000 tonnes will be needed to meet domestic requirements of 700,000 tonnes; this compares with imports of 332,815 tonnes in 1980 and 293,091 tonnes in 1979. Sugar production in 1979/80 was 376,522 tonnes, while consumption was 691,380 tonnes.

Mozambique bulk terminal improvement program[7]. — The Zimbabwe and Swaziland sugar industries are to cooperate in financing a $1.5 million improvement program for the bulk sugar terminal at the port of Maputo in Mozambique. This follows a mechanical breakdown at the terminal earlier this year which resulted in Zimbabwe's export shipments being delayed. The Zimbabwe industry's most serious problem is the railways' difficulty in moving exports to Maputo, however; only 60% of the current season's production has been moved by rail and 150,000 tonnes are stockpiled.

Pakistan sugar statistics[8]. — Against a rising consumption of sugar from an estimated 750,000 tonnes, raw value, in 1978 to 782,000 tonnes in 1979 and 805,000 tonnes in 1980, production fell from an estimated 700,000 tonnes in 1978 to only 609,000 tonnes in 1979 and recovered to 685,571 tonnes in 1980. As a consequence, imports which were only 630 tonnes in 1978 rose to 35,704 tonnes in 1979 and 164,375 tonnes in 1980.

PERSONAL NOTES

As a consequence of recent poor health, **Dr. Harry Evans** has resigned from our Panel of Referees as from the end of 1981. We wish to express our grateful thanks to Dr. Evans for his outstanding contribution during the past eight years to maintaining the high editorial standards of this Journal, and the hope that he may soon be restored to full health.

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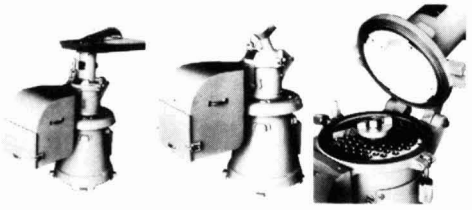
[1] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 480.
[2] *Westway Newsletter*, 1981, (93), 8.
[3] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 497.
[4] *Mauritius Sugar News Bulletin*, July 1981.
[5] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 518.
[6] *Bank of London & S. America Rev.*, 1981, **15**, 164.
[7] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 539-540.
[8] *I.S.O. Stat. Bull.*, 1981, **40**, (7), 69.

No cane testing laboratory is complete without one or both of these JEFFCO MACHINES

Cutter-Grinder

This is used to reduce cane samples into a fine condition to facilitate determination of fibre content, etc. The cut cane is retained in a receiving bin which is sealed to minimise windage and resultant moisture loss. The juice is evenly spread throughout the product.



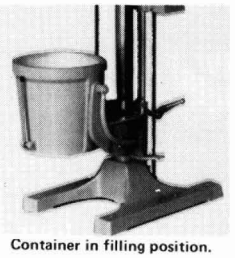
Above left: **Model 268B** will cut prepared cane or that which has come from a pre-breaker. It will also take full stalks including the tops and roots. The opening through which the cane is fed is 152mm. Power by 7.5kw motor.

Above centre: **Model 268BM** is identical to the Model 268B except that it has two smaller inlet funnels and will only handle stalks. Inlet diameter 55mm. It is fast in operation. It has a water inlet on top so that the machine can be flushed out at the end of tests while still running. This shows machine with receiving bin.

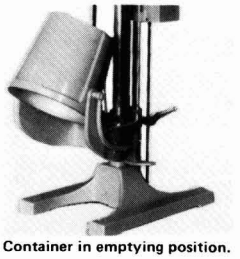
Above right: Illustration of internal cutting arrangement. The cutters which are mounted on a vertical spindle perform a scissors action with the four hardened inserts in the head of the machine. Screen plates with holes of various sizes are available.
DIMENSIONS - with receiving bin.
Unpacked-155 x 115 x 74cm Packed-150 x 126 x 92cm
Cubic - 1.74m3 Weight Packed - 547kg

Wet Disintegrator

Machine in operating position.



Container in filling position.



Container in emptying position.

Above: **The Jeffco Wet Disintegrator Model 292** processes a measured quantity of cane and water resulting in the removal of sugar juice from fibre. It operates by a 2.2kw motor and is available in model numbers 291 - 9 litre and 292 - 14 litre capacity containers incorporating a water jacket for temperature control. Container tilts for easy emptying. Built in timer stops machine automatically at preselected time.
DIMENSIONS
Unpacked-165 x 89 x 56cm Packed-173 x 104 x 57cm
Cubic - 1.02m3 Weight Packed - 337kg

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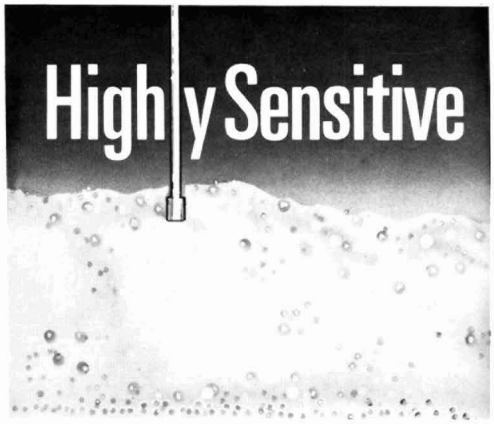

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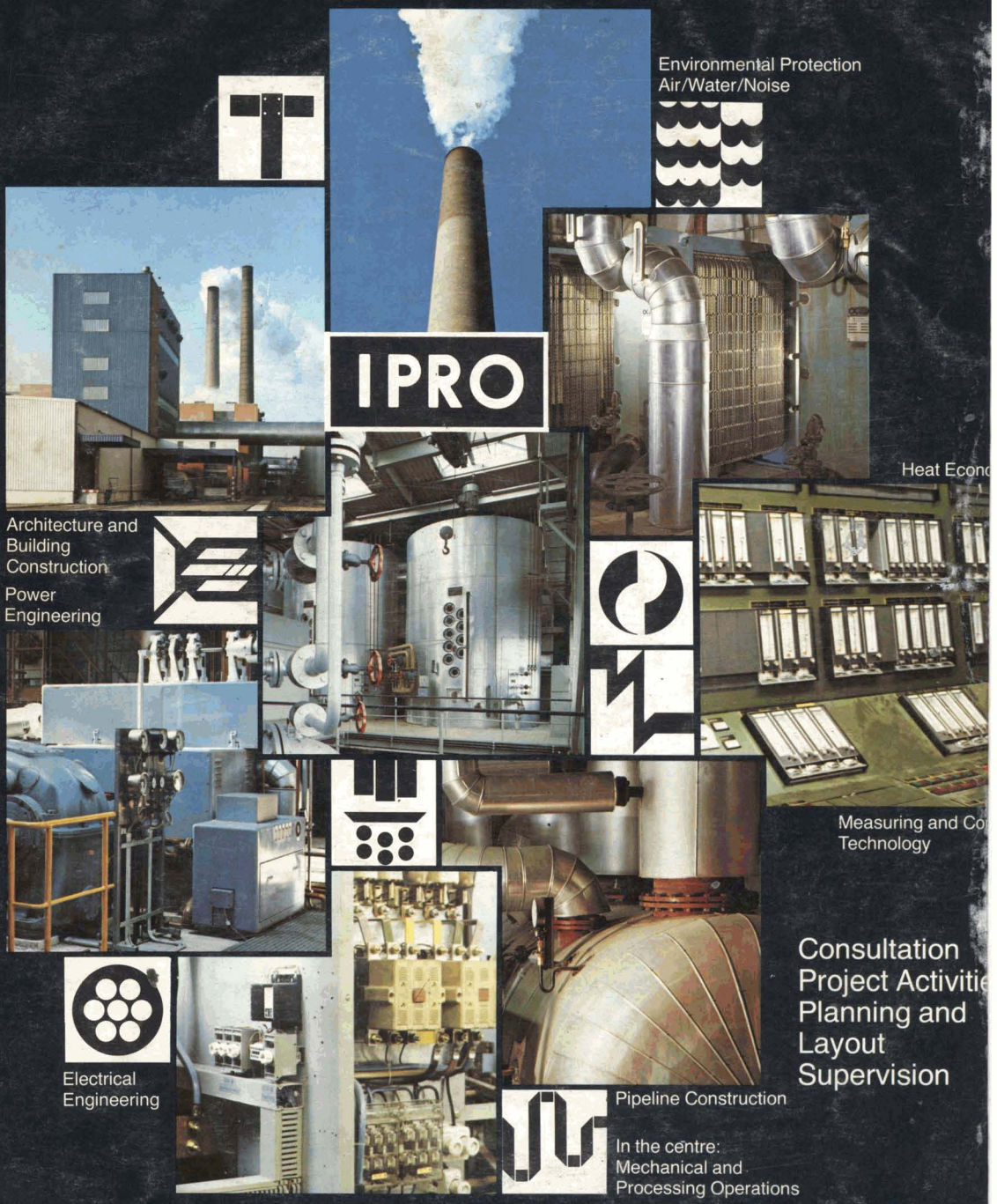

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