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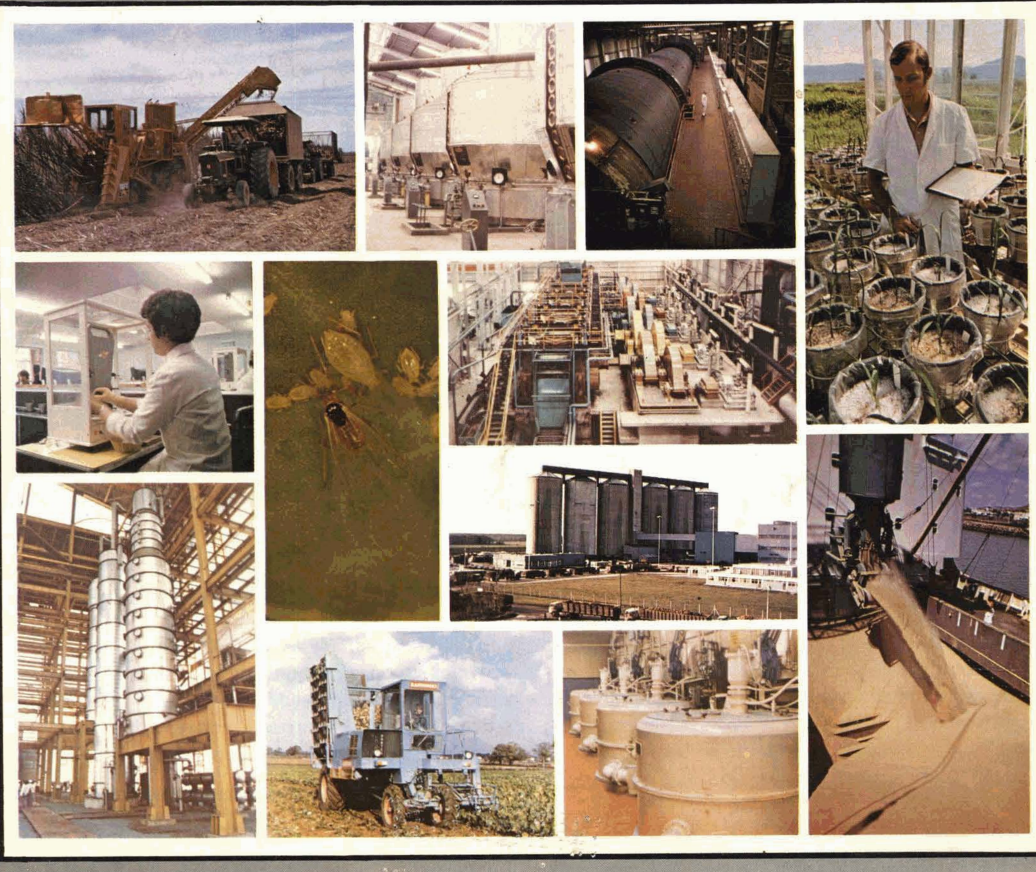

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INTERNATIONAL SUGAR JOURNAL

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# CONTENTS December 1980

# NOTES AND COMMENTS

### Prospects for sugar consumption

Both F. O. Licht GmbH and C. Czarnikow Ltd. have recently published articles concerning the future of sugar consumption in the face of recent developments. Licht's article[1] is based on a historical study and an assessment of the effects of the factors producing differences in consumption growth in individual countries, i.e. differences in population and income growths and elasticities of income and price responses.

Analysis of more than 100 countries' historical and forecast data produces a trend figure for 1980/81 of 91.86 million tonnes for world consumption, rising to 94.04 million in 1981/82 and 100.77 million by 1984/85. However, higher world prices, coinciding with a world recession and increased availability of other kinds of sweeteners at competitive prices, could cause a temporary interruption of the long-term growth trend, and it is thus likely that 1980/81 consumption will not reach the trend level. The extent of the fall will largely depend on how the industrialized countries above all will be able to cope with the current recession. At present it is assumed that consumption will be between 90 and 91 million tonnes, not much different from that of 1979/80. If production in 1980/81 does not reach the projected 88-89 million tonnes, however, consumption could show a marked decline as surplus stocks additional to working requirements have been reduced to such an extent that another major production shortfall could not be covered.

C. Czarnikow Ltd. point out[2] that rationing, whether by coupon or price or indeed by non-availability, acts as a limiting factor on consumption and its effects can already be witnessed in some countries.

"Obviously if there should be a sustained increase in the price of our commodity it would bring a reduction in usage as customers either turn to alternatives or reduce their requirement of sweeteners altogether. This would be a direct result and one which could be readily anticipated and perhaps even quantified.

"There is another factor which could lead to a fall in consumption, however, and this could have a far more lasting effect than a short phase resulting from a temporary period of high prices. Many countries are currently suffering from a slow-down in the level of overall business activity. Already it is being referred to as a world recession and there are fears that it could lead to something approaching the slump of fifty years ago.

"Should there be a dramatic reduction in the level of trade, demand for our commodity would surely fall. It would be a case of lower incomes rather than higher prices affecting consumption.

"The most important factor in the economic health of the international trading community is the state of the economy in the USA. In an economic survey on the United States which has just been published the Organisation for Economic Co-operation and Development (OECD) anticipates that the current downward trend in activity will continue to the end of the year whereafter there may be some recovery. They go on to say, however, that there are considerable uncertainties both as to the magnitude and duration of both recession and recovery."

### World sugar prices

The London Daily price of raw sugar started the month of October at £380 per tonne and ended it at £390 but on three occasions during the month it reached or exceeded £400, attaining £405 on October 17, the highest level since January 1975. The LDP(W) or white sugar price started and finished the month at £378 per tonne but also exceeded £400 on two days, while on most days it was lower than the LDP, reflecting the easier availability of white sugar than raws.

The strength of the market was fuelled by numerous reports of purchases by the USSR, often undetailed and no doubt duplicated, as well as increasing awareness of statistical tightness and reports of poor results in India and in Cuba, as well as bad weather and likely crop losses in Poland and the USSR through delayed harvesting.

### Zimbabwe and the EEC

On November 4 Zimbabwe became the 60th signatory of the Lomé Convention under which the EEC grants special trade and aid concessions to developing countries in Africa, the Caribbean and Pacific areas (the ACP countries). It has been agreed that Zimbabwe can export 25,000 tonnes of sugar annually to the Community at a price comparable to that paid to the EEC's own beet sugar producers, this figure being the same as the quota given to Rhodesia under the old Commonwealth Sugar Agreement. Originally the French representative at the negotiations for Zimbabwe's accession had insisted that there should be a limit of 25,000 tonnes and no guaranteed price, but the guarantee was agreed when it was settled among the Nine that the total of ACP sugar imported would not rise above the current 1,300,000 tonnes per year. To achieve this while allowing the additional sugar from Zimbabwe, unused portions of 14 other ACP countries' quotas will be transferred to Zimbabwe or the sugar re-exported as food aid.

### USSR beet harvesting problems

The full extent of the difficulties confronting the USSR sugar crop this season have been revealed by the Soviet authorities[3]. The cold wet weather of the autumn led farmers to take a calculated risk and delay the start of harvesting until September 20, but rain slowed the lifting of the crop and in the Ukraine, which produces two-thirds of the total Soviet crop, only 59% had been gathered by mid-October. Appeals have been published in Soviet newspapers urging farmers to accelerate transport of beet from the fields to factories before it rotted, but of about 36,000 trucks earmarked to transport the beet almost one-third are unserviceable for one reason or another.

According to the Soviet press, sugar factories in the Russian Federation had processed 2.2 million tonnes less than planned, although shortfalls below targets are usual (in 1979, beet production was 19.6 million tonnes against a target of 33 million). Thus, by October 13, only 57% of the total Soviet crop had been harvested, against figures of 80% and 75% at the corresponding period of the two previous crops. This had risen to 75% by October 24, but the newspaper *Izvestiya* stated that

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1 *International Sugar Rpt.*, 1980, **112**, 535-538.
2 *Sugar Review*, 1980, (1508), 177.
3 *Public Ledger*, October 18, 1980.

the crops remaining in the soil faced imminent frost devastation[4]. Night frosts have been recorded as far south as Rostov in the Ukraine, and further frost and sleet storms were moving across the country. Beets harvested but not clamped or transported to the factories are, of course, at risk, and it would seem likely that the Soviet Union will have a poor crop for the second year in succession; indeed, the official organ *Pravda* has said that the harvest may well be one of the worst in years.

**EEC sugar export estimates for 1980/81[5]**

In a report to EEC Farm Ministers on agricultural markets, the Farm Commissioner, Finn-Olav Gundelach, said that EEC sugar production this campaign is expected to be around 11.7 million tonnes, white value, slightly below last campaign's figure but above the normal level. He said that the Commission expects 1980/81 exports to total around 3.7 million tonnes, of which 2.9 million tonnes would be sold under Community export arrangements, the rest being sold on the world market without subsidy.

As world sugar prices have risen sharply above EEC prices, the EEC Commission has paid no export refunds since May and it does not expect to do so for the rest of this year. This satisfactory situation, whereby the EEC is earning funds from its sugar exports rather than subsidizing them, will probably continue in the immediate future, but in due course world production will rise in response to high prices, as has always happened in the past, and world prices will then fall back.

**Indian sugar production 1980/81**

India is one of the few countries in the world where cane growers are able to decide whether to supply their product to centrifugal sugar factories or to factories making a lower grade product. Production of sugar in India therefore frequently reflects just as much government fiscal policies as applied to sugar and cane as it does weather conditions[6].

Currently there is a wide divergence of opinion over the possible output of sugar in the season which just started. There is no doubt as to the availability of adequate cane for a satisfactory level of sugar production and while government estimates of 6.0 million tonnes of white sugar may be regarded as somewhat optimistic, informed opinion is that 5.5 million tonnes could without doubt be made. However, the high prices which are being paid by the gur and khandsari manufacturers have managed to divert a considerable quantity of cane away from the sugar factories and there have been fears that no more than 4.5 million tonnes would be produced.

The Indian government announced in October that new sugar factories and those which will be starting up in the next three years will be allowed to sell their sugar at free market prices and this may eventually go some way towards boosting production. However, this new policy still clearly falls far short of the aspirations of the sugar producers.

The Indian Sugar Mills Association wants an end to the dual pricing system reintroduced last December under which 65% of production must be sold to the government at a statutory price of 2300 rupees per tonne (US $297.90) with the remainder sold on a free market but at a voluntarily agreed price of 4500 rupees ($582.90) per tonne. These price restrictions limit the amount that the mills can pay for their cane to 180 rupees per tonne ($23.30) whereas gur and jaggery manufacturers, not restricted by government controls, can charge up to 7000 rupees ($906.70) per tonne for their product and pay up to 450 rupees ($58.29) for cane; naturally they obtain as much cane as they wish and the mills go short, leading to insufficient centrifugal sugar production and, it is admitted, some profiteering on the free market sales.

At the start of the current season in October the Government raised the minimum price for cane to 130 rupees ($16.84) per tonne but the ISMA and Opposition politicians consider this too low and consider it should be 280-300 rupees ($36.27 – $38.86), which would, of course require a rise in the price of the sugar sold to the government. Some weeks later, as a measure to reduce diversion of cane from the factories, the government imposed an additional duty on gur which varies between 950 and 2450 rupees ($123.06 – $317.35) per tonne.

**World sugar production, 1980/81**

F. O. Licht have recently published[7] their first estimates of world sugar production for the year May 1980/April 1981 and the figures are reproduced elsewhere in this issue. Total sugar production is expected to reach 87,042,000 tonnes, raw value, against 84,319,000 tonnes in 1979/80 but this is only a half-recovery to the levels of the previous two years which were well over 90,000,000 tonnes. The increase is about 3% up on last year's figures, about double the growth in world population, and indicates a further drastic reduction in world stocks or in world consumption.

The figures for European beet sugar production are the same as Licht's most recent published estimates except that the Hungarian crop is now expected to be some 25,000 tonnes greater at 445,000 tonnes. Substantial increases are expected in Chile and China, while the figure for Iran is tentatively set 100,000 tonnes lower because of uncertainties as to the effects of the war with Iraq on those plants which are close to the border.

In the Western Hemisphere, cane sugar production is expected to fall substantially – by a million tonnes – in Cuba owing to the rust infection, while bigger crops in Argentina and Brazil are expected to more than counterbalance this. Poor weather has afflicted Mauritius and South Africa continues to suffer from drought, reducing crops in those countries, while the increase in Indian sugar production is not now expected to be as great as originally anticipated from the expanded cane area, although the situation could be changed by political decisions in that country.

**C.I.T.S. 17th General Assembly**

The 17th General Assembly of the Commission Internationale Technique de Sucrerie is to be held in Copenhagen, Denmark, during May 30 – June 3, 1983.

The Scientific Committee has selected the following priority themes: (1) Reduction of energy requirements in sugar processing, and (2) Crystallization. Papers on other subjects may also be presented.

In due course, members will be invited to submit research papers to be considered for presentation at the Assembly.

All additional information may be obtained from the General Secretary of the C.I.T.S., Dr. Robert Pieck, at the following address: Aandorenstraat 1, B-3300 Tienen, Belgium.

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4 *ibid.*, October 25, 1980.
5 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 611.
6 C. Czarnikow Ltd., *Sugar Review*, 1980, (1515), 210.
7 *International Sugar Rpt.*, 1980, **112**, 625-629.

# Biological treatment of waste water from a beet sugar processing plant

By A. KLAPWIJK, A.J.M. JANS* and H.J. BRONS
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### *Introduction*

The beet sugar factory of the Centrale Suiker Maatschappij (CSM) at Vierverlaten, Groningen, has a capacity of 8000 tonnes of beets per day. Waste water is produced at different points in the process and a survey of these waste water flows and the estimated concentration of pollutants is given in Table I.

**Table I. Estimated composition of waste water flows in Vierverlaten sugar factory**

| Origin | Daily flow $m^3$ | COD, $\mu g.cm^{-3}$ | $N_{Kj}$, $\mu g.cm^{-3}$ | Daily oxygen equivalent*, kg | pH | Temperature, °C | $Cl^-$, $mg.cm^{-3}$ |
|---|---|---|---|---|---|---|---|
| Fluming waste water⁺ | 500 | 1500 | 40 | 841 | 7.5 | 25 | 0 |
| Condensate | 1350 | 250 | 200 | 1571 | 9.3 | 55 | 0 |
| Juice ion exchange softener waste water | 650 | 800 | 200 | 1114 | 9.3 | 75 | 0 |
| Brine‡ | 100 | 1000 | 1000 | 557 | - | 75 | 60-80 |

* Oxygen equivalent = COD + 4.57 x Kjeldahl-N
⁺ Fluming waste water is that used for washing and transporting of beets and for cooling the vacuum pan condensers; it is heavily contaminated with clay. The concentrations given in the table are for conditions when no condensate or juice softener waste water are discharged into the flumes.
‡ Spent ion exchanger regenerant

The condensate and juice softener waste water are mostly discharged into the flumes and fluming waste water treated in an aeration lagoon. The quantity of COD and Kjeldahl N finally discharged may be decreased further by purification of the waste water in a biological treatment plant. Experiments were carried out to determine the optimal flow system for such treatment.

In 1978 the following three systems were examined (Fig. 1):

(1) Discharge of condensate and juice softener waste water into the flumes, followed by purification of fluming waste water in a batch activated sludge plant. The brine is discharged unpurified into surface water (the Wadden Sea).

(2) Purification of condensate, juice softener waste water in an activated sludge plant using
(a) a two-stage process in the first of which the condensate and juice softener waste water are purified and in the second stage the fluming waste water plus nitrate-containing effluent from the first stage are purified in a denitrifying sludge bed reactor[1], or
(b) a single-stage batch process which alternates aeration with activated sludge treatment; brine is discharged unpurified as in system(1).

(3) Purification of fluming waste water, together with condensate, juice softener waste water and brine in a batch activated sludge plant.

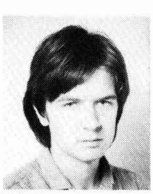
In addition to the experiments with these alternative systems, the nature of the fluming waste water was examined with regard to whether the organic matter present is biologically degradable.


A. Klapwijk


R. de Vletter


A.J.M. Jans


E. Wind


H.J. Brons


J. Baar

### *Nature of the fluming waste water*

During the transport and washing of beet, sugar is lost[2] at the rate of 0.1 – 0.3%. Converting this into COD on a basis of its dilution in 500 $m^3$ of water for a daily slice of 8000 tonnes of beet, gives a COD concentration of 20,000 – 60,000 $g.m^{-3}$. The greater part of this COD is oxidized in the aeration lagoon and, during the first month of the 1978 campaign, the mean COD concentration in the effluent from this lagoon was 1200 $g.m^{-3}$.

At the start of this study we thought that the COD in the fluming waste water was easily bio-degradable. To verify this hypothesis we examined the distribution of COD in different particle sizes and also the oxygen consumption of fluming waste water with and without activated sludge. The fluming waste water was filtered successively through folded filter paper (Schleicher & Schüll) and ultrafilters (Selection BA 85, 0.45 $\mu m$; Diaflo PM 10, >10,000 MW; and Diaflo UM 2, >1000 MW). After each filtration step a part of the filtrate was

* Present address: Grontmij NV, Postbus 153, Zeist, Holland.
[1] Klapwijk: *Thesis, Agricultural University, Wageningen*, 1978, 132 pp.
[2] de Vletter; *Voedingsmiddelentechnologie*, 1971, **2**, 32.

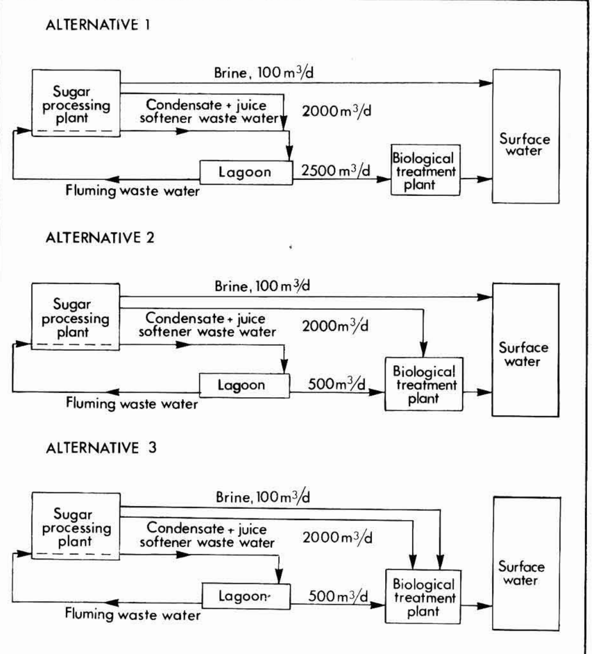



**Fig. 1. Flow alternatives for the treatment of waste water from a beet sugar processing plant**

analysed for COD and the results are summarized in Table II.

**Table II. Distribution of COD in fluming waste water by particle fraction**

| Fraction | COD, g.m$^{-3}$ | % |
|---|---|---|
| Unfiltered fluming waste water | 1640 | 100 |
| Folded paper filtrate | 1210 | 74 |
| Filtrate (<0.45 μm) | 390 | 24 |
| Filtrate (<10,000 MW) | 360 | 22 |
| Filtrate (<1000 MW) | 240 | 15 |

The concentration of the lower fatty acids ($C_1$ to $C_5$) in the filtrate was also analysed; converted to COD, their concentration was 30-45 μg.cm$^{-3}$. A small fraction (15%) of the organic compounds in the fluming waste water are of low molecular weight (<1000). The greatest part of the organic compounds (75%) comprises particles with the same diameter as micro-organisms or larger, which makes it questionable whether they would be easily bio-degradable.

Using a Sapromat apparatus, an attempt was made to obtain more information on the biological decomposition of the organic matter in the fluming waste water by analysing the oxygen consumption of (a) fluming waste water, (b) activated sludge without fluming waste water and (c) activated sludge with fluming waste water. The fluming waste water used in this experiment had a COD concentration of 1400 μg.cm$^{-3}$; after 5 days the oxygen consumption was about 350 μg.cm$^{-3}$ and after 12 days 650 μg.cm$^{-3}$. In the first 5 days only about 25% of the total oxygen demand was satisfied, which is an indication that the organic compounds in the fluming waste water are not easily bio-degradable.

After adding an easily degraded organic substrate to activated sludge we would expect to see an increase in the rate of oxygen consumption (Fig. 2). Comparing the oxygen consumption of activated sludge with and without fluming waste water (Fig. 3) it may be seen that addition of the latter does not markedly increase the rate of oxygen consumption. With and without the fluming waste water, the oxygen consumption is the same at first while, by the end of the experiment, total oxygen consumption of the activated sludge with the fluming waste water is about 400 μg.cm$^{-3}$ higher than without.

Fig. 4 shows the oxygen consumption of fluming waste water unpurified (a) and purified by two methods; in the first (b), the waste water was added to activated sludge, mixed for one minute, settled, and the purified supernatant separated. In the second (c), the fluming waste water was added to activated sludge, aerated for 4 hours, settled and the purified supernatant separated. The oxygen demand of waste water purified by the second method was higher than that of the first method; it thus appears that one minute of mixing gives as good purification as 4 hours aeration. Elimination of the COD is therefore at first caused by physicochemical processes; the dissolved organic compounds are adsorbed onto the sludge particles and then decomposed biologically.

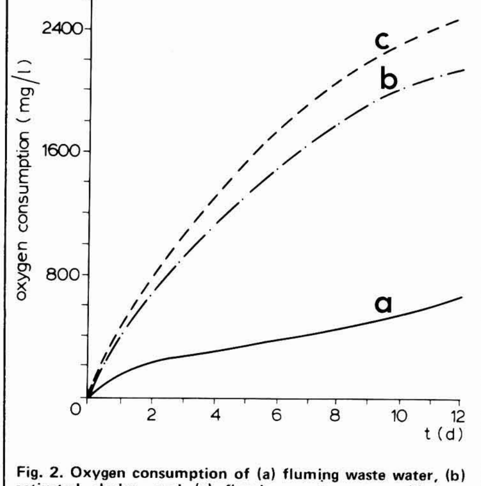



**Fig. 2. Oxygen consumption of (a) fluming waste water, (b) activated sludge, and (c) fluming waste water added to activated sludge. In the last case, after settling, 250 cm$^3$ of supernatant is replaced by 250 cm$^3$ of fluming waste water**

*Conclusion*

From the results of fluming waste water filtration and of the Sapromat experiments we consider that elimination of COD by activated sludge results from adsorption

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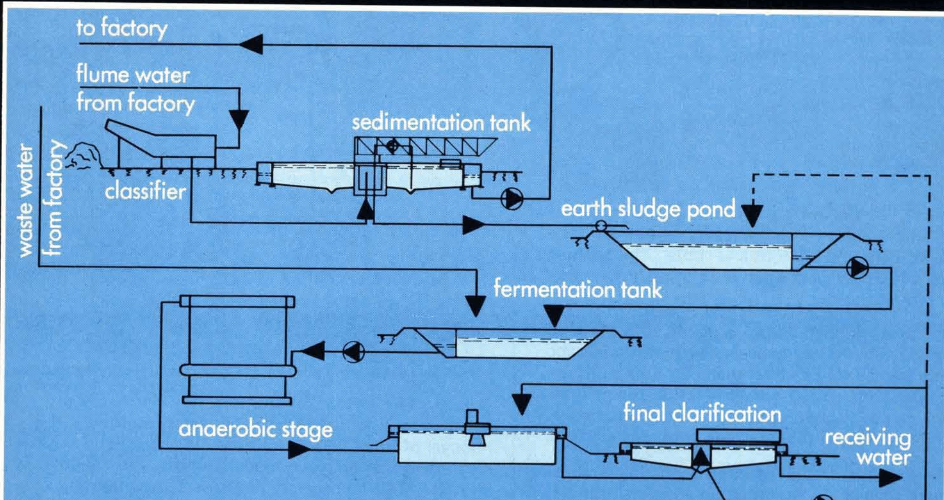


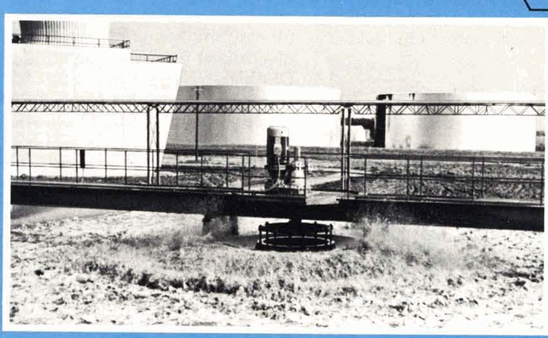

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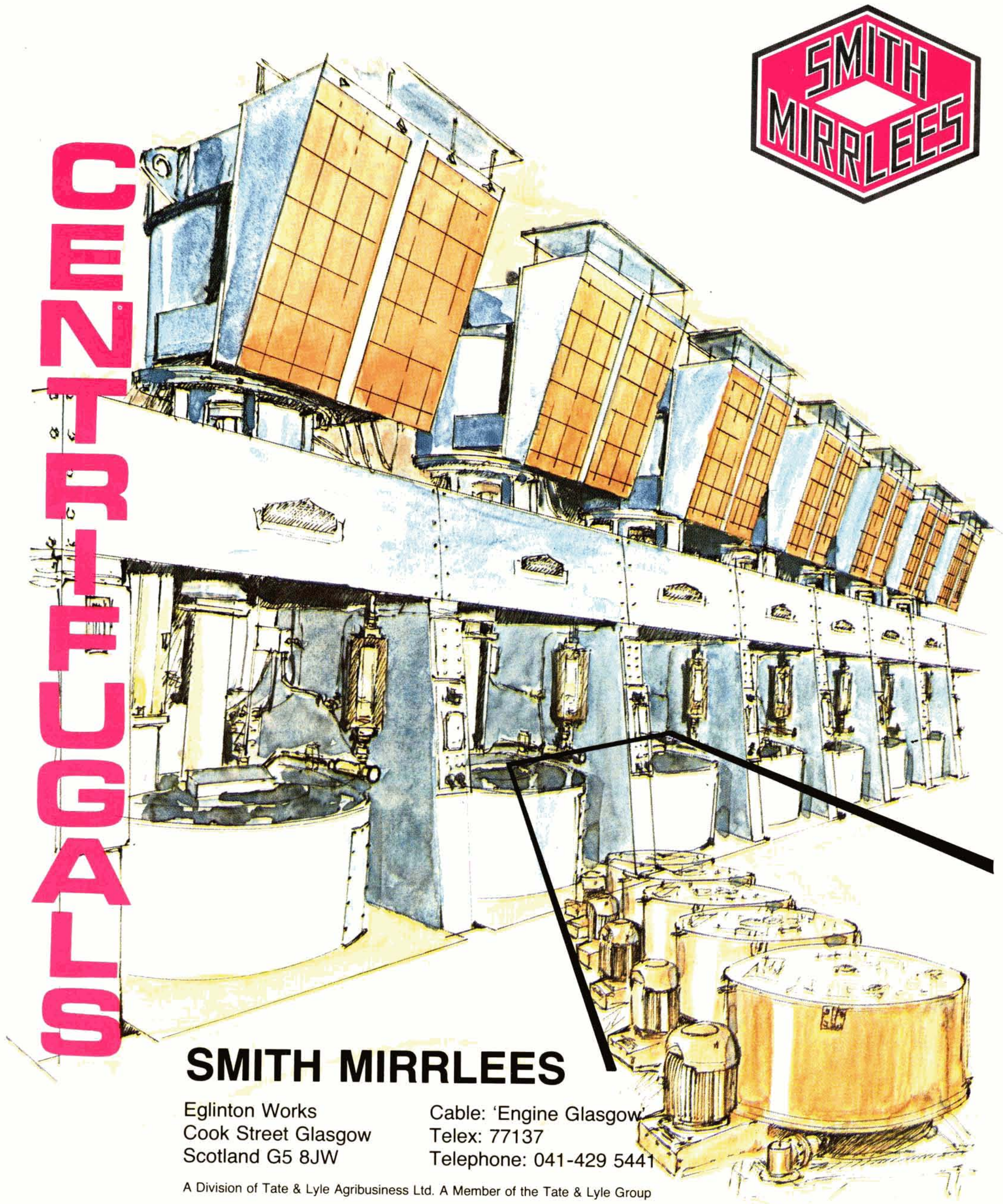
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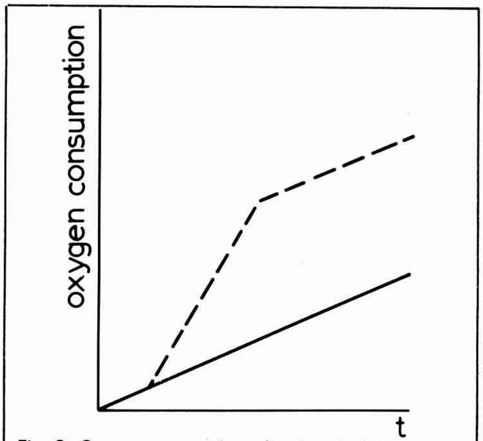


**Fig. 3. Oxygen consumption of activated sludge without substrate (solid line) and after adding substrate (broken line)**

of particles having a diameter of 0.45 μm or more onto the activated sludge flocs. The oxygen consumption curves indicate that the eliminated organic compounds do not serve immediately as substrate for the micro-organisms but, as the sludge ages, much of the eliminated compounds are biologically decomposed. Since a mixing time of one minute gives as much COD elimination as 4 hours of aeration a longer aeration time would not improve results.

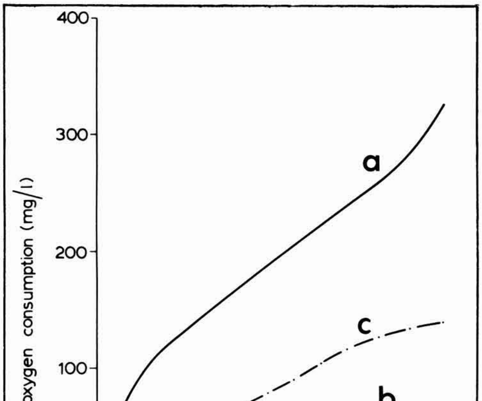


**Fig. 4. Oxygen consumption of (a) fluming waste water, and (c) supernatant from activated sludge mixed with fluming waste water and aerated for 4 hours**

## *BEET SUGAR FACTORY WASTE WATER TREATMENT IN A PILOT PLANT*

### *Introduction*

The following experiments were carried out at pilot plant level:

(1) treatment of fluming waste water in a batch activated sludge plant,
(2) treatment of fluming waste water in an upflow denitrifying sludge bed reactor,
(3) treatment of fluming waste water, condensate and juice softener waste water in a batch activated sludge plant, and
(4) treatment of fluming waste water, condensate, juice softener waste water and brine in a batch activated sludge plant.

The object of this study was to gather information on the ultimate discharge of COD and Kjeldahl-N with these different systems and to determine the stability of the purification process.

### *Materials and methods*

The batch activated sludge plant (Fig. 5) is a polyethylene barrel (height 2.0 m, diameter 1.3m) with an effective capacity of 2400 litres. A stirrer was installed to keep the activated sludge in suspension during periods without aeration. The following program was employed with the aid of a timer:

- feeding with waste, with stirring
- stirring (if required)
- stirring with aeration
- settling and effluent discharge.

The feeding of waste and discharge of effluent were regulated not only by the timer but also by a level controller. The maximum effluent discharge was 950 litres per cycle.

The upflow sludge bed reactor (Fig. 5) is a perspex column (height 3.5 m, diameter 0.3 m) with an effective volume of 275 litres. The active sludge in the reactor is stirred intermittently.

The activated sludge in most of the experiments originated from an activated sludge plant at Zuidhorn. Its sludge volume index was 100 $cm^3.g^{-1}$, the mass of non-volatile suspended solids 50-60% and the daily denitrification capacity 75 $mg.g^{-1}$ TS (TS = mass of total solids).

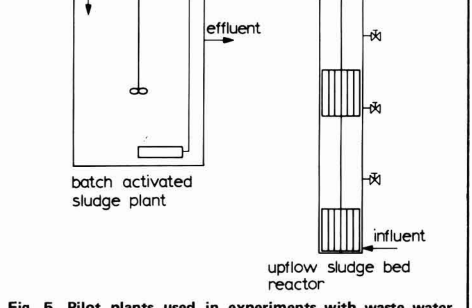


**Fig. 5. Pilot plants used in experiments with waste water from beet sugar processing plants**

## *Results*

*Batch aerobic activated sludge treatment.* – The experiments were carried out between September 11 and October 24, 1978. The results of the treatment at a daily COD sludge load of 0.24 ± 0.09 g COD per g organic solids and a daily N sludge load of 15.7 ± 5.1 mg N per g organic solids are presented in Table III.

**Table III. Results of treatment of fluming waste water in a batch activated sludge plant**

| | Influent, $\mu g.cm^{-3}$ | Effluent, $\mu g.cm^{-3}$ | Efficiency, % |
|---|---|---|---|
| COD | 1180 ± 478 | 347 ± 253 | 71 |
| Kjeldahl N | 65 ± 28 | 15.8 ± 10.6 | 70 |
| Nitrate N | - | 13.7 ± 9.3 | |
| Total N | 65 ± 28 | 29.5 ± 19.9 | 54 |

The treatment efficiency with respect to COD is not high and is of the same order as obtained by physicochemical treatment in earlier experiments[3]. The mean efficiency of removal of total N is high and also of the same order as that obtained by physicochemical treatment of this waste water. We believe that removal of N in our experiment was by physicochemical processes rather than by denitrification. It might be expected that, at a daily sludge load of 15.7 mg N per g of organic solids (OS), all the ammonia would be easily converted into nitrate by nitrifying organisms; however, we did not find a high nitrate concentration.

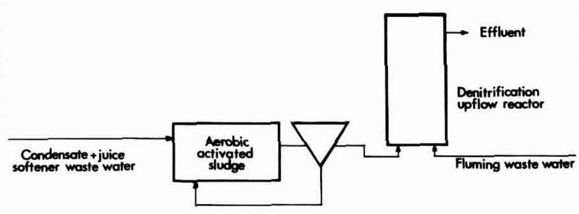


**Fig. 6. Flow diagram for alternative 2a**

Of course the nitrate may be denitrified but from the results with denitrification of fluming waste water above we conclude that the ammonia was not completely nitrified. We think that perhaps the ammonia forms a chelate bond with the organic compounds present and that this prevents nitrification.

The mean activated sludge concentration was 17 ± 4.3 mg $TS.cm^{-3}$ and the sludge volume index was excellent at 30 $cm^3.g^{-1}$. The high content of inorganic matter in the sludge is due to the very high clay content in the fluming waste water. This is a threat to the stability of the activated sludge process because the settler does not function well and the effluent becomes very turbid.

*Treatment in an upflow sludge bed reactor.* – In the purification system 2a (Fig. 6), the nitrate produced in the first stage of fluming waste water treatment is removed by denitrification in the second stage. Fluming waste water was purified by this system in a pilot plant between October 3 and November 16, 1978 and the results from treatment at a daily sludge load of 0.3 g $COD.g^{-1}$ OS and a surface load of 0.7 – 1.1 $m.hr^{-1}$ are summarized in Table IV.

**Table IV. Results of treatment of fluming waste water (25% by volume) together with treated condensate and juice softener waste water (75% by volume) in a denitrifying upflow sludge bed reactor**

| | Influent, $\mu g.cm^{-3}$ | Effluent, $\mu g.cm^{-3}$ | Efficiency, % |
|---|---|---|---|
| COD | 480 ± 160* | 220 ± 100 | 54 |
| Kjeldahl N | 33 ± 14 | 30 ± 26 | 9 |
| Nitrate N | 72 ± 28 | 65 ± 23 | 10 |
| NOE † | 205 ± 52 | 185 ± 65 | 10 |

* About 80 $\mu g.cm^{-3}$ COD is from the purified condensate and juice softener waste water

† NOE (nitrogen oxygen equivalent) is the nitrate removed, expressed in oxygen equivalents;

$$NOE = \frac{20}{7} \Delta \text{ nitrate N}.$$

*Treatment of fluming waste water, condensate and juice softener waste water in a batch activated sludge plant.* Fluming waste water, condensate and juice softener waste water were treated together in a batch activated sludge plant from November 1 to November 23, 1978. The denitrification process was stimulated by delays of 0.5, 1.0 and 1.5 hr after feeding before aeration commenced. Results of the experiments, using a daily sludge load of 0.24 g $COD.g^{-1}$ OS, are given in Tables V and VI.

The COD removal efficiency is very low and the NOE almost negligible. These results are consistent with the results of the treatment of fluming waste water with aerobic activated sludge and, in our opinion, the low NOE removal indicates that the COD elimination in the denitrifying upflow sludge reactor is also a result of a physicochemical process. The activated sludge in the upflow bed reactor was in excellent condition; its mean concentration was 27 ± 6 $mg.cm^{-3}$ TS at a surface load of 0.7 – 1.1 $m.hr^{-1}$ and the mean sludge volume index was 20 ± 9 $cm^3.g^{-1}$.

**Table V. Results of treatment of fluming waste water (30% by volume) and condensate and juice softener waste water (70% by volume) in a batch activated sludge plant**

| | Influent, $\mu g.cm^{-3}$ | Effluent, $\mu g.cm^{-3}$ | Efficiency, % |
|---|---|---|---|
| COD | 613 ± 227 | 125 ± 59 | 80 |
| Kjeldahl N | 120 ± 11 | 6.8 ± 3.8 | 94 |

In the experiment with fluming waste water alone, the effluent COD and N concentration were much higher than in this experiment. Thus, when condensate and juice softener waste water are treated together with fluming waste water the amount of COD and Kjeldahl nitrogen to be removed is much lower than when they

[3] Leentvaar *et al.*: *Tijdschrift van het BeCeWa*, 1978, **8**, 113.

**Table VI. N concentration in effluent for different periods of anaerobic treatment**

| Duration of anaerobic treatment, hr | Influent Kj-N, $\mu g.cm^{-3}$ | Effluent $NO_3^-$ - N, $\mu g.cm^{-3}$ | N removal, % | NOE† $\mu g.cm^{-3}$ |
|---|---|---|---|---|
| 0.5 | | 87 ± 8 | 22 | 57 |
| 1.0 | 120 ± 11 | 54 ± 12 | 49 | 151 |
| 1.5 | | 43 ± 17 | 59 | 183 |

† N Incorporated into biomass = 6$\mu g.cm^{-3}$ (estimate)

are sent to the flumes and the fluming waste water is treated in an activated sludge plant before discharge.

It has also been found that, as a result of the anaerobic period after feeding, nitrate is used in the denitrifying process for the elimination of COD (Table VI). In 1-1.5 hours the organic matter from the waste water available for denitrification is consumed and this results in the removal of about half the nitrogen. The plant operated with a sludge concentration of 10 $mg.cm^{-3}$TS, the concentration of non-volatile solids was 65% and the sludge volume index was about 40 $cm^3.g^{-1}$.

*Treatment of fluming waste water, condensate, juice softener waste water and brine in a batch activated sludge plant.* — About 480 kg per day of oxygen equivalents (= COD + 4.75 x Kjeldahl-N) or about 15% of the total oxygen equivalents to be discharged are in the brine. Work was done to see if the brine could be purified together with the other waste water in an activated sludge plant. This was done by examining the effect of a chloride concentration of about 3 $mg.cm^{-3}$ resulting from mixing brine and other waste water streams before purification.

The same batch reactor and activated sludge were used as in the preceding experiment and the tests took place between November 25 and December 22, 1978. Brine was mixed with the other waste water to give a chloride concentration of 2 $mg.cm^{-3}$ for the first week and 3 $mg.cm^{-3}$ thereafter. As a result of abrupt changes in the chloride concentration of the brine the concentration in the feed varied, sometimes reaching 6 $mg.cm^{-3}$. The daily COD load was 0.32 ± 0.15 g per g OS and the daily Kjeldahl N load was 77 ± 14 mg N per g OS. The mean chloride concentration was 2.55 ± 1.4 $mg.cm^{-3}$. The results are summarized in Table VII.

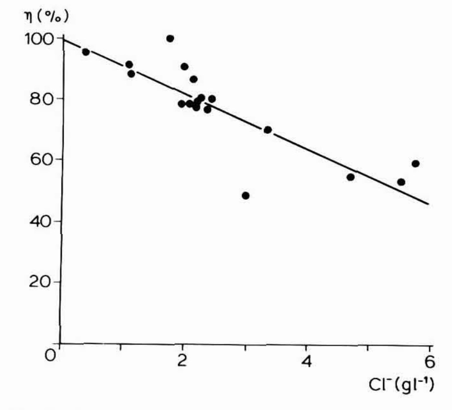


**Fig. 7. Relationship between % Kjeldahl-N removal and influent chloride concentration**

**Table VII. Results of treatment of fluming waste water, condensate, juice softener waste water together with brine in a batch activated sludge plant**

| | Influent, $\mu g.cm^{-3}$ | Effluent, $\mu g.cm^{-3}$ | Efficiency, % |
|---|---|---|---|
| COD | 805 ± 355 | 365 ± 225 | 56 ± 23 |
| Kjeldahl N | 150 ± 28 | 34 ± 22 | 77 ± 14 |
| Ammonia N | - | 26 ± 27 | |
| Nitrite N | - | 44 ± 21 | |
| Nitrate N | - | 37 ± 17 | |
| Total N | 150 | 141 | 6 |

By comparison with the treatment of fluming waste water, condensate and juice softener waste water in combination, the COD removal is very low and that of Kjeldahl N even lower. The high nitrite concentration is particularly striking. Thus the chloride must have had a deleterious effect on the purification of the waste water, especially since nitrification was not even complete. Even though the brine contains only about 480 kg/day oxygen equivalents, with brine in the feed to the purification plant the effluent contains about 1000 kg/day more than when the brine is not added. The relationship between Kjeldahl N removal and chloride concentration is shown in Fig. 7.

An increase in chloride concentration results in an increase of Kjeldahl N in the effluent. The addition of brine not only affects the chloride concentration but also the concentrations of $Na^+$ and $Ca^{++}$, and an increase in their concentrations may change the distribution of cations in the sludge floc and drive out ammonia.

### *Final conclusions*

In this study four alternative process waste water purification schemes were examined, viz. those described as schemes (1), (2a), (2b) and (3) at the beginning of this paper. It was found that the organic compounds in the fluming waste water did not lend themselves to denitrification so that scheme (2a) is not attractive. To choose between the other three alternatives it is necessary to calculate how much COD and Kjeldahl N is discharged in each case and to look at the stability of each purification scheme.

With regard to the first, the discharge of oxygen equivalents for the three schemes have been calculated on a basis of 2500 $m^3$ of waste water and 100 $m^3$ of brine per day (Table VIII). The total discharge of oxygen equivalents in the absence of treatment has been calculated for 1978 and is not the same as in Table I. In the case of schemes (2b) and (3) the Kjeldahl N concentration in the fluming waste water has been corrected since the conditions of our study did not correspond to the proposal that the condensate and juice softener waste water are not discharged into the flumes.

**Table VIII. Summary of oxygen equivalents discharged for the three purification schemes**

| Scheme | Total daily discharge of oxygen equivalents, kg (= COD + 4.57 x Kjeldahl N) Without treatment | With treatment |
|---|---|---|
| 1 | 3648 | 1530 |
| 2b | 3130 | 870 |
| 3 | 3130 | 1350 |

regard to stability, scheme (1) gave problems with excess clay during the last weeks of the experiment, scheme (3) gave problems with sudden increases in chloride concentration, but scheme (2b) gave no serious problems. However, scheme (2b) is not the cheapest of the alternatives and it was decided to do further research in the 1979 campaign using scheme (1) which will involve measures to be taken concerning the clay; results had been promising in the first weeks of the 1978 campaign when less clay was present.

It is also very important to note that, in the several experiments, there were no problems in the start-up of the purification plant. Even in the first few days from the start, using new activated sludge, purification was excellent. We also consider that experiments with pilot plants will be necessary before designing and building a full-scale treatment plant.

*Summary*

In this study alternative schemes for the purification of waste water from a beet sugar factory were examined. Discharge of condensate and juice softener waste water into the flumes followed by treatment of fluming waste water in an activated sludge plant resulted in the discharge of 1050 kg/day of oxygen equivalents ( = COD + 4.75 x Kjeldahl N). After treatment of these waste waters together in an activated sludge plant the discharge contains only 390 kg/day oxygen equivalents. If the brine (spent ion exchanger regenerant), another waste stream which contains 480 kg/day oxygen equivalents, is added to the other waste streams before activated sludge treatment the discharge is 1350 kg/day oxygen equivalents. For highest purification efficiency, therefore, treatment of condensate, juice softener waste water and fluming waste water together, and separate disposal of brine, is the best solution for the beet sugar factory. It was also found that a purification plant with new activated sludge, obtained from a plant treating domestic sewage, was able to purify the sugar factory waste water without any problems from its first day.

**Le traitement biologique de l'eau résiduaire d'une sucrerie de betterave**

Dans cette étude, différents schémas d'épuration de l'eau résiduaire d'une sucrerie de betterave ont été examinés. La décharge des condensats et des eaux de lavage de la décalcification des jus dans les caniveaux, suivie du traitement de l'eau résiduaire des caniveaux dans une installation à boues activées se traduisait par le déversement de 1050 kg/jour d'équivalents oxygène (= DCO + 4,75 x N Kjeldahl). Après traitement de ces eaux résiduaires en mélange dans une installation à boues activées, la décharge ne contient plus que 390 kg/jour. Si la saumure (régénérant épuisé des échangeurs d'ions), un autre circuit résiduaire contenant 480 kg/jour d'équivalents oxygène, est ajoutée aux autres circuits d'eaux résiduaires avant traitement par boues activées, la décharge représente 1350 kg/jour d'équivalents oxygène. Dès lors, pour obtenir le meilleur rendement d'épuration, le traitement simultané des condensats, des eaux de lavage de la décalcification et de l'eau des caniveaux avec la décharge séparée de la saumure, est la meilleure solution pour la sucrerie de betterave. On a trouvé également qu'un poste d'épuration pourvu de nouvelle boue activée obtenue d'une installation traitant des eaux résiduaires domestiques, était capable d'épurer les eaux résiduaires de la sucrerie sans aucun problème dès le premier jour.

**Biologische Abwasseraufbereitung in einer Rübenzuckerfabrik**

In dieser Studie wurden alternative Schemas für die Reinigung von Rübenzuckerfabrikabwässern untersucht. Bei Zugabe von Kondensat und Saftenthärterabwasser zum Schwemmwasser, das in einer Belebtschlammanlage aufbereitet worden war, ergab sich eine Wasserfracht von 1050 kg Sauerstoffäquivalenten (CSB + 4,75 Kjeldahl-N). Nach gemeinsamer Aufbereitung dieser Abwässer in einer Belebtschlammanlage sank die Belastung auf nur 390 kg/d Sauerstoffäquivalente. Falls Ionenaustauscher-Regenerationsabwasser, das 480 kg/d Sauerstoffäquivalente enthält, den anderen Abwässern vor der Belebtschlammanlage zugegeben wird, steigt die Belastung des behandelten Abwassers auf 1350 kg/d Sauerstoffäquivalente. Die günstigste Reinigung der Abwässer einer Zuckerfabrik ist daher die gemeinsame Aufbereitung von Kondensat, Saftenthärterabwasser und Schwemmwasser und die getrennte Behandlung von Ionenaustauscherabwasser. Außerdem wurde festgestellt, daß eine Reinigungsanlage mit neuem aktiviertem Schlamm aus einer kommunalen Abwasseraufbereitungsanlage vom ersten Tag an ohne Probleme Zuckerfabrikabwasser reinigen kann.

**Tratamiento biológico de efluente de una fábrica de azúcar de remolacha**

En este estudio se han examinado esquemas alternativas para la purificación de efluente de una fábrica de azúcar de remolacha. Descarga de agua condensada y efluente de la planta de endulzamiento de jugo en los canales para flotar las remolachas, seguido por tratamiento de efluente de estos canales en una planta con lodo activado, da por resulta una descarga de 1050 kg por día de $O_2$-equivalente (= DOQ + 4.75 x N-Kjeldahl). Después de tratamiento de estos efluentes todos juntos en una planta con lodo activado, la descarga no contiene que 390 kg por día de $O_2$-equivalente. Si se añade salmuera (licor agotado de la regeneración de los cambiadores de iones), un otro efluente que contiene 480 kg por día de $O_2$-equivalente, a los otros flujos de efluente antés del tratamiento con lodo activado, la descarga contiene 1350 kg por día de $O_2$-equivalente. Por eso, respecto la más alta eficiencia de purificación, la solución mejor para la fábrica de azúcar de remolacha es el tratamiento junto de agua condensada, efluente de la planta de endulzamiento de jugo y efluente de los canales, con disposición separada de la salmuera. Se ha encontrado también que una planta para purificación con nuevo lodo activado, obtenido de una planta que trata efluentes domésticos, puede purificar los efluentes de la fábrica de azúcar sin problema desde su primero día.

**Burundi sugar project loan**[1]. — A US $10 million loan has been granted to Burundi by the Arab Bank for Economic Development in Africa and will help with the construction of a 16,000 tonnes/year sugar factory. The project will comprise a 1925-hectare cane plantation and a 1500 t.c.d. sugar factory with a refinery. The complex will meet total domestic demand, and other sources of finance for the total $68.2 million cost include the African Development Bank, the OPEC Fund, supplier credits and the Burundi government.

[1] F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 551.

Trapiches Zanini-Farrel 42" x 84" - Usina São Martinho - trapiches con 4 molinos - 8 000 TCD - 12% FIBRA

# Solamente quien fabrica el mejor trapiche del mundo puede transformar su ingenio en un moderno central azucarero.

En el ramo azucarero, así como en cualquier otro, un buen equipo es de vital importancia para la obtención de un mejor resultado final. Cada pieza, cada equipo influye en el funcionamiento, pero sucede muy a menudo que un buen equipo no puede alcanzar los resultados deseados, debido a una falta de armonía del conjunto en general.

Es por eso que Zanini no solamente fabrica el mejor trapiche del mundo, como también ejecuta proyectos completos para centrales azucareros. La calidad Zanini está siempre presente, para mejor seguridad del central azucarero y mayor tranquilidad del cliente, desde la fabricación del equipo hasta la indispensable asistencia técnica después de la instalación.

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a través de una asociación que reunió en una única fuente, la experiencia, la tradición y el "know-how" de Zanini y Farrel.

Por lo tanto, cuando Ud. piense en trapiches o en un gran proyecto de producción de azúcar, diríjase a aquel que tenga condiciones de suministrar no sólo el mejor equipo como también la mejor solución para la coordinación global de su proyecto. Diríjase a Zanini.


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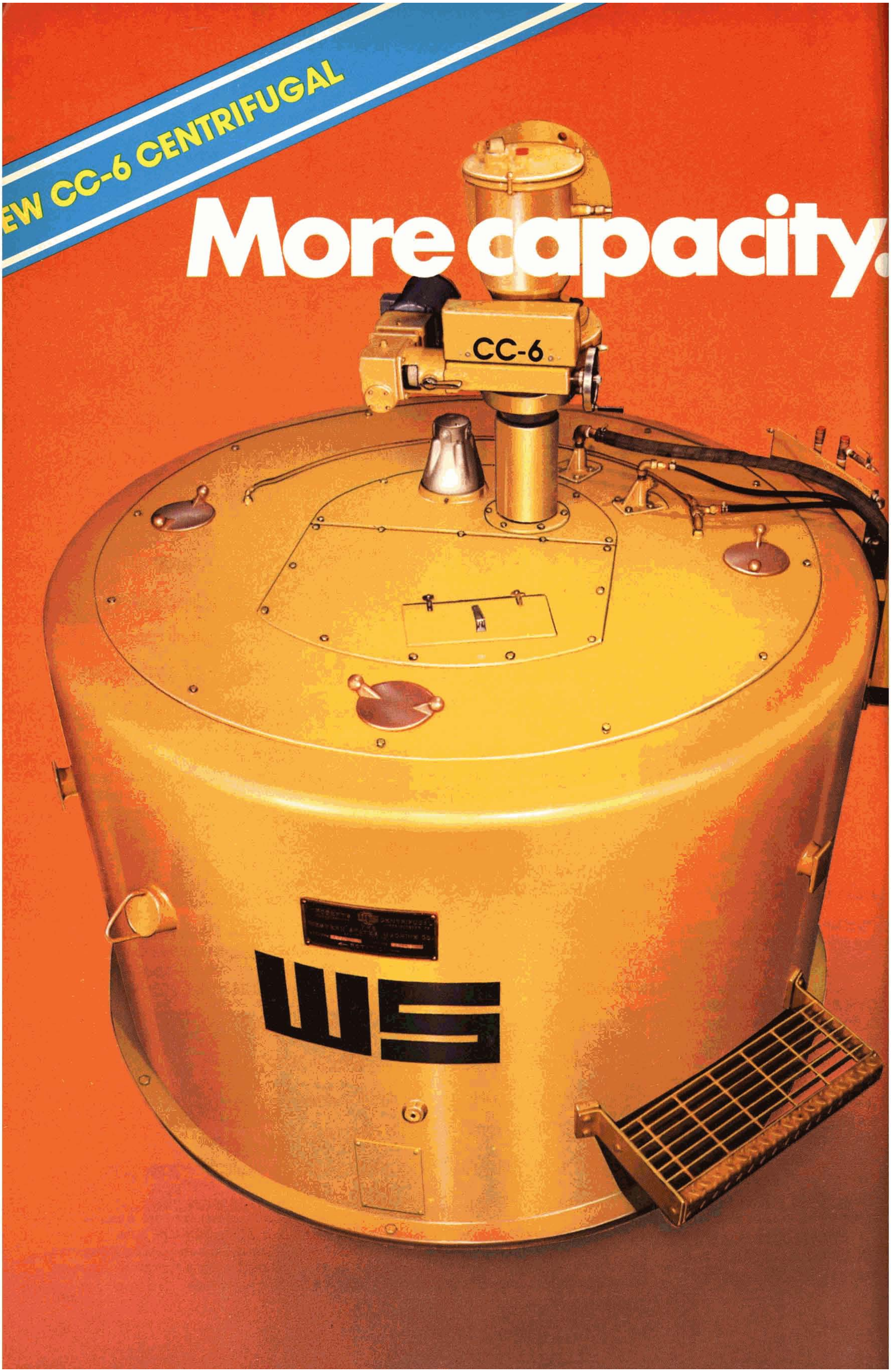
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# Developments in pollution control and environmental protection

By DR. JÜRGEN TSCHERSICH
(Braunschweigische Maschinenbauanstalt AG)

In recent years, diminution of environmental pollution and the idea of environmental protection have come to the fore both in the private and the industrial fields to such a degree that nobody can pass over this problem any more. It is not only the citizens' growing uneasiness at annoyances and damage by outside influences such as noise, odour, dust, radiation, chemicals, etc., threatening his well-being, which has caused this environmental consciousness, but the recently growing sense of responsibility of politicans and of industrial and business associations who have had to recognise that without specific environmental protection there will be damage to nature's ecological balance which might be beyond repair. Private and public initiatives have consequently given rise to many laws and rules stating conditions and specifying maximum limits for environmental loads.

Since there is hardly any industrial plant which does not produce waste water and which does not cause air pollution by odour, solids or noxious gases, large sums of money have had to be and must still be raised to meet the requirements of environmental protection.

The sugar industry all over the whole world also knows these environmental problems and has already made great contributions to substantially reducing the pollution. Like other branches of industry, the sugar industry endeavours to employ energy-saving processes in order that the running expenses for pollution control will not jeopardize the profitability of plants. The following describes processes and equipment which are based on the latest technical developments and which are successfully employed in practical operation.

*Waste water treatment*

While in aerobic waste water treatment the organic substances are transformed by aerobes in one single metabolic step into the final products $CO_2$ and $H_2O$, the anaerobic bacteria can decompose the substrates only in several steps. According to latest findings, anaerobic decomposition proceeds in four stages (Fig. 1). In the first stage, substrates such as carbohydrates, fats and protein are hydrolysed enzymatically. In the second stage, the particulate and dissolved substrates as well as the low-molecular dissolved substrates present in the waste water are transformed into organic acids, alcohols, aldehydes, acetic acid, $CO_2$ and $H_2$. Decomposition in the first two stages is effected by the same groups of bacteria.

It has been proved that most methane bacteria are unable to convert the above-mentioned intermediate products directly to methane and $CO_2$; another group of bacteria transforms the intermediate products in the acetogenic stage to acetic acid. This is followed by the fourth, methanogenic stage, in which the methane bacteria produce methane and $CO_2$. It is essential that the 3rd and 4th stage organisms live in a close symbiosis and are susceptible to shearing stress (Fig. 2).

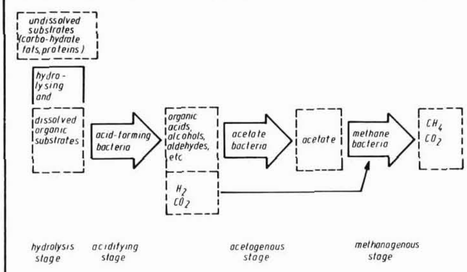


**Fig. 1. Anaerobic decomposition of organic substances**

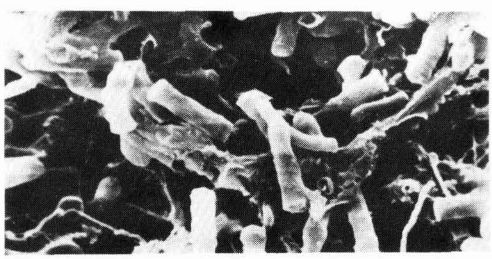

**Fig. 2. Methanogenic bacteria (enlarged)**

*Anaerobic waste water plants*

In the anaerobic and aerobic fields there has been a change in recent years from low-rate to high-rate plants on the basis of new technologies and for economic reasons. As far as reliability is concerned, anaerobic high-rate plants are on a par with anaerobic low-rate plants, since dependable measuring and control techniques ensure a high safety and, as a result, the stability of the decomposition process.

Compared with low-rate plants, high-rate anaerobic plants have the advantage that from an investment and energy consumption point of view they operate much more economically. This becomes particularly evident if one bears in mind that the expected daily volume load of low-rate plants is 1 to 1.5 kg COD/$m^3$, while for high-rate plants it is 10 to 15 kg COD/$m^3$. Thus, high-rate plants can be built smaller by a factor of 10 than low-rate plants. As anaerobic decomposition both in low-rate and high-rate plants proceeds at approx. 35°C, it is obvious that a plant ten times smaller and with a much shorter retention of the waste water can operate at less energy cost than a large-volume plant.

**Dr. Jürgen Tschersich**

The CSM (Centrale Suiker Maatschappij, Amsterdam) process is an "anaerobic high-rate process" which was developed by this Dutch beet sugar company with the cooperation of the Agricultural University of Wageningen. Braunschweigische Maschinenbauanstalt AG (BMA) have taken out a licence for manufacture and sale of these plants for the Federal Republic of Germany and several other European countries. Industrial waste waters highly loaded with organic substances are pretreated biologically; the degree of purification can be 90% and over. The downstream aerobic final treatment stage can be kept correspondingly smaller.

In anaerobic decomposition only a small amount of the organically decomposed substance is converted into new biomass, the major amount being decomposed by the acetate and methane bacteria to biogas. Measurements show that the growth of the bacterial anaerobic sludge is approx. 4% by weight relative to the COD decomposed (40 g sludge growth per kg of COD decomposed). This is a great advantage as against aerobic plants, where the whole organic load – if decomposable without any anaerobic pretreatment – is converted into biomass. This biomass develops in the clarification plant as surplus sludge, lagooning or removal of which causes problems.

*Generation and composition of biogas*

The biogas generated as a by-product in anaerobic waste water treatment can be used in the factory as a high-quality fuel for heating purposes. The biogas generation should not only be looked upon as an economical side-effect, but also with regard to its benefit to process technology. The upflow of the biogas produces a turbulence in the anaerobic tank whereby a mechanical mixing device can be dispensed with. Measurements made in pilot and large-scale plants show that the average generation of gas is approx. 400 litres per kg of COD decomposed. Subject to the type of waste water concerned, the percentage of methane in the biogas is 75 – 90%.

Investigations revealed that in properly operating plants the generation of gas ceased as soon as waste water supply was stopped. Gas generation set in again immediately when, after several hours or even days, waste water supply was started anew (Fig. 3). It is this adaptability which allows the anaerobic activated sludge to be stored in anaerobic tanks at sugar factories between the campaigns without any specific attention. When the new campaign begins, the sludge starts to work again, after an adaptation period of 2 to 3 days, without loss of activity. To the sugar factory this means that at the end of the beet campaign the waste water problem is eliminated as well.

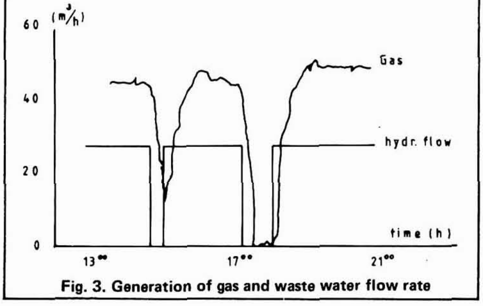


**Fig. 3. Generation of gas and waste water flow rate**

*Pretreatment of waste water*

The highly loaded factory waste waters to be purified should be passed through a lagoon or collected in an equalizing tank or reservoir. The size of the tank or reservoir must be such that the retention time is at least one day. Within this period carbohydrate compounds are decomposed by fermentation and to a great extent converted to low-M.W. fatty acids, which are degraded further in the following anaerobic stage by the acetate and methane bacteria.

Prior to entering the anaerobic stage, the pH must be corrected, if necessary, and the waste water must be heated to approx. 35°C. This is done by means of heat exchangers which, during the campaign, can be heated with the waste heat of the barometric condenser tail water.

If plant operation must be continued after the campaign, the waste water to be purified can be heated with the biogas in a thermo-oil plant.

*Description of the anaerobic CSM plant*

Anaerobic decomposition in a CSM plant proceeds in a tank, which may be either rectangular or round. The rectangular type has the advantage that it can be extended at will by the addition of further units. Two of the most important components in the tank are: (1) the 3-phase separator to separate water, sludge and biogas, and (2) the water supply pipe system.

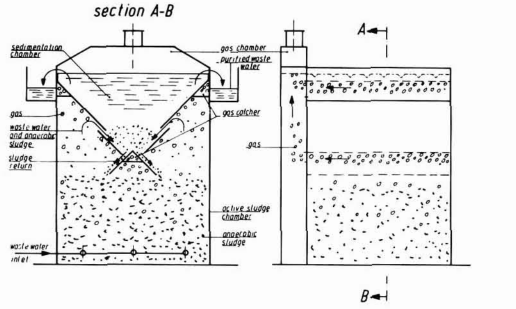


**Fig. 4. Anaerobic tank (CSM system)**

*3-phase separator*

Good decomposition of the organic matter in the waste water can be achieved only if the whole biomass in the tank is available for decomposition. This means that separation of biogas, activated sludge and purified waste water has to take place in the anaerobic tank (Fig. 4).

The patented 3-phase separator is a component which separates the biogas, the anaerobic sludge and the purified water. In the anaerobic tank the installation of a 3-phase separator provides settling units, at the outside of which the biogas ascends into a gas chamber equipped with a gas offtake. In the settling units the anaerobic activated sludge, which has good settling properties, is separated from the purified waste water by sedimentation. The sludge flows through the openings in the bottom of the settling units back into the activation chamber and takes part again in the new treatment cycle. The purified water flows over the lateral overflows into a collecting trough, whence it is discharged from the plant.

*Waste water supply system*

The waste water supply system is so designed that the arrangement provides for optimum mixing in the tank of the incoming waste water and the activated sludge. Investigations made with regard to the water supply have shown that the supply influences the purification efficiency of the plant. The supply pipe system is so designed that each supply pipe covers an area of 5 $m^2$. This hydraulic water flow, together with the ascending biogas, provides for intimate mixing in the plant, which ensures that the anaerobic activated sludge is distributed through the entire tank and that short-circuiting of inlet and outlet streams cannot occur (Fig. 5).

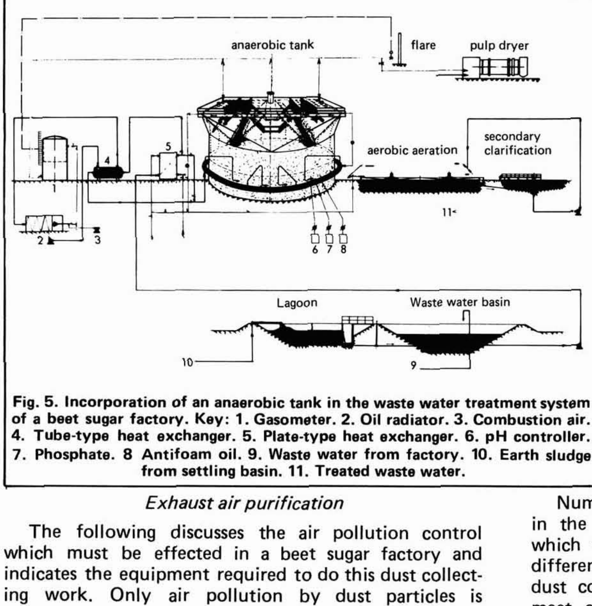


**Fig. 5. Incorporation of an anaerobic tank in the waste water treatment system of a beet sugar factory. Key: 1. Gasometer. 2. Oil radiator. 3. Combustion air. 4. Tube-type heat exchanger. 5. Plate-type heat exchanger. 6. pH controller. 7. Phosphate. 8 Antifoam oil. 9. Waste water from factory. 10. Earth sludge from settling basin. 11. Treated waste water.**

*Exhaust air purification*

The following discusses the air pollution control which must be effected in a beet sugar factory and indicates the equipment required to do this dust collecting work. Only air pollution by dust particles is considered.

The following table gives a general view of the source and nature of the pollution, the selection of the appropriate equipment, and the dust concentration in the exhaust air that can be achieved.

| | | | |
|---|---|---|---|
| Boiler (solid fuels) | Flue gases with fly ash | E-filters<br>Multi-cyclones | $<$ 100-150 mg/Nm$^3$ |
| Rotary pulp dryer | Drying vapours with organic dust | Multi-cyclones<br>Wet separators | $<$ 100-150 mg/Nm$^3$<br>$<$ 50 mg/Nm$^3$ |
| Pellet cooler | Air with organic dust | Cyclone separator | $<$ 75 mg/Nm$^3$ |
| Sugar drying and cooling plant | Air with sugar dust | Cyclones with wet separator | $<$ 50 mg/Nm$^3$ |
| Aspiration plants for material transfer points, sifters, bins, silos and packing plants | Air with organic dust | Self-cleaning filter | $<$ 10 mg/Nm$^3$ |

Purification of the aspiration plant exhaust air by self-cleaning filters does not cause any difficulties. Preferably, bag filters equipped with a mechanical or pneumatic cleaning device are used.

To purify the pellet cooler exhaust air it is sufficient to employ a cyclone separator. The addition of moisture before the pressing process makes the dust particles from the pulp dryer dust collector agglomerate and renders them easily separable. The exhaust air from the sugar drying and cooling plant also contains a large percentage of superfine sugar particles and the dry cyclone separator is therefore followed by a wet separator. Thorough spraying of the pre-purified exhaust air with condensate washes even the superfine particles out of the gas. A high- efficiency entrainment separator fitted above the wet separator prevents the emission of liquid droplets.

Purification of the pulp dryer vapours is much more complicated. The greater demands made on the dust collectors have to be attributed, above all, to the different quality of the wet material fed to the rotary dryer. In view of the necessity (caused by the high prices of fuel) to dewater the extracted pulp by mechanical means to the greatest degree possible, the material is subjected to a high mechanical strain. In modern pulp presses dry substance percentages of 20-22% and over are quite normal. The large amount of superfine dust particles in the raw gas dust results from this mechanical strain. Furthermore, the dust content in the raw gas is substantially influenced by the following parameters: drum load, amount of molasses mixed with the pulp, and dust content in the boiler exhaust gas mixed to the drying gases.

Numerous measurements made of the dust content in the raw gas, along with particle size analyses, by which was established the exhaust gas situation under different drying conditions, now permit the design of dust collecting installations for pulp dryers which can meet all requirements that may arise. The range of possible particle compositions can be taken from Fig. 6. Subject to the emission limit required for flue dust, either dry dust collection or dry-wet dust collection is practised.

*Dry dust collection* (Figs. 7 & 8)

The essential components of the BMA dust collecting system are the raw gas conduit serving as a raw gas stream distributor, the cyclone separators, the pure gas conduit, and the dust discharging installation with conveyors and rotary air locks. Subject to local conditions and to the amounts of exhaust gas concerned, one or more dust collecting lines are arranged in parallel. Special attention was paid to the design of the raw gas conduit which has to distribute the gas-dust mixture to all cyclones at the same time. It is important that the dust composition is not altered in the raw gas conduit and that deposits are prevented. An advantage of the dust collector arrangement as shown is that there is

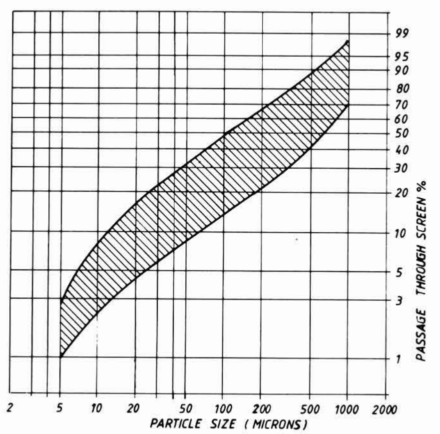


**Fig. 6. Particle size distribution in the raw gas dust from pulp drying plants**

access to each cyclone.

Separation of the dust from the raw gas proceeds in the cyclone separators. Of those types available (Fig. 9), BMA employ that with spiral inlet and conical dust separating chamber. These cyclones are distinguished by a particularly high separating efficiency, a relatively low pressure loss, and a well centred stream. As compared with an axial cyclone, this type can be fabricated at less cost and the danger of choking is quite small. Beneath the cyclones are provided the dust bins. Above the dust outlet of the bin is fitted the shielding cone which prevents the cyclone stream from absorbing the dust from the dust outlet again and thus impairing the separation efficiency.

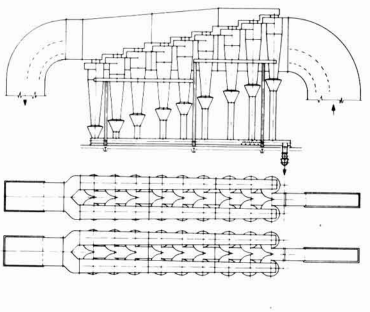

**Fig. 7. Dry dust collector for a pulp drying plant**

Designing of the cyclone is done with the aid of an EDP programme. Pressure loss, raw gas composition and cyclone geometry are given. Measurements have shown that the raw gas dust content is approx. 3.2g/Nm$^3$. The degree of separation and the cyclone dimensions are computed by applying the fractional efficiency curve specific for the type of cyclone concerned. At a raw gas dust content $<$ 10 g/Nm$^3$, only the separation efficiency caused by the cyclone eddy flow is considered. Separation beyond the limit load is disregarded.

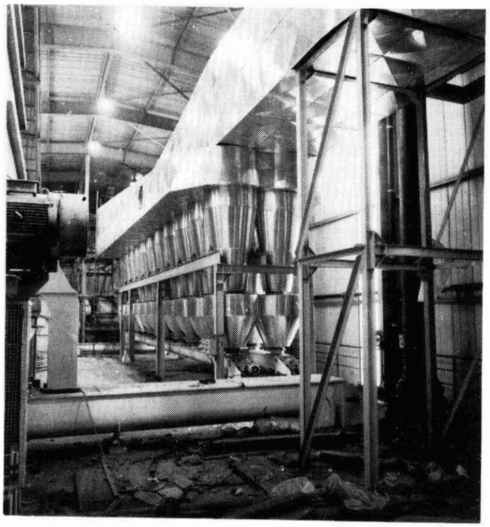

**Fig. 8. View of a multi-cyclone battery in a pulp drying plant**

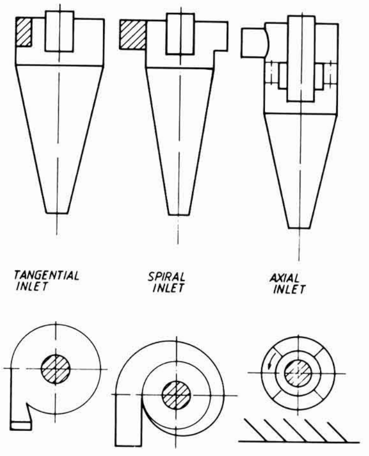


**Fig. 9. Main types of cyclones**

The computed cyclone is optimized on a test stand with test dust. Fig. 10 shows the fractional efficiency curve of a cyclone before (left) and after (right) optimization on the test stand. The chart shows substantially improved fractional efficiencies for particle sizes between 3 and 12 microns. The particle diameter limit, at which 50% of the particles are still separated, improved from 10.5 to 8 microns. Beneath the dust bins, the separated dust is discharged by screw conveyors.

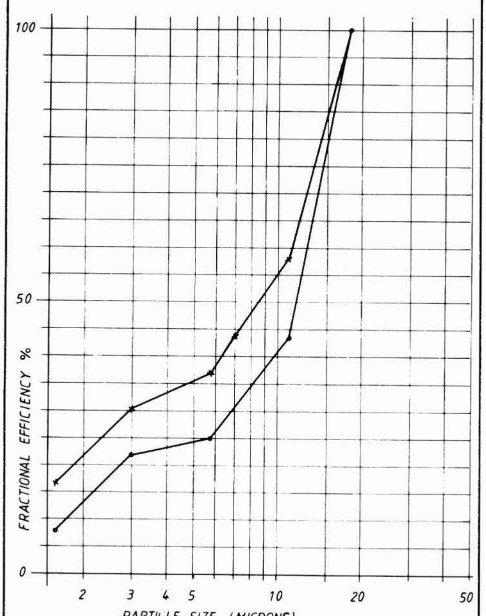


**Fig. 10. Cyclone optimization on BMA test stand**

To avoid pressure equalization streams between the individual cyclones, the dust screw conveyors between the dust intakes are of the tubular type. Exclusion of air from the dust collecting system is by means of rotary air locks fitted behind the dust screw conveyors. The pure gas collecting conduits are arranged above the raw gas conduits. The purified gases enter the pure gas conduits through immersion-tube outlet spirals. The outlet spirals recover part of the torsional energy of the gases and thus keep the resistance of the plant at a low level.

The fan mounted behind the dust collectors conveys the purified gas to the stack. It is advisable that the fan be fitted at the suction side of the dust collector, for if it is fitted at the delivery side a segregation of the raw-gas dust mixture at an impeller speed of approx. 900 rpm can hardly be avoided.

As the dew point of the wet drying vapours is 70°C, it is necessary that the entire dust collecting system be thoroughly insulated to prevent the temperature from falling below the dew point. Lately, an encapsulation of the entire system has proved very expedient and cost-saving.

*Dry-wet dust collection*

The BMA system (Fig. 11) is capable of achieving pure gas dust contents far below 50 mg/Nm$^3$. The system therefore lends itself to meeting the lower dust emission limits which are expected for the future. The system comprises the dry dust pre-collector with one or more large cyclone separators, the dynamic wet dust collector with water injector, the gas scrubber, and the sheet-steel stack with mounted high-capacity mist eliminator.

Dust collection proceeds as follows: First, the dryer exhaust gases enter the pre-collector at a temperature of approx. 115°C and a dust content of approx. 3.2 g/Nm$^3$. The pre-collector purifies the gas to a dust content of approx. 300 mg/Nm$^3$. The dust collected is fed back to

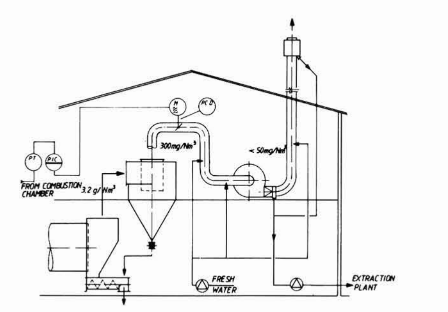


**Fig. 11. BMA dry-wet dust collector for a pulp drying plant**

the material dried. Before the wet collector the gases are saturated by injection of water. If the amount of water for dust collection was injected later, it would evaporate completely and prevent the collection process. The principle of wet centrifugal force dust collection is applied in this system. The dust collector water nozzle proper is fitted at the suction socket of the wet collector. The atomized water injected at 3 bar excess pressure forms a continuous film in the collecting zone and on the blade wheel, and flows off continuously together with the dust particles. The degree of separation can be seen from the fractional efficiency chart (Fig. 12).

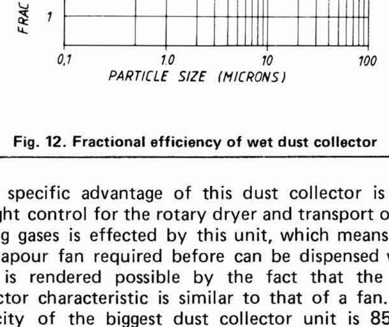


**Fig. 12. Fractional efficiency of wet dust collector**

A specific advantage of this dust collector is that draught control for the rotary dryer and transport of the drying gases is effected by this unit, which means that the vapour fan required before can be dispensed with. This is rendered possible by the fact that the dust collector characteristic is similar to that of a fan. The capacity of the biggest dust collector unit is 85,000 m$^3$.hr$^{-1}$ at a total pressure difference for the whole plant of 2250 Pa. For large amounts of exhaust gas it is intended that an adequate number of dust collector units should be arranged in parallel.

After dust collection, the saturated gas is cooled by water injection to a degree below the sulphuric acid dew point. This desulphurizes the exhaust gas in part and, at the same time, produces acid water for the diffusion process. The treated gases are emitted through a sheet-steel stack. In order to prevent with certainty any acid-containing droplets of water from escaping the stack, the droplets in the gas have to be caught before the stack mouth. The separator used for this purpose is so designed that droplets having a diameter of 20 microns are separated completely, which means that no liquid particles can drop out of the escaping exhaust gas. All those components coming into contact with wet exhaust gas or with the turbid liquid are made of stainless steel, and so will not suffer any acid corrosion.

Supervision of dust emission from the above plants is done by gravimetric measurements and by continuous automatic monitoring. These measurements include, above all, the quantity of exhaust gas, the temperature, the pressure, and the moisture content of the gas. Equivelocity partial gas suction serves for determining the dust concentration.

It is recommended to use continuous measuring devices for routine checks of the dust emission. The dust concentration is measured optically by the light scatter technique. The result is recorded continuously on a control chart. If the automatic monitoring system is used at the stack of the wet dust collecting system, it is operated through a bypass at the stack.

*Summary*

Developments in processes and plant for the reduction of sugar factory emission and waste water pollution load are described.

**Développements dans la maitrise de la pollution et la protection de l'environnement**

On décrit des développements de procédés et des équipements pour réduire l'émission et la charge polluante d'eaux usées d'une sucrerie.

**Entwicklungen im Bereich der Verschmutzungsbekämpfung und des Umweltschutzes**

Beschrieben werden Entwicklungen der Verfahren und Einrichtungen zur Verminderung der Emission und des Abwasserverschmutzungsgehalts einer Zuckerfabrik.

**Desarrollos en control de contaminación y protección del ambiente**

Se describen desarrollos en procesos y plantas para la reducción de emisiones del ingenio azucarero y de la carga de contaminación de efluente.

# Pollution control in CSR's sugar mills and refineries

By A. T. AITKEN, A. M. KENNEDY and M. R. PLAYER

*Introduction*

CSR Limited is Australia's largest sugar miller and refiner. It has been in both businesses for over 100 years and is an industry leader in sugar technology. CSR operates seven sugar mills, all in the state of Queensland. The Company operates six refineries, one in each of the mainland state capitals of Australia and one in Auckland, New Zealand. The location of the mills and refineries can be seen in Figure 1.

*Clean air legislation in Australia*

Since all the Company's sugar mills operate in the state of Queensland they and the New Farm refinery are affected by Queensland legislation. The other refineries operate in different states and, since environmental matters fall within the authority of state legislatures, there are different acts, regulations and administering bodies affecting each. In general, the plants are licensed by both clean air and water quality authorities. In some cases licence conditions may reflect the general standards expected of all factories in the locality or industry, in others they may be specific to the particular facility, having been specially negotiated.

The regulation of atmospheric emissions, as it affects sugar factories, is concerned with three main factors: smoke density, particulate concentrations and the presence of sulphur dioxide at ground level. Smoke density is measured according to the Ringelmann scale. The measurement of the particulate content of stack gases involves the proper sampling of such gases. This is not normally done as a routine matter; stacks are checked periodically and, if found to be within the regulations, it is assumed that the boiler equipment conforms unless there is a known malfunction.

*Emission standards*

The standard expected in respect of smoke density is not greater than Ringelmann 2 in all plants except the Yarraville refinery for which no standard is specified.

The allowable level of particulates varies from factory to factory. In Queensland, where sugar mills operate bagasse-fired boilers, the maximum allowable levels are


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**Fig. 1. Location of sugar mills and refineries**

0.80 g/std $m^3$ in existing bagasse-fired boilers but 0.69 for new installations. For the coal-fired refinery boilers at New Farm the limit is 0.45 g/std $m^3$. In the other refineries a variety of standards also apply. Pyrmont with its present coal-fired boilers has a limit of 0.40, although for new plant 0.25 g/std $m^3$ would be required. Yarraville, Glanville and Cottesloe, all employing natural gas-fired boilers, have maximum allowable limits of "nil", 0.45 g/std $m^3$ and "no limit specified", respectively.

The control of sulphur dioxide emissions at ground level is normally achieved by either specifying chimney heights or the permissible level of sulphur in the fuel. In Australia, the natural gas has negligible sulphur content and coals normally have less than 1%. Authorities in Sydney and Melbourne call for fuels with less than 1% sulphur so this normally affects only the choice of oil for oil-burning equipment. In Queensland, the New Farm refinery has a sulphur limit of 3% placed on its fuel which is normally coal although facilities are available to burn oil. Likewise, oil is used as a standby fuel in many sugar mills and the 3% limit applies to them also. Sugar mill boiler stacks are up to 65 m high to conform with ground level sulphur dioxide emission requirements while burning oil.

### *Smoke and particulates abatement*

The boiler station and char kilns at Yarraville are natural gas-fired and there would not normally be any significant smoke emission. The Glanville and Cottesloe refineries also employ gas firing, so in respect of the Ringelmann 2 standard there is no difficulty in conforming to this requirement. The Pyrmont and New Farm refineries are normally coal fired and the fluctuating factory demands made on these boiler stations make it difficult to conform with Ringelmann 2 without special attention being given to combustion control. At Pyrmont, because of its inner city location, the decision was taken in 1977 to install a Thermoflex bag filter to remove effectively both smoke and particulates, leaving the stack so clean that it is nearly impossible to know by visual observation whether the boiler is running or not.

### *Pyrmont refinery bag filter*

Pyrmont refinery has three coal-fired boilers with a total rating of 144,000 kg of steam per hour and has to provide steam for three major factories in the Pyrmont complex. The steam load normally averages 95,000 $kg.hr^{-1}$ with peaks reaching 115,000 $kg.hr^{-1}$. Although solids emission levels were at most times marginally below the statutory requirements of 0.40 g/std $m^3$, the spreader stoker boilers were likely to emit solids greater than allowable levels during sudden load changes, coal quality variations and mechanical breakdowns.

It had been planned to continue to reduce boiler stack emissions by improved boiler controls and demand

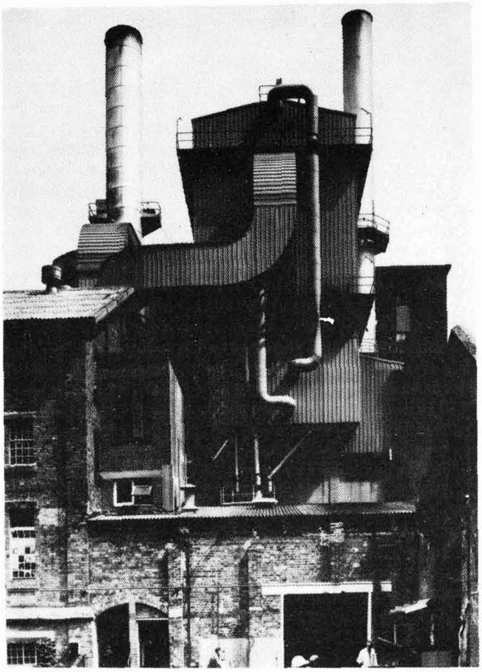


Fig. 2. Bag filter at boiler station, Pyrmont

modulation. However, increasing concern for the surrounding community and the immediate need to be seen by regulatory authorities to be achieving a rapid reduction in levels of pollutants led to the major installation of a stack gas filter. The final installation was a Thermoflex bag filter supplied and commissioned by Joy Manufacturing Co. Pty. Ltd. (Figure 2).

The bag filter system consists of twelve compartments, each containing 66 cylindrical glass fibre cloth bags, providing a total available area of 6630 $m^2$. The dust-laden flue gas passes up through the inside of the bags, through the cloth wall and then out the stack. The collected solids are removed by periodically isolating each compartment in turn and forcing cleaned flue gas in reverse through the bags. The bag house has been designed to filter 3100 $m^3.min^{-1}$ of flue gases at 170°C with a dust burden of 10-12 g/std $m^3$. Solids emissions of 0.02 g/std $m^3$ have been achieved. The pressure drop across the bag house and ducting is up to 7 inches water gauge.

*Char kiln stack emissions*

Four out of the five refineries use bone char for decolorization of sugar liquors. All kilns were traditionally fired on bunker oil and each faced smoke emission problems during light-up and times of poor combustion. These problems have been alleviated by using higher grades of fuel. Two refineries have converted to natural gas firing, and the remaining two to distillate firing.

*Sugar mill boilers*

Dust burdens from bagasse-fired sugar mill boilers range from 2 to 25 g/std $m^3$ depending upon the combustion chamber geometry, air to fuel ratio and bagasse properties such as moisture and ash levels. Mills began controlling the fly-ash emissions in 1970 when the sugar growing districts were placed under the Queensland Clean Air Act.

Since that time a number of collector types have been installed to reduce emissions at CSR mills. Early collectors were based on dry cyclone collection techniques. Because of the fine dusts characteristic of sugar mill stack emissions these barely met the licence requirements. Tests on the size distributions of particulates from sugar mill boilers indicate that 35% are smaller than 10 microns. Figure 3 shows collector efficiency curves for three types of cyclone arrester. It can be seen that efficiences are poor on dusts of 5 microns or less.

In the late 1960's, the Company decided to install wet collectors in its Queensland sugar mills because dry collection techniques appeared to meet the required emission levels only marginally. One of the incidental advantages of this decision was the ability to dispose of high BOD liquid effluent to the fly ash arrester's scrubbing fluid make-up. This make-up fluid replaces that lost in the stack gases by way of evaporation. Two types of wet collector are being used.

The first is the wetted louvre arrester based on the design of the CSR entrainment arrester (Figure 4) used in evaporators and vacuum pans. The dust-laden flue gas follows a zig-zag path between stainless-steel corrugated

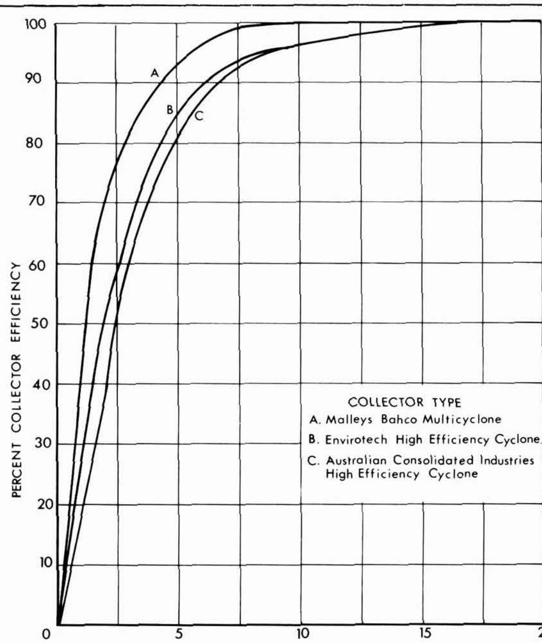



Fig. 3. Efficiencies of cyclone-type fly ash collectors

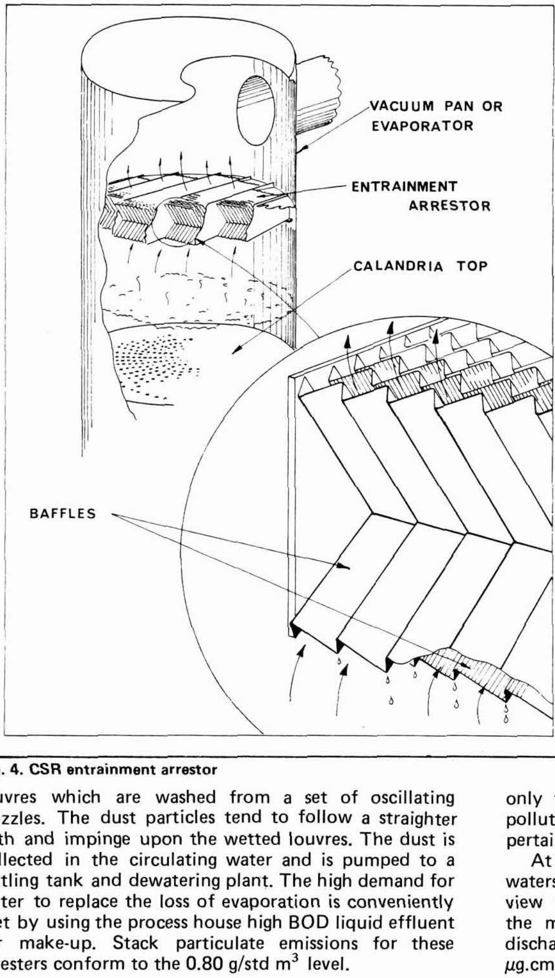



**Fig. 4. CSR entrainment arrestor**

louvres which are washed from a set of oscillating nozzles. The dust particles tend to follow a straighter path and impinge upon the wetted louvres. The dust is collected in the circulating water and is pumped to a settling tank and dewatering plant. The high demand for water to replace the loss of evaporation is conveniently met by using the process house high BOD liquid effluent for make-up. Stack particulate emissions for these arresters conform to the 0.80 g/std $m^3$ level.

The second type of wet arrester has recently been installed at CSR's Victoria mill to treat the flue gases from their new John Thompson 277,000 kilograms steam per hour bagasse-fired boiler. The arrester comprises six Ducon Multivane Type L scrubbers in parallel. Each Ducon unit consists of a vertical cylinder with a tangential gas inlet and a conical bottom section for the removal of sludge. The scrubber section eliminates dust by intermixing the scrubber liquid with the cyclonic flow of gas to force the dust particles against the sides of the unit. Emission levels from this high efficiency arrester are commonly as low as 0.01 g/std $m^3$ during normal operation. During normal crushing at Victoria mill over 1200 $m^3$/day make-up water is required. This is a significant proportion of the normal liquid effluent flow and therefore has greatly reduced the load on the existing liquid effluent treatment plant.

### *Water quality legislation*

Australia's water quality legislation concerns the discharge of water into natural waterways. Nearly all of the Company's sugar factories have two waste water streams, condenser water and process water. Condenser water is normally drawn from the river or harbour upon which the factory is situated and returned to the same body. Where the river water is not particularly clean in the first place, licence standards are written to reflect the additional load which is allowable. Since all of the sugar refineries discharge process wastes to the sewer only the condenser water discharges are of interest to pollution control authorities. The licence conditions pertaining to these discharges are set out in Table I.

At Queensland sugar mills the capacities of receiving waters to absorb pollutants are being studied with a view to nominating appropriate licence standards. In the meantime interim standards generally calling for discharges not to exceed 20 $\mu g.cm^{-3}$ $BOD_5$ and 30 $\mu g.cm^{-3}$ suspended solids prevail.

**Table I. Licence requirements applicable to CSR sugar refineries**

| Water Quality | Pyrmont | Yarraville | New Farm | Glanville and Cottesloe |
|---|---|---|---|---|
| $BOD_5$ | $\not>$ 20 $\mu g.cm^{-3}$ above receiving water | $\not>$ 15 $\mu g.cm^{-3}$ on average and $\not>$ 20 $\mu g.cm^{-3}$ at any time above receiving water | $\not>$ 20 $\mu g.cm^{-3}$ above receiving water | General standard not substantially altering the nature of the receiving water |
| Suspended solids | $\not>$ 30 $\mu g.cm^{-3}$ above receiving water | Nil above receiving water | $\not>$ 30 $\mu g.cm^{-3}$ above receiving water | |
| pH | Within 6.5 – 8.5 | Within 6 – 9 | Within 6.5 – 8.5 | |
| Temperature | Not to raise receiving water by $> 5^\circ C$ | Not to raise receiving water by $> 30^\circ C$ | Not to raise receiving water by $> 25^\circ C$ | |

Fig. 5. One of six Ducon fly ash arrestor vessels, Victoria mill

increasing significantly in recent years and there is every indication they will continue to do so. Consequently, it is becoming increasingly more attractive for these refineries to install their own effluent treatment plants.

*Effluent treatment installations*

Liquid effluent treatment systems employed in sugar mills are either batch ponding systems or continuous activated sludge treatment plants. Batch ponding systems require fairly large areas of land for construction of the ponds and ideally should be remote from towns and houses because odours sometimes cause complaints. CSR's Hambledon and Pleystowe mills have batch ponds while Invicta and Kalamia own large amounts of land such that process water can simply be absorbed onto the land or used to irrigate sugar cane. The size of batch ponds depends on a number of factors such as rainfall, evaporation, seepage, quantity and quality of effluent produced by the mill. These pond systems can require at least 30 hectares for a mill producing 2600 $m^3$ of effluent per day.

*Refinery process wastes*

There are two major process wastes in sugar refineries, char cistern drain water and carbonatation mud solids. Char cistern drain water amounts to about 250 litres per tonne melt and has relatively high temperature and BOD at around 90°C and 1200 $\mu g.cm^{-3}$, respectively. All refineries send this water to the sewer. At Pyrmont and Yarraville the municipal trade waste authority accepts suspended solids. Cooled char drain water is used to sluice the Sweetland filter mud from the presses, the slurry then entering the sewer system.

The Pyrmont, Yarraville and New Farm refineries pay a trade waste disposal charge based on volume and strength of the waste sent to the sewer. The range of charges and their bases are as follows:

(a) Volume of effluent: charges range from 10 to 20 Australian cents per $m^3$.
(b) $BOD_5$ content: where $BOD_5$ exceeds 600 $\mu g.cm^{-3}$ charges range from 2 to 4 cents/kg in addition to the volume charge.
(c) Suspended solids content: where suspended solids content exceeds 600 $\mu g.cm^{-3}$, charges range from 4 to 7 cents/kg in addition to the volume charge.

Restrictions on temperature and pH of material entering the sewer also apply. Cooling of char drain water is normally the only treatment called for, though both pH and temperature correction is required for discharge of spent regenerant from the ion exchange decolorization unit operated at Glanville. Municipal authorities in Adelaide and Perth do not have specified charges for trade wastes put to the sewer. There appears to be an increasing tendency for municipal authorities to have industry bear the real cost of treating trade wastes. Charges in Sydney and Melbourne have been

*Activated sludge treatment plants*

Activated sludge treatment plants are used at Victoria, Macknade and Goondi sugar mills to treat all the process waste water to a quality suitable for discharge into the local waterway. These plants can generally meet the required standards of 20 $\mu g.cm^{-3}$ $BOD_5$ and 30 $\mu g.cm^{-3}$ suspended solids. The quantity of water to be treated at these mills is not directly proportional to the mill's crushing rate because each has different arrangements for its condenser cooling water and fly ash collection.

Victoria mill has a spray pond system for cooling water and any surplus from the spray ponds is treated in the activated sludge treatment plant. However, a considerable quantity of high-BOD waste water is used in the fly ash collection system described elsewhere in this paper.

Macknade mill draws approximately half of its condenser cooling water from the Herbert River upon which it is situated and the other half from a cooling tower system. Any overflow from the cooling tower system is sent to the effluent treatment plant. Macknade's CSR-type fly ash arresters do not require as much water as Victoria's Ducon units.

Goondi draws all its condenser cooling water from the North Johnstone River so there is no surplus water from this system going to the effluent treatment plant. Goondi's fly ash arresters, like Macknade's, are CSR louvre baffle type and require less water than the Ducon units. In summary, the approximate quantities of water treated in the activated sludge treatment plants are given in Table II.

CSR's activated sludge treatment plants were developed by the Company from a pilot plant operated at Victoria mill from 1969 to 1971. The essential features of these plants are as follows: water passes over DSM screens to remove bagasse fibre then proceeds to an oil and sand separating tank whence the overflow gravitates to the primary pond. The overflow from the

**Table II. Quantities of liquid waste treated in sugar mill activated sludge treatment plants**

| | Normal Weekday Waste | | Weekend Waste | |
|---|---|---|---|---|
| Mill | Daily flow, $m^3$ | $BOD_5$ | $m^3$ | $BOD_5$ |
| Victoria | 2590 | 420 | 1200 | 2540 |
| Macknade | 1130 | 1060 | 500 | 4120 |
| Goondi | 2060 | 690 | 800 | 3560 |

primary pond passes through the primary clarifier with the underflow sludge being returned to the primary pond while the overflow gravitates to the secondary pond. Overflow from the secondary pond is pumped to the secondary clarifier whence the clear overflow is discharged to the waterway. The secondary clarifier underflow is returned to the secondary pond. Sometimes there is surplus sludge from the primary and secondary clarifiers which is not returned to their respective ponds but is sent to waste disposal via the sludge stabilization pond.

Since Queensland sugar mills operate on a 5-day week basis, there is a considerable volume of high-BOD weekend wash-down produced over a few hours. If sent directly to the effluent ponds this would represent a large slug which could be expected to upset the smooth running of the system. A weekend waste pond is provided to collect these wastes as well as any large accidental spillages. These wastes are then fed gradually into the treatment plant so that the weekend pond is emptied in time to receive the next week's wash-down.

An aerial view of the Victoria mill effluent treatment plant is given in Figure 6 and the specification of major equipment items is set out in Table III. The wastes which enter the primary pond at 400 – 800 $\mu g.cm^{-3}$ $BOD_5$ are digested anaerobically. Lime is added to the primary pond for automatic control of pH while nutrients such as ammonia and superphosphate are added manually according to the daily analysis of the mixed liquor. The aerators in the primary pond provide agitation of the pond's contents and reduction of odour from the surface of the pond.

**Table III. Specification of major equipment items for activated sludge treatment plant, Victoria Mill**

| Pond-Duty | Volume, $m^3$ | Construction | Aerators, kW | Clarifiers Dia,m | Clarifiers Vol,$m^3$ |
|---|---|---|---|---|---|
| Primary | 3800 | All ponds have earth walls | 2 x 18 | 9.8 | 150 |
| Secondary | 5000 | with butyl lining and rock spall | 2 x 56 | 16.0 | 370 |
| Weekend | 2300 | | 2 x 11 | | |
| Sludge stabilization | 1500 | | 1 x 11 | | |

The secondary pond is operated aerobically with a controlled dissolved oxygen level in the range 1 to 3 $\mu g.cm^{-3}$. For optimum operating conditions the suspended solids levels in both ponds are maintained between 2000 and 4000 $\mu g.cm^{-3}$ but preferably at 2500 $\mu g.cm^{-3}$. BOD reduction in the primary pond is typically 50-70% and in the secondary pond 85-95%.

*Solid waste disposal*

The solid wastes from sugar mills and refineries consist of boiler ash, fly ash, carbonatation mud and filter mud. There is no particular environmental legislation pertaining to solid waste disposal except that clean waters legislation frequently states that solids must be disposed in a manner which will not result in stream pollution. This places some limitations on the use of solid wastes for land fill.

*Carbonatation mud*

All CSR's refineries use carbonatation and filtration for clarification of melter liquor. This process produces mud solids which are mainly calcium carbonate to the extent of approximately 1% of raw sugar melt. As stated previously, Pyrmont and Yarraville dispose of their mud by slurrying with char drain water and sending it to the sewer. Actually some 50% of these mud solids are dissolved when the refinery waste is mixed with waste from the adjacent distillery. The distillery waste is acidic and needs to be neutralized.

At New Farm and Glanville refineries, mud is disposed of as a cake with 50% moisture taken from a rotary vacuum belt filter. This mud is used for land fill. It has been found that rotary vacuum belt filters are very satisfactory for dewatering mud since they require minimal operator supervision and, depending on wash water used, very low sugar losses can be obtained.

*Sugar mill fly ash*

It has been a longstanding practice in Australian sugar mills to return filter mud to the canefields. With the installation of fly ash arresters in the late 1960's the question of where to dispose of this material arose. Trials were conducted on mixing fly ash with filter mud and testing the mixture for its value of canefields. At some mills there has been an enthusiastic response for this mixture while at others filter mud alone is returned to the cane fields while fly ash is dumped elsewhere.

Fly ash collected in wet arresters must be dewatered to a degree which is dictated by the eventual disposal system. Wet fly ash behaves rather like quicksand. It appears to be a solid but with slight vibration it becomes very fluid. Transporting wet fly ash in a truck can result in its being slopped over the sides making a dust nuisance when the material dries out.

Probably the most satisfactory fly ash, mill mud and surplus activated sludge disposal system in the the Company's mills is at Macknade. Here all three materials are mixed to make a product which is highly acceptable to farmers and avoids the problems associated with disposing of sludge on land and transporting fly ash on its own. Basically, the fly ash dewatering system produces a product dry enough to combine with the filter mud and still able to accept the very fluid surplus activated sludge.

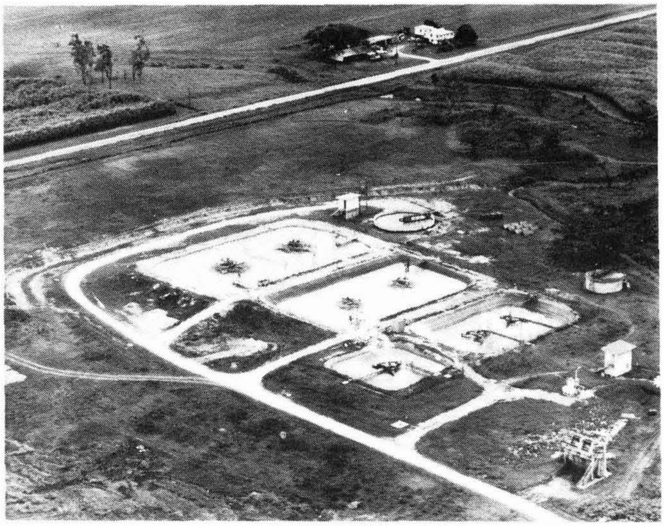


**Fig. 6. Aerial view of activated sludge treatment plant, Victoria mill**

have dewatering plants which operate on slightly different principles, though the objective of producing dewatered fly ash which is as dry as possible is common to them all.

*Conclusion*

For over a decade CSR have been involved in the development and application of technology to improve environmental aspects of its factory operations. The results have been significant. No longer does fly ash from mill boiler stacks fall on neighbouring residential areas, no longer do refineries contribute to the photochemical smog in their respective cities. Following the reduction of BOD discharged to waterways, these have been substantially restored for the greater enjoyment of the community.

This fly ash dewatering system comprises a 13.9 m diameter Envirotech clarifier thickener into which the arrester scrubbing fluid is directed. The overflow returns to the scrubbing unit while the underflow is further dewatered on a 1.83 m diameter Eimco top-loading rotary vacuum filter. This plant handles about 960 $m^3.hr^{-1}$ of arrester fluid containing 1.2% solids. The 10 $tonnes.hr^{-1}$ dewatered ash contains approximately 60% water and is eminently suited to mixing with the filter mud and absorbing the activated sludge treatment plant's surplus sludge. Figure 7 shows the installed fly ash dewatering plant at Macknade. Other CSR mills

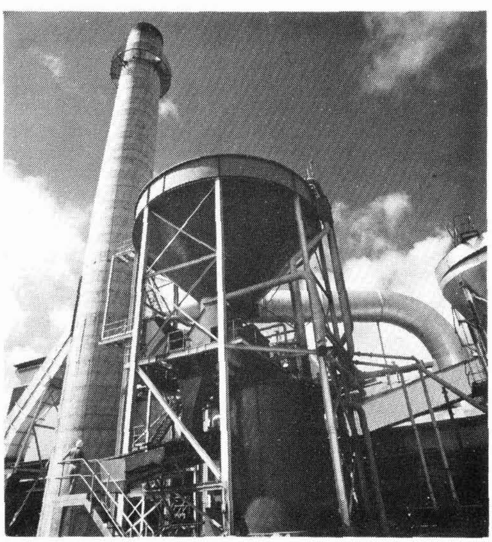


**Fig. 7. Fly ash dewatering system, Macknade mill**


*Summary*

A detailed account is given of the measures adopted by CSR Ltd. at their Australian raw sugar factories and refineries for control of environmental pollution and to meet local legal requirements in this respect.

**Contrôle de la pollution dans les sucreries et raffineries de CSR**

On donne un exposé détaillé sur les mesures adopteés par CSR Ltd. dans leurs sucreries et raffineries australiennes afin de contrôler la pollution d'environnement et se conformer aux règlements légaux locaux en ce regard.

**Regelung der Umweltverschmutzung in Zuckerfabriken und Raffinerien von CSR**

Berichtet wird ausführlich über die von CSR Ltd. in ihren australischen Rohzuckerfabriken und Raffinerien ergriffenen Massnahmen zur Regelung der Umweltverschmutzung und zur Befolgung der entsprechenden behördlichen Verordnungen.

**Control de contaminación en los ingenios y refinerías de CSR**

Se presenta un resumen detallado de las medidas adoptado por CSR Ltd. en sus plantas para la producción y refinación en Australia de azúcar crudo para control de contaminación del ambiente y para conformar con las necesidades legales de las administraciones locales en este respecto.


**US beet sugar production estimates**[1]. — Total sugar beet area to be harvested in 1980 is expected by the USDA to reach 1,177,100 acres, 4.8% more than the 1,123,700 acres harvested in 1979. Drought has caused declines of 8000 acres in Minnesota and 1700 acres in Texas but increases are expected in other states, attributable to strong world and domestic prices for sugar. On a basis of 12.7% recoverable sugar, raw value, the national yield average for 1977/79, this area would yield 3,000,000 short tons of sugar, raw value, against the 1979 outturn of 2,879,000 tons.

[1] *McKeany-Flavell Sweetener News*, September 19, 1980.

# SUGAR CANE AGRONOMY

**An evaluation of irrigation at Mackay.** L. S. Chapman and C. W. Chardon. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 117-123. – In the Mackay area some 40% of farms have irrigation equipment, encouraged by taxation concessions and readily available finance. The benefits and disadvantages of irrigation are identified and experiments have been made to quantify them, using data from 1972 to 1978. It is concluded that installation of the spray irrigation system studied has not been economically justified under the stated assumptions.

**The potential of distillery waste as sugar cane fertilizer.** J. F. Usher and I. P. Willington. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 143-146. – Vinasse from the Sarina distillery is sprayed onto a disposal site where the solids are degraded by soil organisms. The concentrated plant nutrients plus sludge which continuously accumulates in the catchment dams on the disposal site are removed and applied as fertilizer to farms in amounts up to 200 tonnes.ha$^{-1}$. Trials show that the material has a fertilizer value of $A 5,359,000 per year in terms of the cost of the cheapest form of fertilizer containing its nutrients, although it is available free to farmers.

**Row spacing, sett rate and population control in relation to cane and sugar yield – a review.** S. Shanmugasundaram and K. Venugopal. *Indian Sugar*, 1979, **28**, 685-693. The results of experiments conducted in various Indian states, as reported in the literature, are discussed. Optimum row spacing varies between 2 and 3½ ft, while the optimum sett rate is between 10,000 three-budded setts and 50,000 two-budded setts per acre. Detillering as a means of keeping the plant population within 50-70,000 per acre was found to have no significant effect on cane and sugar yield.

**Intercropping cereals in sugar cane.** S. H. Gawhane and R. S. Patil. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.1-Ag.10. – See *I.S.J.*, 1977, **79**, 223.

**Effect of harvesting dates on the yield and quality of plant and ratoon crops of sugar cane.** P. P. Singh. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.11-Ag.17. – See *I.S.J.*, 1978, **80**, 239.

**Response of sugar cane to row spacing and nitrogen in the Tarai tract of Uttar Pradesh.** R. S. Dixit and J. S. Saroj. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.19-Ag.21. – See *I.S.J.*, 1978, **80**, 239.

**Weed control – some important considerations.** D. G. Dakshindas. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.41-Ag.46. – See *I.S.J.*, 1978, **80**, 239.

**Intercropping of potato in sugar cane.** D. G. Dakshindas. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.55-Ag.59. – See *I.S.J.*, 1978, **80**, 239.

**Companion cropping with sugar cane (Co 740).** V. G. Dagade, V. D. Patil and S. J. Ranadive. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.65-Ag.70. – Trials showed that intercropping affected cane tillering but not germination, yield and quality. The most profitable system was kno-khol + cane, followed by onion + cane.

**Weed control in sugar cane of Kolhapur region.** V. S. Mane and C. D. Salunkhe. *Proc. 27th Ann. Conv. Deccan Tech. Assoc. (India)*, 1976, (1), Ag.71-Ag.77. – Herbicide trials are reported. While hand weeding gave a cane yield which was greater than all but one of the treatments, highest yield was given by Diuron pre-emergence herbicide at 2.5 kg.ha$^{-1}$.

**Mixed cropping of hybrid maize in sugar cane ratoon.** R. S. Patil, S. B. Mulik and S. J. Ranadive. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.89-Ag.94. – Maize intercropping with ratoon cane was investigated. Of eight different planting systems, seven reduced cane and sugar yield, only the eighth system (planting of the maize by dibbling, five weeks after ratooning, on one side of the ridge at 30 cm spacing) increasing yield. However, while the increase is considered non-significant, the greater profitability of maize + cane is considered sufficient to justify intercropping.

**The effect of burning before harvest on the quality of sugar cane.** V. S. Mane and V. D. Patil. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976 (1), Ag.95-Ag.98. – Trials on pre-harvest burning of cane showed that it affected Brix, sucrose content and purity, which fell with increase in time before harvesting, while the dextrose content rose. The average weight of the burnt cane was lower than that of standing green cane. The N, $P_2O_5$ and $K_2O$ contents rose. Harvesting burnt cane within 24 hours is advisable.

**Water requirements of sugar cane with particular reference to India.** P. C. Prasad. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.99-Ag.111. – The title subject is examined and comparison made between the cane water requirements in various countries. The rainfalls, irrigation intensities and cane yields in Indian cane-growing states are tabulated. While Class A Pan evaporation has been found to be a reliable guide to irrigation requirements in India, it is stated that the ready availability of irrigation water in India has resulted in scant attention being paid to the question of water use efficiency of cane crops, although future strains on water resources will necessitate examination of water economics.

**Technique of pre-harvest maturity testing of the sugar cane crop to increase productivity of sugar.** A. P. Gupta. *Indian Sugar Crops J.*, 1979, **6**, 23-26. – The formation and accumulation of sugar in cane, and factors affecting the process, are briefly explained, and the National Sugar Institute method of pre-harvest maturity testing based on Brix measurement by hand refractometer is described. The equipment and staff required for the method, results obtained, economics and the advantages of maturity testing are also indicated.

# CANE PESTS AND DISEASES

**Evaluation of certain readily available lepidoptera as suitable alternative laboratory hosts for rearing *Lixophaga diatraeae* (Tns.), a parasite of *Diatraea* spp.** W. G. des Vignes. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 91-96. *L. diatraeae,* an important parasite of *Diatraea* spp., was reared successfully for five generations on *Ancylostomia sterecorea* (Zell.), *Trachylepidia fructicassiella* (Rag.), *Rupela albinella* (Cr.), *Acigona ignitalis* (Hmps.), *Galleria mellonella* (L.), *Diatraea lineolata* (Wlk.), *D. saccharalis* (F.), *D. impersonatella* (Wlk.) and *Hypsipyla ferrealis* (Hmps.) without showing any adverse effects on fecundity. *Rupela* and *Galleria* seemed to be the most desirable hosts since no food change was required after inoculation with *Lixophaga* and many puparia were formed. *Trachylepidia* also showed desirable characteristics, but preventing the diapause was time-consuming.

**Recent outbreak of sugar cane root borer and white grubs in Barbados.** M. M. Alam. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 97-111. — The ecology, biology and host range of root borer *Diaprepes abbreviatus* (L.) and white grub *Clemora smithi* (Arrow) are briefly reviewed and an account given of a serious outbreak of the two pests in Barbados, together with a description of their feeding habits and the effects of their damage to the cane crop. A heavy attack of another similar grub, *Ligyrus tumulosus* (Burm.), has also occurred on young plant cane and was found to be most prevalent where there were heavy applications of filter cake used in land levelling. Light trapping experiments with U.V. and tungsten lamps are recorded, together with the effects of rainfall and the phase of the moon. Control measures are described; these include physical control by digging up cane stumps, ploughing and cultivation, biological control by indigenous and introduced predators and parasites, the use of trap plants, and chemical control. None of the five pesticides employed at one location was effective, but Furadan brought a significant reduction at another. Recommendations on the use of chemicals are made.

**Culmicolous smut *(Ustilago scitaminea)* in Guyana — its status in the sugar industry (1976).** V. M. Young-Kong. *Proc. 1976 Meeting W. Indies Sugar Tech.,* 112-117, 129. — Smut was discovered in Guyana in 1974, and replacing of two highly susceptible varieties with resistant ones in a replanting program is under way. In the meantime, measures to contain the disease include careful selection of seed cane sources, limitation of cultivation of susceptible varieties, surveying and roguing of cane fields, mechanical tillage and flooding of fields to be replanted, and maintenance of close liaison between the estates and the Guyana Sugar Experiment Station.

**Sugar cane smut disease, *Ustilago scitaminea* Sydow; its appearance in Trinidad.** L. C. Goberdhan and W. I. N. Washington. *Proc. 1976 Meeting W. Indies Sugar Tech.,* 118-124, 129. — Smut was observed for the first time in April 1976 in Trinidad but (at the time of the Conference in November 1976) was restricted to only one estate. A control program has been started which involves replacement of three susceptible varieties with a resistant one, inspection of nursery areas to ensure healthy planting material, regular field surveys, roguing, and adoption of harvesting, ploughing and replanting practices to minimize survival of spores. All varieties are being screened for susceptibility, and a number of fungicides are being evaluated.

**The potential impact of sugar cane smut *(Ustilago scitaminea)* on the Caribbean sugar industry.** V. M. Young-Kong. *Proc. 1976 Meeting W. Indies Sugar Tech.,* 125-129. Within 16 months of the discovery of smut in Guyana in 1974, the disease had spread to Martinique and Trinidad. Other Caribbean islands are at risk because of the widespread cultivation of a highly susceptible variety, HJ 5741. Of 35 commercial varieties grown in the area and tested against smut, 8 were highly susceptible, 12 susceptible, 11 resistant and 4 moderately resistant. The need to test the remaining cultivated varieties and newer promising selections is emphasized.

**Cane diseases in Réunion.** Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 27-28 *(French).* — Information is given on the various diseases found in cane in Réunion. Smut *(Ustilago scitaminea)* is regarded as posing the greatest danger to the crop; it is always present in the south and west of the island, and could have a disastrous effect if susceptible varieties were grown in those regions, particularly R 568 and R 569. Some foreign varieties have proved susceptible to the disease. R 570 and R 526 have been found to be susceptible to pokkah-boeng, which has developed under favourable weather conditions. Some non-commercial seedlings and two foreign varieties have also exhibited susceptibility. Yellow spot *(Cercospora koepkei)* has attacked certain varieties, but is not considered a serious disease. Rust *(Puccinia erianthi),* hitherto considered of minor importance, has spread sufficiently to cause some anxiety; its only control lies in the growing of resistant varieties. Brief mention is made of other diseases.

**Cane pests in Réunion.** Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 29 *(French).* — Mention is made of the death of very young shoots as a result of infestation of setts by the mealy bug *Saccharicoccus sacchari;* S 17 and R 570 were the two varieties involved. The pest has been under control hitherto, having been first noted in Réunion in 1962, and reasons for its reinfestation are not known. It is recommended to plant only setts which are free of it and to remove extraneous material which could hide the pest. Other pests mentioned include the scale insect *Pulvinaria iceryi* and two species of night moth *(Leucania spodoloreyi* and *Simplicia* sp.)

**Sugar cane varieties naturally infected by smut in Florida in 1978.** D. G. Holder. *Sugar J.*, 1979, **41**, (11), 19. — A report is presented which summarizes the field incidence of smut in the summer and autumn of 1978 in regard to the varieties affected. Two fields of CL 49-200 were apparently the centre of the original infection in the state, while CL 54-336 variety cane was the most affected variety (in terms of number of fields). However, CL 54-378 variety is widely planted in the infected area and showed a low incidence of infection. The disease did not cause any yield losses in the 1978 season.

# CANE SUGAR MANUFACTURE

**A technique of measuring the steam and vapour produced/consumed in certain areas of the sugar factory.** M. Mangru. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 261-264. – Steam and vapour production and usage in evaporators, pans and juice pre-heaters and heaters may be measured in terms of the condensates produced, and a technique is described for doing this with the aid of separate tanks for condensate, one of which is used to feed the boilers and the other to record the inflowing quantities.

**An experimental comparison of different types of dryer systems for sugar drying.** D. R. McGaw. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 265-274. – A program of experimental work has been carried out to determine the most suitable types of non-mechanical dryer systems for both granulated and washed grey sugar. The systems investigated were the packed bed, back-mix fluidized bed, plug-flow fluidized bed, spouted bed, gravity counterflow and pneumatic dryers. Some studies were also carried out on microwave drying. The results showed that the back-mix fluidized bed, spouted bed and pneumatic dryers operated satisfactorily for granulated sugar. The packed bed and pneumatic dryers were the most suitable systems for washed grey sugar drying. Rapid drying of both types of sugar was achieved with microwaves.

**Specification of design parameters for dual-fired mill boilers.** E. G. Williams. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 323-329. – For good reasons, the purchase of additional small boilers to meet increasing steam requirements, as in the 1950's, has been replaced by the purchase of one or two large boilers. The capital investment is likely to be $A 2- 4 million, and for capital expenditure on this scale the preparation of suitable detailed specifications is necessary to ensure proper analysis of tenders and obtain the best investment value. Aspects of dual-fired boilers necessary in such preparation are discussed.

**Factors affecting tube wear in bagasse fired boilers.** P. W. Levy and G. I. Frost. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 331-337. – The higher amount of mineral matter in bagasse from mechanically harvested cane has tended to increase tube wear through erosion of recent years. Factors governing erosive wear are summarized and principles to apply in reducing such wear discussed, as well as aspects of designing for minimum wear.

**Outboard roller cane carriers.** N. M. Zyniecki. *Sugar y Azúcar*, 1979, **74**, (4), 26-29. – The role and requirements of outboard roller cane carriers are discussed and the major components of such a carrier and its advantage over conventional carriers described. Details are given of chain pull and the corresponding increased power requirement for a carrier conveying 6000 t.c.d.

**World's longest sugar belt commences operation in Australia.** M. R. Player. *Sugar J.*, 1979, **41**, (12), 20-21. Details are given of the 5.76-km belt conveyor used to feed raw sugar along a loading jetty from the bulk terminal at Lucinda to ships of up to 40,000 tons deadweight (the berth at the terminal being limited to vessels of up to 7000 tons deadweight). The belt travels forward at a maximum speed of 24.4 miles.$hr^{-1}$ (approx. 39 km.$hr^{-1}$); to allow for the fact that the ship may not wish to take all the sugar on the belt after loading, the belt is reversible at a speed of 2.4 miles.$hr^{-1}$ (approx. 4 km.$hr^{-1}$). The belt is housed in a gallery; on one side of the beltway a surveillance vehicle can be driven to any point for maintenance purposes, while a pedestrian walkway is provided on the other side. Aluminium panels covering the gallery are designed to withstand winds of cyclonic force that are prevalent in the area in summer. A roadway to the side of the gallery allows movement of a single vehicle between shore and ship-loading gantry. The gallery is supported on steel beams resting on pairs of piles sufficiently high above the water to permit passage of small boats beneath. Cathodic protection prevents sea-water corrosion of the hollow steel piles, which are also protected by a tar epoxy coating in the splash zone. To prevent sugar spillage in the gallery, the belt is flipped over for the return run and turned right side up at the terminal.

**The effect of massecuite Brix on final molasses purity.** C. H. Chen, Y. C. Cheng, T. P. Hsieh and W. F. Lin. *Rpt. Taiwan Sugar Research Inst.*, 1978, (82), 31-40 *(Chinese)*. A pilot-scale vacuum pan of 1 $m^3$ and a crystallizer of 2 $m^3$ capacity were installed in a carbonatation factory for final massecuite boiling from *C*-magma and *B*-molasses. The results of 26 strikes at a massecuite Brix of 95-99° showed that concentration had no significant effect on sugar recovery at a Brix greater than 97°, whereas a marked drop in recovery occurred at a Brix below 96°. Final molasses purity increased by almost 0.7 unit for each °Bx reduction.

**Juice flow.** P. Rein. *Colloquium on clarification and filtration* (SMRI), 1979, 1-8. – The effect of fluctuations in mixed juice flow on clarification is discussed; it is mentioned that juice flow from diffusers is apparently more irregular than from mills. In the Huletts Group, a level transmitter on the mixed juice surge tank sends a signal to a gap-action controller, the output from which is the set-point for a flow controller; the system automatically compensates for changes in crushing rate or juice flow rate. While a control valve or a variable-speed pump can be used for flow control, the former has the disadvantages of increasing pump maintenance as a result of the higher loads imposed, excessive power consumption and considerable valve wear, unless stainless steel is used in construction. Pressure loss resulting from throttling of control valves is illustrated. The size of the surge tank is discussed. Examination of the question of juice degradation in tanks shows that there is no danger of this provided no solids are allowed to accumulate or settle out during the residence times typical of the Group factories (ranging from 2.7 to 8.3 min). The benefits of flow control are indicated.

**Clear juice quality and usage of flocculants.** G. S. Shephard. *Colloquium on clarification and filtration* (SMRI), 1979, 9-15. – The fundamentals of primary flocculation and of secondary flocculation induced by polacrylamide flocculants are explained, and the significance of juice degree of hydrolysis and laboratory testing of flocculants are discussed. The effect of flocculant dosage rate on performance is briefly examined, and a recommended procedure for flocculant solution preparation is described.

**pH control and liming systems.** D. J. Radford. *Colloqium on clarification and filtration* (SMRI), 1979, 16-19. Requirements for steady automatic pH control of mixed juice liming are listed, including adequate juice flow uniformity, smooth lime addition to provide a steady flow at constant density for a given setting, good lime-juice mixing, adequate reaction time, minimum dead time lag between lime addition and pH measurement, reliable pH measurement, and linearity between pH and lime addition to permit pH control to within 0.1 unit. Details are given of the system used at Tongaat, and the development of liming systems up to 1920 (when cold liming was the accepted method) and since 1920 (when hot liming was introduced in Cuba) is surveyed. Insufficient information is available to show the relative merits of hot or cold liming in South Africa.

**Practical clarifier operation.** R. Blunt. *Colloquium on clarification and filtration* (SMRI), 1979, 20-27. The operation of a multi-tray RapiDorr clarifier at Noodsberg factory is described. Residence time is approx. 100 min at a rated capacity equivalent to 155-200 tch. Manual and automatic controls are described, as are shutdown procedures and modifications to the clarifier.

**Residence time and bacterial control.** A. B. Ravnö. *Colloquium on clarification and filtration* (SMRI), 1979, 28-32. — Aims of good clarification are listed, and the mechanics of juice settling discussed; because of hindered settling (whereby each settling particle displaces an equivalent volume of juice which must move upward and yet is hampered where the solids concentration is sufficiently high), the solids concentration has a distinct effect on settling rate, while mud thickening is governed (beyond a certain point) by the rate of collapse of the structure created by the particles which are mechanically supported by one another, such collapse depending on the amount of mechanical compresssion caused by the weight of successive layers of mud or on the shear applied by the scraper arms. Other factors considered include juice and mud residence times, which are quite distinct from each other and have to be controlled separately, mud solids loading and shutdown. While retention of juice at an elevated temperature leads to inversion and reducing sugars degradation to form organic acids, with a resultant drop in both purity and pH, leading to yet more rapid inversion, reduction in juice temperature below 75°C leads to significant bacterial losses. One practice mentioned for loss reduction is maintenance of a temperature of 75°C and addition of lime immediately before shutdown; another practice allows the temperature to fall below 75°C in order to reduce chemical inversion yet further, formalin being added during the last 2-3 hours of crushing in order to inhibit bacterial decomposition, but no lime is added. The point is made that, despite indications to the contrary in the literature, at Hulett factories bacteria have been found at above 75°C in clarifiers, some even proving viable. Bacterial losses can be very high in the filter circuit, particularly where there are large mud retention tanks and mud recirculation systems. The difference in pH between mud and clear juice should be $\ngtr$ 0.2 unit. Using one clarifier instead of two but maintaining the same total throughput reduced the pH difference considerably, while filter performance was found to improve.

**Non-sugar balance.** A. Rouillard. *Colloquium on clarification and filtration* (SMRI), 1979, 33-38. — Work at the SMRI has shown that the non-pol ratio is a good indicator of clarification efficiency, low values being associated with high non-sugars elimination and vice versa. Statistical analysis of factory results for six years was used to determine the effects of certain parameters on the ratio. High juice phosphate contents gave low ratios; it is emphasized that the amount of phosphate in the juice is governed not only by the quantity in the cane but also by the dilution caused by imbibition water. Multilinear regression of phosphate, Brix and retention time indicated an apparent direct proportionality between non-pol ratio and Brix, although the effect was relatively small. Decrease in the retention time tended to increase the ratio. Increase in the ratio was accompanied by increase in the quantity of inorganic substances going to molasses, causing a drop in the reducing sugars:ash ratio.

**Clarifier modification and maintenance.** G. Ashe. *Colloquium on clarification and filtration* (SMRI), 39-44. While the most important clarifier maintenance task is lubrication of the drive head, the most important clarifier components as regards frequent inspection and attention are the mud scrapers. Lubrication of mud pump components is also important, but many clarifiers use an adjustable overflow pipe instead of mud pumps. Guidance is given on conversion of a conventional Bach and Dorr clarifier to a trayless type of short retention time.

**Filter operation.** P. Hoareau. *Colloquium on clarification and filtration* (SMRI), 1979, 45-49. — Important factors governing operation and control of rotary vacuum filters are examined, including mud solids content (which is optimum at 5.5-6.0%), quality of bagacillo (which should be fine and free from long fibres, and added at a fibre:mud ratio of 0.40-0.45), lime addition to bring the pH to 7.8-8.0 (lime saccharate being preferred to milk of lime because of the former's faster reaction rate), feed temperature ($\nless$ 85°C after bagacillo addition) and feed flow rate to the filter trough (which should be continuous and proportional to the filtration rate, with avoidance of intermittent mud removal from the clarifier and change of filter drum speed, while the mud level in the filter trough should be constant and evenly distributed over the entire length of the filter, mud overflow into the overflow tanks being avoided). Factors of importance for efficient filter operation are discussed, including vacuum, wash water temperature, filter speed, cake thickness, volume of wash water and spray nozzle spacing, diameter and type. Variables to be determined for filter station chemical control are listed.

**Bagacillo separation and conveying.** S. North-Coombes. *Colloquium on clarification and filtration* (SMRI), 1979, 50-58. — Size classification of bagasse in Australia and South Africa is indicated, and bagacillo requirements shown to be 1-1.5% on cane. Means of separating bagacillo from bagasse are described with the aid of diagrams. Details are given of a louvre-type separator developed in South Africa; modifications have been made to the original design in order to overcome certain problems which are indicated.

# FS in the Philippines

Fletcher and Stewart have been actively engaged in the supply of plant and equipment to the Philippine sugar industry for over a decade.

We have recently completed our fourth turnkey project in the islands namely the Batangas sugar refinery located on the island of Luzon.

The refinery process, capable of producing 550 tonnes of high quality refined sugar per day, also incorporates a self-contained recovery plant to convert refinery reject liquors to raw sugar for recycling with the incoming raws.

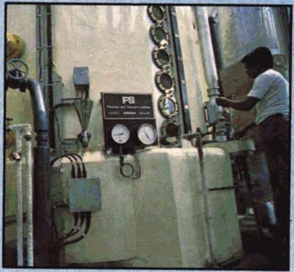
The Batangas refinery will play an important role in the Philippine Sugar Commission's (PHILSUCOM) strategy for improving the quality of sugar produced in the islands and so encourage the further development of local industries such as soft drinks and fruit canning without the need for importing the special grades required by these users.

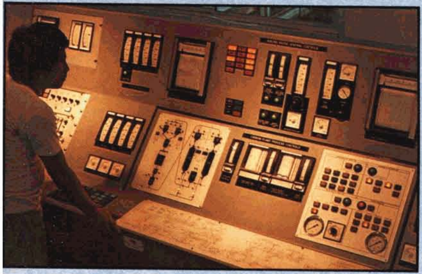
**FS Turnkey Projects in the Philippines**

- **Northern Cotabato Sugar Factory 4000 MTCD—raw**
- **Davao Sugar Factory 4000 MTCD—raw**
- **Bicolandia Sugar Factory 4000 MTCD—raw**
- **Batangas Sugar Refinery 550 MTCD—high quality refined granulated white sugar**

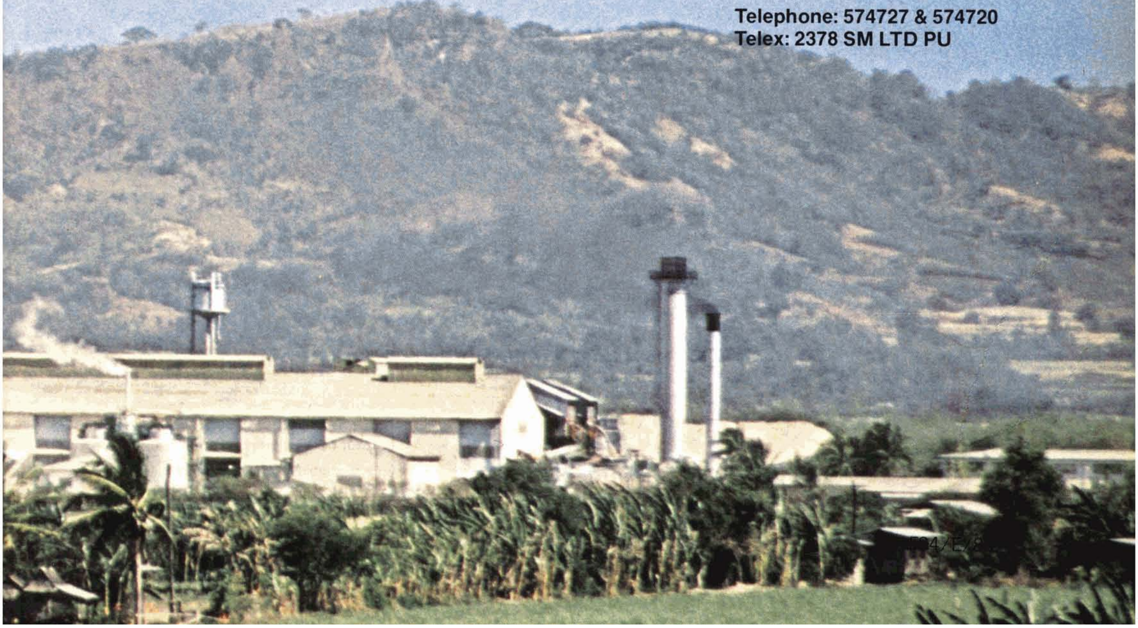
Fletcher and Stewart also have manufacturing and associate business companies, both solely concerned with projects planned for the islands - offering on-the-spot localised knowledge.

CANE REFINED SUGAR
NET WEIGHT







# BEET SUGAR MANUFACTURE

**Heat calculation of beet sugar manufacture as a function of the raw juice purification scheme.** G. N. Mikhatova. *Sakhar. Prom.*, 1979, (5), 54-58 *(Russian)*. — A procedure for drawing-up a heat balance based on a multiple-effect evaporator is described for two juice purification schemes: (1) cold preliming at $< 50°C$, fractional cold and hot liming at 50-60°C and 75-88°C, respectively, with recycling of 100% unfiltered 1st carbonation juice or 20% mud to preliming, and defecation of filtered 1st carbonatation juice, and (2) a scheme including hot preliming and hot main liming. A typical balance is calculated, and it is shown that scheme (2) is better as regards steam consumption, provided the beet quality is sufficiently high.

**Diffuser midbay acidification. Supplementary studies.** J. F. T. Oldfield, M. Shore and N. W. Broughton. *Sucr. Belge,* 1979, **98**, 109-116. — See *I.S.J.*, 1979, **81**, 279.

**Investigations on sucrose loss in preliming.** G. Pollach and L. Wieninger. *Proc. 16th Gen. Assembly CITS,* 1979, 515-527 *(German)*. — A pilot plant-scale Brieghel-Müller preliming trough was installed in a sugar factory for determination of sugar losses by means of a sucrose, dextrose, levulose and lactic acid balance. Despite some difficulties in application of an enzymatic method of determining small sucrose differences, it was found that use of disinfectant in the diffuser reduced bacterial infection in preliming sufficiently to prevent permanent sucrose degradation. With periodic addition of formalin in preliming, the maximum losses (occurring just before the next dosage of formalin was due) were commensurate with the limits of detection of the sucrose (approx. 0.3%), at a preliming temperature of $\geqslant 30°C$. From the results it is concluded that it is not possible to determine the actual loss in preliming on the basis of dextrose, levulose and lactic acid determination.

**Decrease of sugar losses as a result of thin juice deionization under alkaline conditions.** H. Zaorska, S. Zagrodzki, D. Sucharzewska and K. Lisik. *Proc. 16th Gen. Assembly CITS,* 1979, 529-540. — Details are given of a method of thin juice treatment incorporating passage through fixed beds of granular active carbon followed by deionization with cation exchange resin in ammonium form and anion exchange resin in carbonate form, in two pairs of columns; purity was increased and the ash and colour contents decreased, while the reducing sugar content was maintained at constant level. After excess ammonium carbonate has been distilled-off, the juice can be concentrated to 67°Bx and used as liquid sugar or for white sugar production. The ammonium carbonate can be used for regeneration of the resin, while the desorbed non-sugars can be concentrated and added to beet pulp. The process does not yield any waste water, while molasses losses are reduced and sugar yield on beet increased.

**Residence time spectra in sugar industry vessels with reference to sugar losses.** T. Baloh. *Proc. 16th Gen. Assembly CITS,* 1979, 555-569 *(German)*. — Since the occurrence of a residence time spectrum in a vessel is attributable to a number of factors, knowledge of the theoretical fundamentals will show which factors affect the pattern and how it is possible to narrow the spectrum. The author considers four models: vessel with plug flow, vessel with real flow (such as a DDS diffuser), straight-through stirred vessel and a stirred vessel cascade (where such vessels are in series); the residence time spectra established experimentally are discussed, and suggestions offered on means of reducing losses caused by sugar degradation under alkaline conditions and by the action of heat as a function of time.

**Practical aspects of improving molasses exhaustion.** D. Schliephake, K. Austmeyer and U. Gerber. *Proc. 16th Gen. Assembly CITS,* 1979, 623-654 *(German)*. — The question of molasses exhaustion is discussed and the possibility of improving it through optimization of low-grade boiling and crystallization examined. Mathematical approaches made by a number of authors to the question of target molasses purity are described, and research at Braunschweig Technical University on the kinetics of crystallization in impure solutions is reported. Results of investigations of low-grade boiling at a number of West German sugar factories are also examined.

**Sensors for automatic measurements.** P. Devillers. *Proc. 16th Gen. Assembly CITS,* 1979, 703-719 *(French)*. — A report is presented of the sub-committee set up by the Scientific Committee of the CITS to consider the role of sensors in automatic control within the sugar factory. The report lists the properties required of suitable sensors, followed by the various parameters at each process station which lend themselves to control, with an indication of the degree of importance of control in each case.

**The route of antifoam agents through the sugar factory.** O. S. Malmros and J. Tjebbes. *Proc. 16th Gen. Assembly CITS,* 1979, 779-797. — Details are given of a method for determining alkoxylated compounds, such as used in antifoam agents, based on employment of a modified Dragendorff reagent and of atomic absorption spectroscopy for $Bi^{+++}$ determination. Application of the method showed that only 15-20% of surfactant added was found in molasses, the remainder being adsorbed on various materials, particularly carbonatation mud, beet pulp and possibly evaporator surfaces. Sugar crystal surfaces carried typically 0-0.4 ppm, while crystal interiors were not examined. Determination of surfactants by concentration on XAD-4 resin holds great promise.

**Developments in applied continuous sugar crystallization. The inclined tube crystallizer.** A. Pot, L. C. Giljam, L. H. de Nie and D. Hoks. *Proc. 16th Gen. Assembly CITS,* 1979, 799-837. — Details are given of the inclined tube crystallizer (ITC) used for continuous crystallization of B-melt sugar in parallel with discontinuous vacuum pans at Roosendaal factory in Holland. Developed by Stork-Werkspoor Sugar B.V. in collaboration with Suiker Unie, the unit is a simplified version of an earlier model designed on the basis of an idea of de Vries and tested at Dinteloord[1]. (The unit was simplified for economic reasons.) The crystallization theory, particularly crystal

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[1] *I.S.J.*, 1970, **72**, 221.

size distribution (CSD), on which the ITC is based is explained, and details are given of the unit and its performance during the 1975 and 1976 campaigns. Results showed that the system is mechanically reliable and simple to operate, with a minimum of attention needed. Massecuite of a consistent quality was produced at a rate of 15-20 tonnes.$hr^{-1}$, equivalent to a specific hourly throughput (0.4-0.5 tonnes.$m^{-3}$) at least 15% greater than that of the batch pans, while the specific vapour demand was at least 15% lower. While the CSD did not reach the desired level, the ITC proved suitable for routine production of B-melt sugars in conjunction with a continuous centrifugal, and may therefore be suitable for production of other melt sugars. However, further improvement in the CSD is not possible with the ITC without considerable change in the flow pattern, while the problem of incrustation, which necessitated a stoppage for cleaning every 3-4 weeks, cannot be solved with the unit in its present geometrical form. On the other hand, the experience gained has increased understanding of continuous crystallization, and the future aim is to develop a crystallizer that is more suited to the de Vries process for white sugar production.

**Contribution of modern techniques to sugar factory automation.** G. Windal. *Proc. 16th Gen. Assembly*, 1979, 839-858 *(French)*. — Automation problems specific to the sugar industry are summarized, and recent progress in development of systems is outlined. Specific applications within the sugar factory are described, and particular mention is made of the great value of the micro-processor and of Farandole software.

**Calorimetric investigations of the enthalpy of beet cossettes at temperatures from −20 to +20°C.** J. Grabka and S. Zagrodzki. *Gaz. Cukr.*, 1979, **87**, 97-101 *(Polish)*. Calculation of the heat energy used in diffusion requires knowledge of the specific heat and enthalpy of the cossettes. Investigations of enthalpy at temperatures in the range between −20 and +20°C, typifying conditions during the campaign in a Polish sugar factory, are reported. The investigations incorporated a study of the amount of water frozen in the beets. Comparison was made between the amount of heat required for diffusion where the beets had been defrosted and where they remained unthawed; use was made of a counter-current beet washer containing condenser water at 40°C. Results showed that the heat requirement was reduced by between 30 and 50% as a result of preliminary defrosting.

**Factors reducing beet sugar yield.** E. Waleriańczyk. *Gaz. Cukr.*, 1979, **87**, 104-106 *(Polish)*. — The adverse effect of soil and leaf trash in the form of infection and juice purity drop during diffusion is discussed on the basis of experimental investigations and data from the literature. Also discussed is the inadvisability of mixing healthy beet with beet of low quality — rotted beet with slime formation contain 17 times more invert sugar than healthy beet, while frozen and subsequently defrosted beet contain 3 times more invert. The enzymatic activity of the rotted beet is 9 times greater and that of the defrosted beet 14 times greater than for healthy beet.

**System for mud level control in a vacuum filter.** J. Koj and W. Luczyński. *Gaz. Cukr.*, 1979, **87**, 106-107 *(Polish)*. — The electro-pneumatic system described, which has been tested on carbonatation mud filters at Jovein sugar factory in Iran during two campaigns, consists of two vertical probes, separated by a small distance and one higher than the other. Control of the mud level is based on opening and closing of a feed valve under the action of signals transmitted from the probes when the mud level is too low or too high.

**Charging device at Sárvár sugar factory.** A. Simon. *Cukoripar*, 1979, **32**, 91-94 *(Hungarian)*. — Details are given of the rotary limestone and coke charger feeding the lime kiln at Sárvár, and of the system for feeding lime (purchased from elsewhere because of inadequate output of the kiln) into the warehouse and recovering it for use in process.

**Determination of the state of equilibrium of a quadruple-effect evaporator in a sugar factory by means of a HP 97 computer.** J. Gerse and A. Zsigmond. *Cukoripar*, 1979, **32**, 94-98 *(Hungarian)*. — The iteration method was applied to computer programming of material and heat balances for a quadruple-effect evaporator so as to derive optimum operating conditions. A numerical example based on a daily beet slice of 3130 tonnes and a thin juice quantity of 127% on beet at a Brix of 13.6° is presented.

**Defoaming in the sugar industry.** T. Csomár. *Cukoripar*, 1979, **32**, 116-120 *(Hungarian)*. — The theory of foam formation is briefly explained, and factors leading to foaming of raw juice during diffusion are discussed. Experience with antifoaming agents in a number of countries is mentioned, and practices in the Hungarian sugar industry are described. Desirable features of antifoaming agents are listed, and typical results indicated. The economics are also briefly discussed, whereby it is pointed out that during the 1977/78 campaign in Hungary nearly 421 tonnes of antifoaming agent were used in the processing of just under 4 million tonnes of beet.

**Equalization of an evaporator as a controlled system.** J. Řádek and V. Valter. *Zuckerind.*, 1979, **104**, 512-514 *(German)*. — Two stochastic methods are presented for experimental analysis of an evaporation model as a contribution to establishment of a control system. It has been found that stochastic methods are better than deterministic methods for equalization of the process steps where the process is a complex one, particularly where time constants have a greater value and where no disturbance is permissible.

**Work hygiene investigations in a sugar factory.** H. Breternitz, K. Huke and W. Schunk. *Lebensmittelind.*, 1979, **26**, 265-269 *(German)*. — Investigations of atmospheric conditions (air circulation velocity, temperature and relative humidity), noise level and vibration frequency were conducted at each process station in a beet sugar factory. While atmospheric conditions were worst in the centrifugal station, noise was greatest at the beet end, particularly that emanating from the washer; however, many process stations suffered from high levels of both factors. On the other hand, vibration at all stations was below the permissible maximum.

**Innovations in the field of yard operation and beet handling.** Anon. *Zuckerind.*, 1979, **104**, 589-599 *(German)*. Descriptions, diagrams and photographs are given of various pieces of equipment manufactured by Braunschweigische Maschinenbauanstalt AG, Bammann & Schreiber and Gebr. Büttering for beet yard operations, beet washing, flume water treatment, etc.

# LABORATORY STUDIES

**Investigations on colour formation in juices and sugar.** W. Kofod Nielsen, R. F. Madsen and B. Winstrom-Olsen. *Proc. 16th Gen. Assembly CITS*, 1979, 743-777. — The analysis of raw juice for phenolic compounds by high-pressure liquid chromatography and the importance of such compounds in colour formation are described[1]. Means of reducing the quantity of phenolic compounds or minimizing their influence are examined, covering both agronomic and processing aspects. A high degree of oxidation in diffusion and pre- and main liming, preferably at neutral pH and low temperature, reduces the risk of high 2nd carbonatation juice colour caused by the phenolic compounds, while use of a peeling machine (which is described) will remove trash, crown and peel which contain a large proportion of colour-forming compounds.

**Mathematical model of the crystallization rate of sucrose in pure solutions.** S. Zagrodzki and W. Krysicki. *Proc. 16th Gen. Assembly CITS*, 1979, 859-871. — As an extension to the work on sucrose crystallization rates in an extremely thin diffusion boundary layer[2], empirical formulae were developed to define the relationship between crystallization rate and temperature under the experimental conditions. Comparison between calculated and experimental values showed a difference of only ± 5%. The calculated values were also compared with values obtained from differential equations relating to crystallization kinetics; it was thus possible to calculate the thickness of the diffusion boundary layer at different temperatures under stationary conditions provided that an approach of the diffusion boundary layer to zero at high-speed movement of the crystals can be assumed.

**Determination of the filtration coefficient.** K. S. Schoenrock, T. H. Henscheid and M. Kearney. *Sucr. Belge*, 1979, **98**, 101-106 *(French)*. — A simple system intended to replace the Brieghel-Müller micro-method (considered too inaccurate) for determination of filtration coefficient CF is described. It comprises a vertically clamped, graduated burette connected to a vacuum source and receiving droplets of filtrate from below the filter medium (cloth or paper) located beneath a vertical extension piece containing the sample. The coefficient is measured as the gradient of the straight line representing the mean change in flow rate with successive fractions of 5 $cm^3$ of filtrate. When the level of filtrate in the burette first reaches the zero mark (representing usually about 2 $cm^3$), timing of the flow is started, after which each fraction is timed up to a total of seven fractions. CF is then given by $(Tn\text{-}T1)/(n\text{-}1)$, where $Tn$ and $T1$ are, respectively, the time required to collect the last and first filtrate fractions, and $n$ is the total number of fractions collected. A more accurate value is obtained from the slope of the curve of mean change in flow rate. The method has been applied to 1st carbonatation juice and thickener underflow to show that alkalinity has a highly significant but very small effect on the coefficient, while the greatest effect was exerted by the available CaO:non-sugars ratio.

**Spectroscopic study of calcium complexes of sucrose.** C. Francotte, J. Vandegans, D. Jacqmain and G. Michel. *Sucr. Belge*, 1979, **98**, 137-144 *(French)*. — Sucrose tricalcium complexes were prepared by adding CaO rapidly and slowly, respectively, to sucrose solution and by adding $CaCl_2$ to a solution after initial pH adjustment with NaOH. The filtered complexes were then studied by Raman and infra-red spectroscopy. While the infra-red spectra were the same, irrespective of method of preparation of the complexes, there was a distinct difference between the Raman spectra for the complexes formed by CaO addition to the sucrose and that formed by addition of $CaCl_2$; the CaO spectra were of the same pattern as for pure CaO and were unaffected by the speed of CaO addition to the sucrose solution. On the other hand, the lines of spectra established before complexing were completely absent after it, while the spectrum for the complex formed by $CaCl_2$ addition was clearly different from the others. Possible interpretations of the mechanism of complex formation are given on the basis of the results.

**Cane testing systems.** D. Byfield, *Proc. 1976 Meeting W. Indies Sugar Tech.*, 232-236. — Cane sampling methods are classified in two groups: those which are based on analysis of a first expressed juice sample, and those based on direct analysis of a sample of the cane to be tested. The former is employed in Jamaica, with an analysis of 10% of deliveries for extraneous matter; introduction of this latter test has been responsible for a drop in average extraneous matter from 10% to 6%. Direct cane sampling and analysis is described with an account of the various sampling techniques, methods of cane preparation and fibre determination.

**Polarimetry for sugar analysis.** M. F. Nolting. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 281-291. — The history of polarimeter development is described and the principles of the modern automatic instrument are discussed.

**Automation in sugar analysis.** M. F. Nolting. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 301-303. — The Saccharodata system referred to is one which is used for receiving and processing measurements, identifying and cross-checking them, calling for re-measurement of suspect data, operation of alarms, etc.

**A method for the determination of maleic hydrazide and its α-D-glucoside in foods by high-pressure anion-exchange liquid chromatography.** W. H. Newsome. *J. Agric. Food Chem.*, 1980, **28**, 270-272. — Details are given of a HPLC method for determination of maleic hydrazide (used as sprouting inhibitor in e.g. stored beet) and its α-D-glucoside. The column used was coupled to a light absorption detector provided with a 313-nm wavelength filter. Recovery of the hydrazide added to beet at levels of 1 - 50 ppm ranged from 85 to 100%, and of the glucoside from 84 to 94%. A mixed bed resin was used to remove any interfering substances as well as free maleic hydrazide when the glucoside was being determined. The higher M.W. of the glucoside resulted in a higher limit of detection than for the free maleic hydrazide.

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[1] *I.S.J.*, 1979, **81**, 332-336, 362-367.
[2] Zagrodzki: *ibid.*, 1977, **79**, 146.

# PATENTS

## UNITED KINGDOM

**Sugar derivatives containing vinyl groups and their copolymers.** Tate & Lyle Ltd., of London, England. **1,495,548.** April 16, 1974; December 21, 1977. Derivatives of saccharides (sucrose, $\alpha$-D-galactopyranose) are claimed in which at least one hydroxy group has been replaced by a *p*-vinyl benzoyloxy group and the remaining hydroxy groups are unsubstituted or are substituted by protecting (acetyl) groups [2,3,3',4,4'-penta-O-acetyl-1',6,6'-tri-O-(*p*-vinylbenzoyl) sucrose]. Also claimed are copolymers of ($\leqslant$5 mole % of) (1-15% of) ($\leqslant$10% of) such derivatives with another ethylenically unsaturated monomer (styrene, methyl methacrylate).

**Insolubilized dextrose isomerase.** Mitsubishi Chemical Industries Ltd. and Seikagaku Kogyo Co. Ltd., of Tokyo, Japan. **1,496,201.** March 27, 1975; December 30, 1977. Dextrose isomerase [of >400 (700 – 3000) (1000 – 2000) $U.cm^{-3}$] is immobilized by adsorption on a porous anion exchange resin [having a quaternary ammonium (trimethyl ammonium or dimethylethanol-ammonium) ion exchange group (and a styrene-divinyl benzene copolymer matrix)] having a porosity of >4.5% (7 – 50%) (7 – 20%), measured by the aqueous dextran method and an ion exchange capacity of >0.035 (> 0.05) (0.035 – 0.3) (0.05 – 0.1) $meq.cm^{-3}$, measured by the polyanion salt decomposition method.

**Dextrose isomerization.** L. Givaudan & Cie., of Vernier-Genève, Switzerland. **1,496,309.** May 3, 1976; December 30, 1977. – The isomerization is carried out using a mutant of *Streptomyces glaucescens* NRRL-B-2900 or a dextrose isomerase enzyme isolated from it.

**Manufacture of $\alpha$-galactosidase by micro-organism.** Hokkaido Sugar Co. Ltd., of Tokyo, Japan. **1,497,459.** December 16, 1975; January 12, 1978. – The mould *Absidia griseola* (ATCC 20430) or *A. griseola* var. *iguchii* (ATCC 20431) is aerobically cultivated in a medium comprising an inducer (lactose, melibiose, raffinose or galactose) and suitable sources of C, N and inorganic salts [together with (0.2 – 1.0% of) citric, lactic, glycolic, fumaric, glutaric, malic, tartaric, succinic, malonic, maleic, pyruvic or galacturonic acid]. Mycelia of the mould are added to beet juice or molasses to decompose the raffinose present.

**Preparation of citric acid.** Experimentalny Zavod Bio-khimicheskikh Preparatov Instituta Mikrobiologii Imeni Avgusta Kirkhenshteina Akademii Nauk Latviiskoi SSR, of Riga, USSR. **1,499,093.** July 28, 1976; January 25, 1978. – A nutrient medium containing sources of carbon, nitrogen and mineral salts (molasses) is used to cultivate the strain *Aspergillus niger* P-1, selected from the strain 3Y-119 by combined action of ultra-violet radiation, ethyleneimine and N-nitrosomethyl urea, the strain P-1 producing citric acid yields of up to 99% and averaging 97 – 98% on sugar used, and having morphological characteristics which are specified.

**Production of a surface-active material containing sucrose esters.** Tate & Lyle Ltd., of London, England. **1,499,989.** October 17, 1974; February 1, 1978. – Solid, particulate (<250 $\mu$m) sucrose is reacted with at least one $C_1$ – $C_6$ alkyl (methyl) ester (a mixed ester from a naturally-occurring mixture of triglycerides) of a fatty acid of at least $C_8$ [$C_{10}$ – $C_{22}$ ($C_{16}$ – $C_{18}$)] in the presence of [at least 2% (5 – 12%) of] a basic trans-esterification catalyst (an alkali metal carbonate or alkoxide) at 110° – 140°C [120° – 130°C (125°C)] at atmospheric pressure, in the absence of any solvent. The product may be purified by treating (stirring at between ambient temperature and 100°C) with an aqueous salt of a metal (Ca) forming an insoluble soap with a fatty acid and separating such insoluble matter; it is then extracted with a solvent (acetone, methyl ethyl ketone, ethyl acetate) which dissolves lower alkyl esters of fatty acids but not sucrose esters, and then with another solvent (ethanol or *iso*-propanol) which dissolves the sucrose esters but not the fatty acid soaps.

**Purification of sucrose esters.** Tate & Lyle Ltd., of London, England. **1,500,341.** February 13, 1976; February 8, 1978. – A mixture produced by trans-esterification which contains fatty acid mono- and di-esters of sucrose, fatty acid mono-, di- and tri-glycerides and fatty acid soaps is treated (at up to 70°C) with a metal salt [$CaCl_2$, Ca acetate, $MgSO_4$, $ZnCl_2$ or Zn acetate, $Al_2(SO_4)_3$ or $NH_4Al(SO_4)_2$] in water or a $C_1$ – $C_4$ alkanol (*iso*-propanol or ethanol) and, if water, extracting the insoluble material produced to give an alkanolic solution of the sucrose ester which is evaporated to dryness. (The mixture may first be extracted with ethyl acetate, methyl ethyl ketone or 1,2-dichloroethane to remove the glycerides.)

**Dextrose solution purification and isomerization.** CPC International Inc., of Englewood Cliffs, NJ, USA. **1,500,828.** October 3, 1975; February 15, 1978. Dextrose solution (a starch hydrolysate) is passed through a bed of chelating resin, a complex adsorbing exchange resin or a selectively adsorbing cation exchange resin whereby heavy metals (Zn, Pb) are removed, and then through an immobilized dextrose isomerase enzyme bed.

**Beet harvester.** Wilhelm Stoll Maschinenfabrik GmbH, of Lengede/Broistedt, Germany. (A) **1,501,898.** September 10, 1975; February 22, 1978. (B) **1,502,743.** January 18, 1976; March 1, 1978.

**Isomerization of dextrose into levulose.** Mitsubishi Chemical Industries Ltd. and Seikagaku Kogyo Co. Ltd., of Tokyo, Japan. **1,503,035.** June 25, 1975; March 8, 1978. – Dextrose is isomerized by a (*Streptomyces*-derived) dextrose isomerase enzyme (immobilized by adsorption on a macroporous anion exchange resin or cross-linked agar cyanogen halide derivative) in the presence of [0.005 – 5 (0.02 – 0.5) mGm/litre of) $Fe^{++}$ or $Fe^{+++}$ ions and (2 – 20 mGm/litre of) $Mg^{++}$ ions.

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*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 £1.25 each). United States patent specification are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).*

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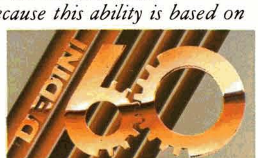


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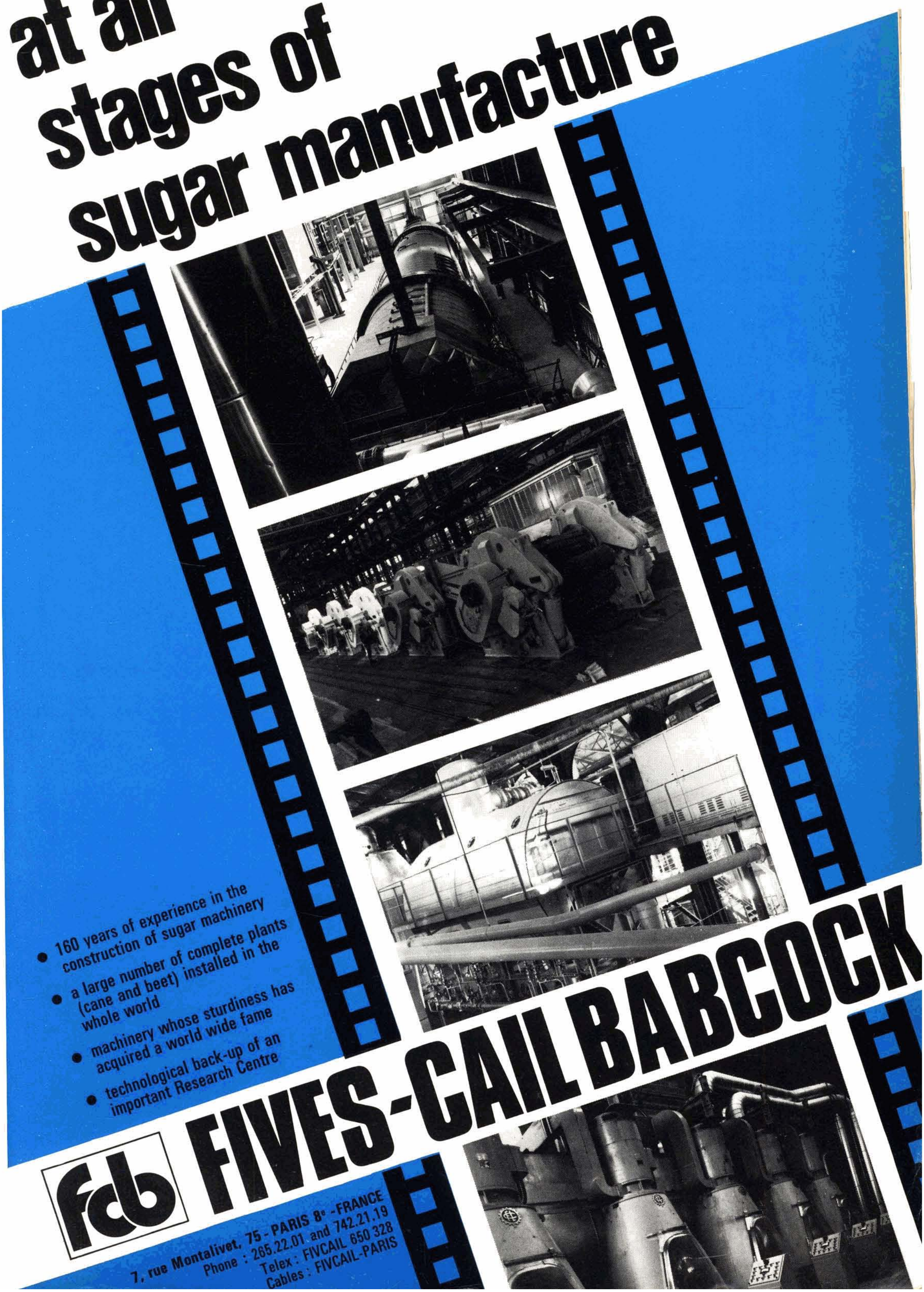
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**Process for isomerization of dextrose into levulose.** Y. Fujita, A. Matsumoto, H. Ishikawa, T. Hishida, H. Kato and H. Takamisawa, *assrs.* Mitsubishi Chemical Industries Ltd. and Seikagaku Kogyo Co. Ltd., of Tokyo, Japan. **4,008,124.** June 20, 1975; February 15, 1977. See UK Patent 1,503,035[1].

**Surface active material.** K. James, of Reading, England, *assr.* Tate & Lyle Ltd. **4,032,702.** October 15, 1975; June 28, 1977. – See UK Patent 1,499,989[2].

**Sugar *p*-vinylbenzoyl ester and copolymers.** T. J. Lucas, of London, England, *assr.* Tate & Lyle Ltd. **4,042,538.** April 11, 1975; August 16, 1977. – See UK Patent 1,495,548[3].

**Preparation of a colourless sugar syrup from cane molasses.** R. Riffer, of Berkeley, CA, USA, *assr.* California and Hawaiian Sugar Co. **4,046,590.** September 8, 1976; September 6, 1977. – A colourless, low-ash, high-purity sugar syrup is produced from cane molasses by diluting it with water (to about 70°Bx), heating it, centrifuging it to remove insoluble solids, acidifying (with HCl) to about pH 4 and immediately passing it (at atmospheric pressure and at about 80°C) through a (strongly acidic cationic) ion exclusion resin (with about 4% divinyl benzene cross-linkage), wherein sugars are adsorbed and impurities are excluded; water is then passed through the resin to elute and recover the sugar solution. This may then be passed through a bed of granular carbon and then through a strongly acidic cation exchange resin and a strongly basic anion exchange resin, either separately or as a mixed bed. The colour of the eluted material is measured and fractions of $> 204,000\ a^*_{420}$ discarded, those of $25,000 - 203,000\ a^*_{420}$ concentrated and recycled, and those of $< 24,000\ a^*_{420}$ concentrated and recovered as the final product.

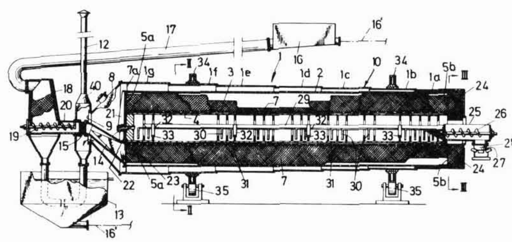
**Cane planter.** A. Diz, of West Palm Beach, FL, USA. **4,047,631.** December 9, 1976; September 13, 1977.

**Treatment of sugar cane with N-(perfluoroacyl)-N-phosphonomethyl glycine.** M. L. Rueppel, of Kirkwood, MO, USA, *assr.* Monsanto Co. **4,047,926.** May 3, 1976; September 13, 1977. – The ripening of sugar cane is modified and its sucrose yield increased by treatment (2 – 8 weeks before harvest) with an effective amount of a substance having a formula $C_nF_{2n+1}$-CO-N($CH_2COOH$)-$CH_2$-$HPO_2$-R, where R = H or $C_nF_{2n+1}CO$ and n is 1 - 4 [bis-N,O – trifluoroacetyl)-N-phosphonomethyl glycine].

**Beet harvester.** F. W. Eisenhardt and W. S. Tonsfeldt, *assrs.* Alloway Manufacturing Inc., of Fargo, ND, USA. **4,049,058.** August 28, 1975; September 20, 1977.

**Beet diffuser.** A. J. Gillain, of Brussels, Belgium, *assr.* Ateliers Belges Réunis. **4,049,386.** October 22, 1975; September 20, 1977.

The diffuser comprises a rotary drum 10 made of a number of cylindrical sections Ia, Ib, Ic....Ig, joined together and holding inside two co-axial cylindrical drums 2,3 of perforated metal. These are connected by radial walls 7 running the length of the drum and connected to it by extensions which thus form a rigid unit which rotates as one body. The space between the two perforated cylinders 2,3 is thus divided by walls 7 into a series of chambers running the length of the diffuser. The feed end is closed by a stationary baffle 21 having an aperture which corresponds to the cross section of the chamber, and a duct 14 is connected to this aperture so as to deliver beet cossettes to the feed end 5a of each chamber in turn as the drum rotates.



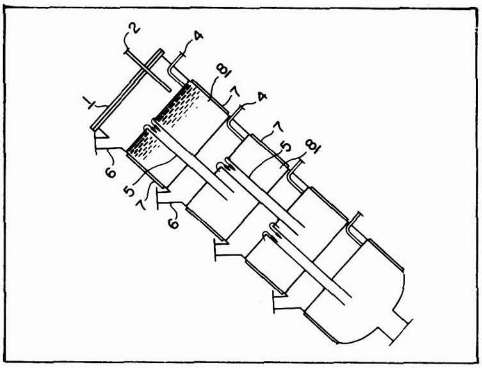
The cossettes are sent to the diffuser from scalder 16 and pass into the hopper 18; excess liquid drains into manifold 13. The cossettes are then delivered by screw 19 through an expansion bellows 15 into duct 14 and so successively into each chamber. The drum may be at a slight angle to encourage the movement of cossettes along the chamber as the drum rotates, exhausted cossettes finally being discharged from the ends 5b by means of paddles 24 into the outlet channel 25 from which they are taken by conveyor 26 to conveyor 27. Within the inner perforated drum 2 is mounted a beam, supported on small wheels 33, which carries pipes 30 through which extraction liquid and other material may be delivered to appropriate places along the drum. Water fed at the cossette discharge end of the drum eventually reaches the other end and overflows through the opening 9 in the end cover 8 into sheath 40 and so into the manifold 13. The counter-current passage of water and cossettes permits extraction of the sugar from the latter, intimate mixing being possible because the water can flow through the perforations in the walls and drums forming the boundaries of the chambers.

**Continuous sugar crystallization.** N. Nakazato, K. Hiratsuka and T. Furukawa, of Kudamatsu, Japan, *assrs.* Hitachi Ltd. **4,050,953.** June 21, 1976; September 27, 1977.

The evaporator-crystallizer is in the form of a number

[1] *I.S.J.*, 1980, **82**, 384.
[2] *ibid.*
[3] *ibid.*

of connected stages (preferably 5 – 15), each of which 8 is provided with a sugar solution inlet 4, a heating element 7, a vapour outlet 6 and an overflow 5 to the succeeding stage. An inlet 2 is provided for a seed crystal supply to the first stage while a slurry outlet leads from the final stage.

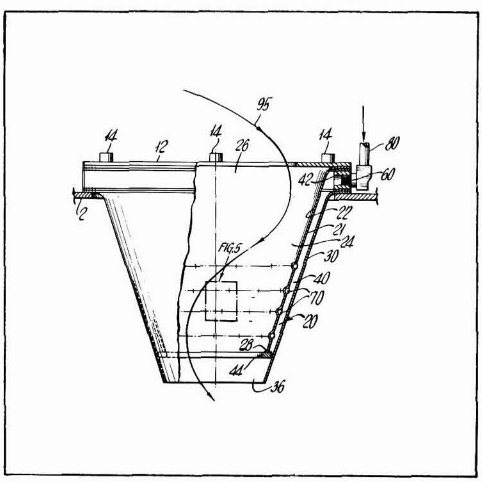


Sugar from the solution crystallizes onto the seed crystals as they pass through the successive stages and the occurrence of conglomerates and false grain is suppressed by providing inter-crystal distances of 0.26 – 0.59 mm in the solution in the first stage, and feeding the sugar solution into all stages except the first and last at an approximately equal rate, the feed to the first stage being at least 50% greater.

**Preheating device for a continuous centrifugal.** M. J. Vertenstein, of Denver, CO, USA, *assr.* CF & I Engineers Inc. **4,052,304.** July 21, 1976; October 4, 1977.

Crystal separation from a massecuite is better when the viscosity of the molasses is low, and devices have been used to reheat the massecuite to reduce the viscosity. Air drawn through the centrifugal cools the massecuite, however, and to overcome this the top cover 2 of the centrifugal supports two frustro-conical members 20, 30 closed by a flange 44 through which the massecuite feed passes.

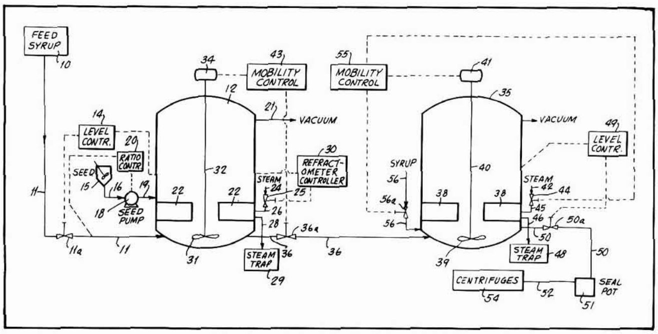
The upper space between the members is closed by a spacer 42 through which passes an inlet 60 for steam supplied through pipe 80. The inner member 20 is provided with nozzles 70 so that steam enters the space 40 between the members and is then directed downwardly, mixing with and warming the air drawn into the interior of the centrifugal by its rotation.




**Dextrose isomerase preparation.** J. M. Kelly and J. L. Meyers, of Stockton-on-Tees, England, *assrs.* Imperial Chemical Industries Ltd. **4,053,361.** March 24, 1975; October 11, 1977. – The enzyme is produced by cultivation (at 20 – 40°C and pH 4.5 – 8.0) of a *Curtobacterium* sp. *(C. citreum, C. pusillum, C. luteum, C. helvolum* or *C. alvedum)* in a medium containing a carbon source (dextrose or xylose) and inorganic nutrients (as well as ammonia, a nitrate, an amino-acid or urea as a source of N).

**Continuous crystallization of sugar.** M. Dmitrovsky and A. H. Kokke, *assrs.* Amstar Corporation, of New York, NY, USA. **4,056,364.** January 19, 1976; November 1, 1977.

The crystallization takes place in two vacuum pans




12, 35 operating in series, feed syrup being supplied to the first from a tank 10 through pipe 11 and valve 11a. The valve is regulated by a level controller 14 and seed crystal slurry is admitted from a tank 15 by way of a pump 18 and pipe 19, the amount being governed by the ratio controller 20 which adjusts it to suit the rate of refinery syrup feed. The contents of pan 12 are stirred by stirrer 31 driven by motor 34 and heated by a steam coil or other means 22. Steam flow is governed by the controller 30 which operates in proportion to the refractometric Brix of the massecuite mother liquor.

The mixture of mother liquor and crystals passes along pipe 36 to the second pan which is maintained at a lower vacuum than the first, is similarly provided with a stirrer 39 and heating device 38. Additional syrup may be added through pipe 56 and the steam supply is regulated in accordance with the mobility as determined from the stirrer motor current. A level control 49 is provided which governs the release of massecuite through discharge pipe 50. The conditions of temperature, etc. are such as to ensure appropriate growth of the small seed crystals in the first pan and of the larger crystals in the second pan.

# World sugar production estimates, 1980/81[1]

| | 1980/81 | 1979/80 | 1978/79 |
|---|---|---|---|
| | tonnes, raw value | | |
| BEET SUGAR | | | |
| Belgium/Luxembourg | 910,000 | 991,000 | 902,000 |
| Denmark | 455,000 | 492,000 | 442,000 |
| France | 4,230,000 | 4,313,000 | 4,063,000 |
| Germany, West | 2,800,000 | 3,088,000 | 2,997,000 |
| Holland | 895,000 | 927,000 | 1,034,000 |
| Ireland | 185,000 | 190,000 | 204,000 |
| Italy | 1,850,000 | 1,698,000 | 1,630,000 |
| UK | 1,240,000 | 1,255,000 | 1,109,000 |
| *Total EEC* | *12,565,000* | *12,954,000* | *12,381,000* |
| Austria | 435,000 | 408,000 | 357,000 |
| Finland | 120,000 | 100,000 | 104,000 |
| Greece | 205,000 | 319,000 | 354,000 |
| Spain | 945,000 | 714,000 | 1,128,000 |
| Sweden | 350,000 | 350,000 | 339,000 |
| Switzerland | 90,000 | 118,000 | 107,000 |
| Turkey | 1,180,000 | 1,068,000 | 1,096,000 |
| Yugoslavia | 805,000 | 852,000 | 780,000 |
| *Total West Europe* | *16,695,000* | *16,883,000* | *16,646,000* |
| Albania | 40,000 | 40,000 | 20,000 |
| Bulgaria | 230,000 | 240,000 | 180,000 |
| Czechoslovakia | 810,000 | 920,000 | 885,000 |
| Germany, East | 700,000 | 720,000 | 780,000 |
| Hungary | 445,000 | 511,000 | 553,000 |
| Poland | 1,300,000 | 1,580,000 | 1,763,000 |
| Rumania | 570,000 | 570,000 | 603,000 |
| USSR | 7,600,000 | 7,500,000 | 9,100,000 |
| *Total East Europe* | *11,695,000* | *12,081,000* | *13,884,000* |
| Afghanistan | 4,000 | 4,000 | 15,000 |
| Algeria | 10,000 | 12,000 | 12,000 |
| Azores | 9,000 | 9,000 | 8,000 |
| Canada | 115,000 | 110,000 | 129,000 |
| Chile | 230,000 | 63,000 | 104,000 |
| China | 650,000 | 510,000 | 435,000 |
| Iran | 400,000 | 500,000 | 493,000 |
| Iraq | 10,000 | 13,000 | 14,000 |
| Israel | 0 | 14,000 | 15,000 |
| Japan | 515,000 | 512,000 | 406,000 |
| Lebanon | 12,000 | 12,000 | 13,000 |
| Morocco | 330,000 | 335,000 | 362,000 |
| Pakistan | 32,000 | 32,000 | 34,000 |
| Syria | 32,000 | 11,000 | 20,000 |
| Tunisia | 8,000 | 7,000 | 9,000 |
| Uruguay | 55,000 | 45,000 | 47,000 |
| USA | 2,675,000 | 2,616,000 | 2,984,000 |
| *Total Other Continents* | *5,087,000* | *4,805,000* | *5,100,000* |
| Total Beet Sugar | 33,477,000 | 33,769,000 | 35,630,000 |
| CANE SUGAR | | | |
| Spain | 3,000 | 4,000 | 5,000 |
| *Total Europe* | *3,000* | *4,000* | *5,000* |
| Barbados | 125,000 | 139,000 | 117,000 |
| Belize | 110,000 | 112,000 | 103,000 |
| Costa Rica | 209,000 | 198,000 | 195,000 |
| Cuba | 5,800,000 | 6,800,000 | 8,048,000 |
| Dominican Republic | 1,180,000 | 1,100,000 | 1,222,000 |
| Guadeloupe | 110,000 | 96,000 | 111,000 |
| Guatemala | 480,000 | 398,000 | 376,000 |
| Haiti | 65,000 | 59,000 | 65,000 |
| Honduras | 220,000 | 187,000 | 169,000 |
| Jamaica | 265,000 | 254,000 | 291,000 |
| Martinique | 7,000 | 8,000 | 10,000 |
| Mexico | 2,790,000 | 2,784,000 | 3,078,000 |
| Nicaragua | 227,000 | 178,000 | 212,000 |
| Panama | 235,000 | 225,000 | 226,000 |
| Puerto Rico | 160,000 | 175,000 | 177,000 |
| St. Kitts | 38,000 | 35,000 | 41,000 |
| El Salvador | 215,000 | 192,000 | 284,000 |
| Trinidad | 120,000 | 127,000 | 144,000 |
| USA – Hawaii* | 973,000 | 992,000 | 961,000 |
| – Mainland | 1,540,000 | 1,518,000 | 1,436,000 |
| *Total N. & C. America* | *14,869,000* | *15,577,000* | *17,266,000* |

| | 1980/81 | 1979/80 | 1978/79 |
|---|---|---|---|
| | tonnes, raw value | | |
| CANE SUGAR, contd. | | | |
| Argentina | 1,600,000 | 1,411,000 | 1,397,000 |
| Bolivia | 290,000 | 295,000 | 289,000 |
| Brazil | 8,300,000 | 7,017,000 | 7,767,000 |
| Colombia* | 1,280,000 | 1,233,000 | 1,107,000 |
| Ecuador | 350,000 | 352,000 | 353,000 |
| Guyana* | 300,000 | 310,000 | 316,000 |
| Paraguay | 75,000 | 68,000 | 69,000 |
| Peru* | 540,000 | 580,000 | 715,000 |
| Surinam | 12,000 | 12,000 | 10,000 |
| Uruguay | 45,000 | 26,000 | 47,000 |
| Venezuela | 390,000 | 395,000 | 351,000 |
| *Total S. America* | *13,182,000* | *11,699,000* | *12,421,000* |
| Angola | 40,000 | 36,000 | 39,000 |
| Cameroun | 55,000 | 50,000 | 45,000 |
| Chad | 30,000 | 20,000 | 20,000 |
| Congo | 25,000 | 20,000 | 20,000 |
| Egypt | 675,000 | 672,000 | 678,000 |
| Ethiopia | 166,000 | 164,000 | 166,000 |
| Ghana | 8,000 | 6,000 | 8,000 |
| Ivory Coast | 150,000 | 111,000 | 47,000 |
| Kenya | 435,000 | 420,000 | 322,000 |
| Liberia | 4,000 | 4,000 | 3,000 |
| Madagascar | 113,000 | 106,000 | 123,000 |
| Madeira | 1,000 | 1,000 | 1,000 |
| Malawi | 145,000 | 114,000 | 97,000 |
| Mali | 18,000 | 16,000 | 15,000 |
| Mauritius | 500,000 | 730,000 | 705,000 |
| Morocco | 38,000 | 24,000 | 36,000 |
| Mozambique | 220,000 | 214,000 | 180,000 |
| Nigeria | 38,000 | 35,000 | 31,000 |
| Réunion | 260,000 | 262,000 | 273,000 |
| Senegal | 55,000 | 41,000 | 20,000 |
| Somalia | 45,000 | 35,000 | 30,000 |
| South Africa | 1,745,000 | 2,244,000 | 2,241,000 |
| Sudan | 330,000 | 141,000 | 146,000 |
| Swaziland | 330,000 | 253,000 | 262,000 |
| Tanzania | 130,000 | 114,000 | 120,000 |
| Uganda | 10,000 | 5,000 | 4,000 |
| Upper Volta | 30,000 | 28,000 | 31,000 |
| Zaire | 50,000 | 55,000 | 52,000 |
| Zambia | 110,000 | 102,000 | 73,000 |
| Zimbabwe | 345,000 | 314,000 | 319,000 |
| *Total Africa* | *6,101,000* | *6,337,000* | *6,107,000* |
| Bangladesh | 172,000 | 101,000 | 142,000 |
| Burma | 40,000 | 39,000 | 40,000 |
| China | 2,200,000 | 2,180,000 | 2,285,000 |
| India | 5,900,000 | 4,240,000 | 6,367,000 |
| Indonesia | 1,440,000 | 1,400,000 | 1,336,000 |
| Iran | 100,000 | 150,000 | 160,000 |
| Iraq | 15,000 | 25,000 | 20,000 |
| Japan | 248,000 | 241,000 | 302,000 |
| Malaysia | 60,000 | 90,000 | 75,000 |
| Nepal | 15,000 | 15,000 | 25,000 |
| Pakistan | 870,000 | 592,000 | 628,000 |
| Philippines | 2,420,000 | 2,375,000 | 2,342,000 |
| Sri Lanka | 25,000 | 20,000 | 27,000 |
| Taiwan | 760,000 | 873,000 | 891,000 |
| Thailand | 1,265,000 | 1,032,000 | 1,862,000 |
| Vietnam | 50,000 | 30,000 | 25,000 |
| *Total Asia* | *15,580,000* | *13,403,000* | *16,527,000* |
| Australia | 3,335,000 | 3,040,000 | 2,978,000 |
| Fiji | 495,000 | 490,000 | 359,000 |
| *Total Oceania* | *3,830,000* | *3,530,000* | *3,337,000* |
| Total Cane Sugar | 53,565,000 | 50,550,000 | 55,663,000 |
| Total Beet Sugar | 33,477,000 | 33,769,000 | 35,630,000 |
| Total World Sugar | 87,042,000 | 84,319,000 | 91,293,000 |

* 1981, 1980, 1979 calendar years.

1 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 625-629.

# BREVITIES

**South African sugar factory**[1]. — It was announced in August that Huletts are to build on the Natal North Coast what will be the largest sugar factory in South Africa. The project is subject to government approval and suitable financial arrangements. It will cost R 120,000,000 and will produce about 500,000 tonnes of sugar a year. The new factory will replace the ageing Felixton and Empangeni mills which will be closed. At present Felixton can make up to 105,000 tonnes a year and Empangeni more than 130,000 tonnes. The new factory will be built in two stages; the first will start operating from April 1983 at an estimated 300 t.c.h. and take cane from Empangeni which will close in December 1982. Felixton will close at the end of 1983 and the milling rate of the new factory will then be increased to 600 t.c.h.

**Sugar refinery for Kenya.** — Finnsugar Engineering, a division of the Finnish Sugar Co. Ltd., has been awarded a contract for the supply of Kenya's first sugar refinery. It is to be built for Miwani Sugar Mills Ltd. and will have an initial capacity of 36,000 tonnes of refined sugar per year, with the possibility of later expansion to 60,000 tonnes. Finnsugar Engineering will take care of the process design, supply of equipment, personnel training, installation supervision and commissioning of the plant, which is intended to start production in 1982. Finland has great experience in the refining of raw cane sugar; the first Finnish refinery was founded in 1756 and refining has continued since. Today there are two refineries in Finland, the Porkkala refinery, built in 1965 and one of the most modern in Europe, which has a daily capacity of 700 tonnes of sugar, and the Vaasa refinery, the most northerly in Europe, which processes 350 tonnes daily.

**Oil, sugar and alcohol.** — It has become evident that the war between Iran and Iraq is not the lightning affair originally expected and that it may continue for some time, with disruption of oil supplies from the two countries as well as damage to the production and refining installations. This can only lead to pressure on oil prices which will cause many of the tropical sugar producers to consider very carefully the desirability of committing themselves, as Brazil has done, to a program of alcohol production as a fuel substitute to reduce their dependence on increasingly expensive and hazardous supplies of oil. This will, of course, require very large investments of capital but also will tend to reduce the availability of cane for production of sugar. Although this would be a longer-term effect, since distilleries are not established overnight, it could be an aggravating factor in the not too distant future if investment in new crop plantings and sugar production plants are not expanded.

**New sugar statistics publication.** — F. O. Licht are to introduce a new publication of pocket size, protected by a plastic cover, which will provide sugar supply and distribution statistics for the period 1970/71 to 1979/80, covering 115 countries' individual figures, international tables of production, consumption, imports, exports and final stocks, as well as consumption trends for the next five years. The price will be DM 65, £16 or US $37.50 and it will be available from F. O. Licht, P. O. Box 1220, D-2418 Ratzeburg, Germany.

**UK 1981 beet payment.** — Prices, terms and conditions for purchase of the 1981 sugar beet crop have been determined by Professor D. K. Britton following lack of agreement between the National Farmers Union and the British Sugar Corporation Ltd.[2] The price is to be the minimum applicable under EEC regulations plus a pulp allowance of £1.51 per tonne of clean beet, adjustable in accordance with pulp selling price, plus other allowances totalling £0.75 per tonne. If the EEC minimum price falls short of £22.52 per tonne the UK payment will be increased by half the difference while, if the regional premium is removed or partly removed for 1981/82, a further allowance of £0.20 or a proportion of this amount will be added. Assuming a beet pulp price of £95 per tonne and a minimum price rise of 5% compared with 1980/81, this would yield £24.78 per tonne if the regional premium is retained or £24.49 if it is removed, compared with the likely level of £23.90 for the current campaign.

## Colombia sugar exports[3]

| | 1979 | 1978 |
|---|---|---|
| | tonnes, raw value | |
| Chile | 98,994 | 24,000 |
| China | 24,000 | 0 |
| Morocco | 24,800 | 0 |
| Portugal | 72,520 | 0 |
| Tunisia | 12,240 | 12,000 |
| USA | 45,480 | 96,000 |
| | 278,034 | 132,000 |

**Major sugar project in Somalia.** — Somalia's largest development scheme, the US $188 million Juba Sugar Project, was inaugurated on September 3, 1980. It is situated on the west bank of the Juba River, 105 km north of the port of Kismayo in the Middle Juba region. The project is expected to produce 70,000 tonnes of mill white sugar per annum by 1984 and commercial production has already started on schedule. The Juba Sugar Project was formed as an autonomous agency in July 1977 following two years of feasibility, planning and design studies and field trials by Booker Agriculture International Ltd. who now act as managing agents. Implementation of the project has involved the development of 8000 hectares of irrigated sugar cane, erection of a sugar factory processing 3360 tonnes of cane per day, and the construction of estate buildings, housing, roads and infrastructure. The factory, with a production capacity of 1700 tonnes of sugar per week over a crushing season of 41 weeks, has been designed, supplied and commissioned by Fletcher and Stewart Ltd. It will produce raw sugar of 99° pol but provision has been made for future extension to 5280 t.c.d. and conversion if required to 50% raw and 50% white sugar output. Furthermore, consideration has been given in the design to future addition of a distillery to consume all the final molasses produced. Prior to the project, Somalia produced 32,000 tonnes of sugar, raw value, against consumption in 1979/80 of 63,000 tonnes. The new plant will therefore make Somalia self-sufficient in sugar by 1981 and provide a likely surplus of 20,000 tonnes for export by 1984.

**Beet pile reclamation order.** — The Bray-sur-Seine sugar factory has recently ordered from Soc. Nouvelle des Ets. A. Maguin a beet storage installation including a dry beet reclamation unit which incorporates a screw conveyor. Experiments on the design were conducted during the 1979/80 campaign and the new unit is operating in the 1980/81 campaign.

### PERSONAL NOTES

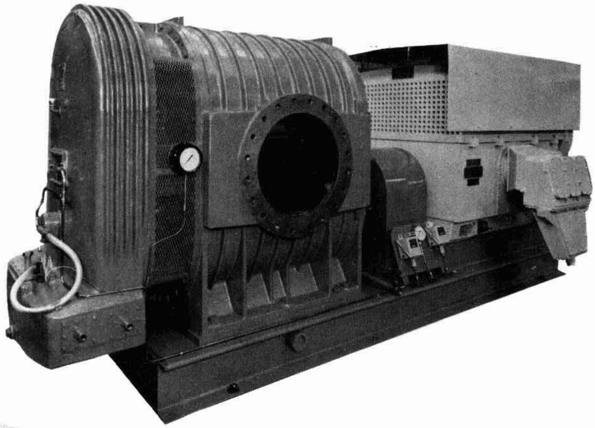
On September 18, **Prof. Dr. Ing. Stanislaw Zagrodzki** died suddenly in Warsaw, Poland. Born in 1906, he was a world-renowned expert on sugar technology, teaching and conducting research at Lodz Technical University. As well as being a member of the Food Technology and Chemistry Committee of the Polish Academy of Sciences, he was an active member of the Scientific Committee of the Commission Internationale Technique de Sucrerie, of ICUMSA, and of many other organizations. He was an author and co-author of 220 papers and had patented 40 inventions.

**G. E. (Gus) Hrudka** died suddenly on September 10. Born in Austria, he worked for various sugar companies in Germany, the USA (Colorado, California and Hawaii), Ireland and Turkey, moving to Canada where he spent six years with the Manitoba Sugar Company before joining Canada & Dominion Sugar Co. as General Superintendent of the beet sugar division in 1944. In 1957 he moved to Toronto as project engineer of the new Toronto Redpath refinery of which he became Refinery Manager. In 1964 he was appointed Vice President in charge of beet operations and he retired in 1968, thereafter acting as a consultant.

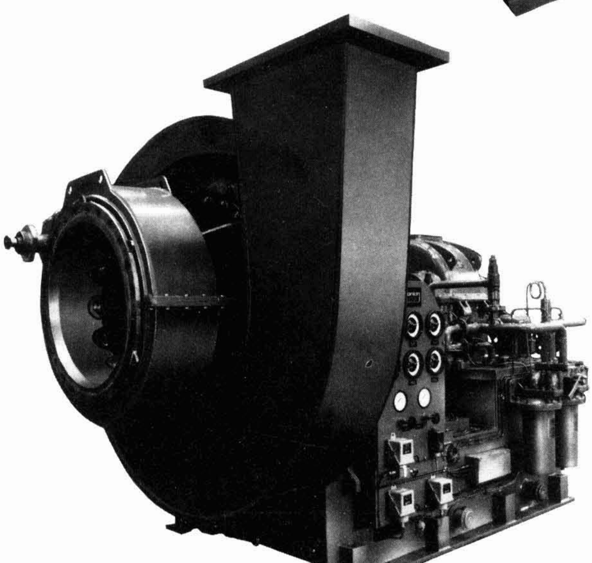
Six well-known cane research workers, most with 30 years of service, have retired from Louisiana State University this year. They include **Dr. Elias Paliatseas, Dr. René Steib, Dr. J. Campbell, Dr. E. P. Roy, Dr. E. R. Stamper** and **Dr. M. T. Henderson.**

**John López-Oña** has won the Meade Award of Sugar Industry Technologists for the best paper presented at the Annual Meeting in Chicago in May of this year. A plaque will be presented to him at the 1981 meeting in March. This is the second occasion that Mr. López-Oña has won the award.

[1] *S. African Sugar J.*, 1980, **64**, 332.
[2] See *I.S.J.*, 1980, **82**, 356.
[3] *I.S.O. Stat. Bull.*, 1980, **39**, (8), 28.







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