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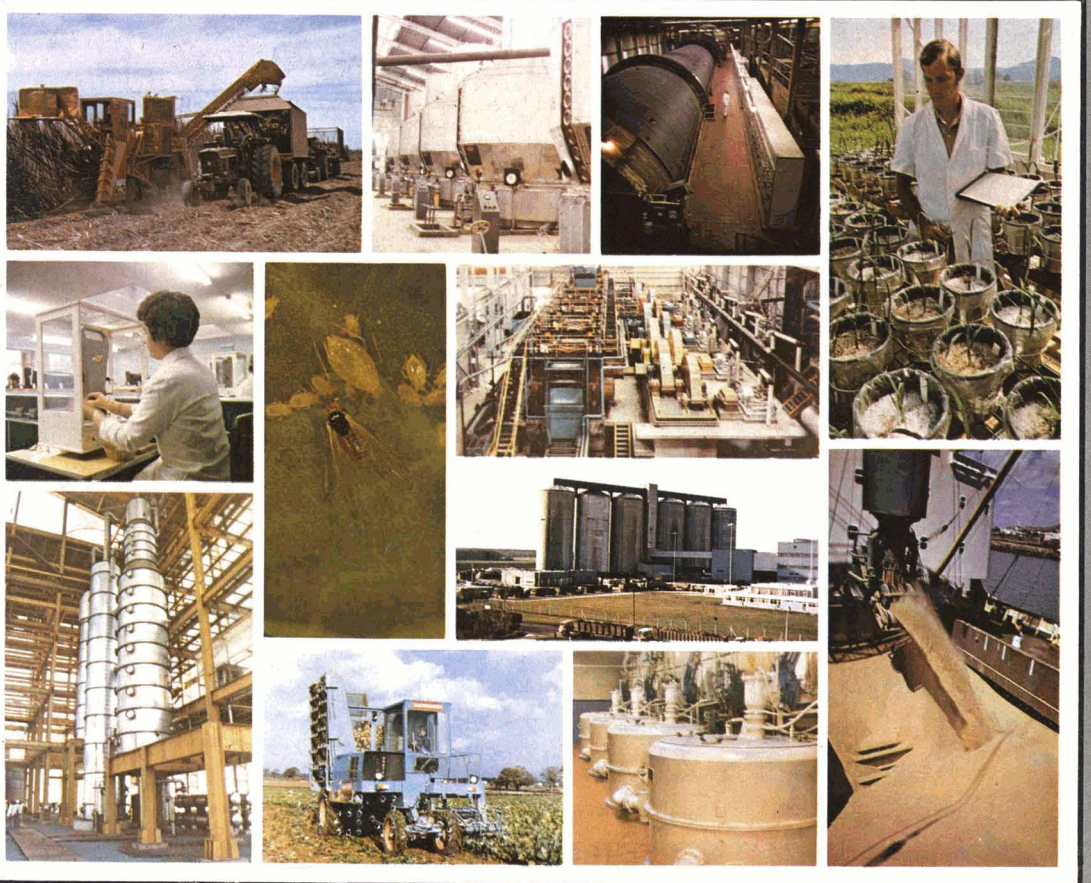

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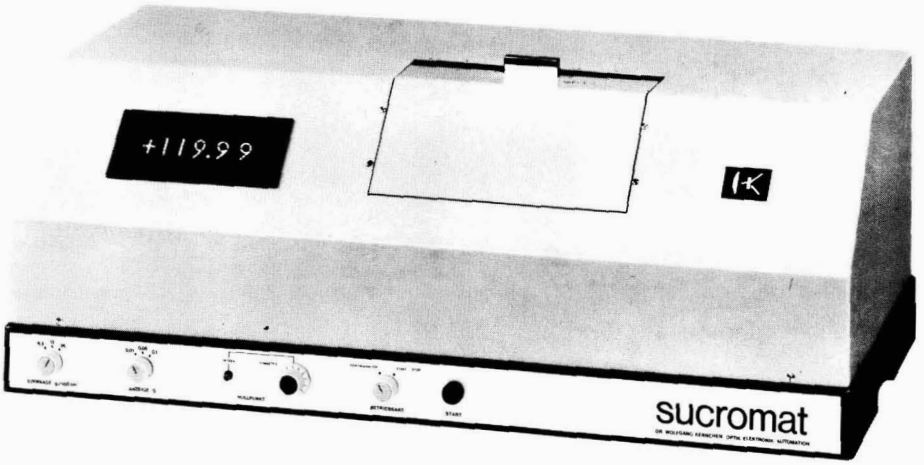

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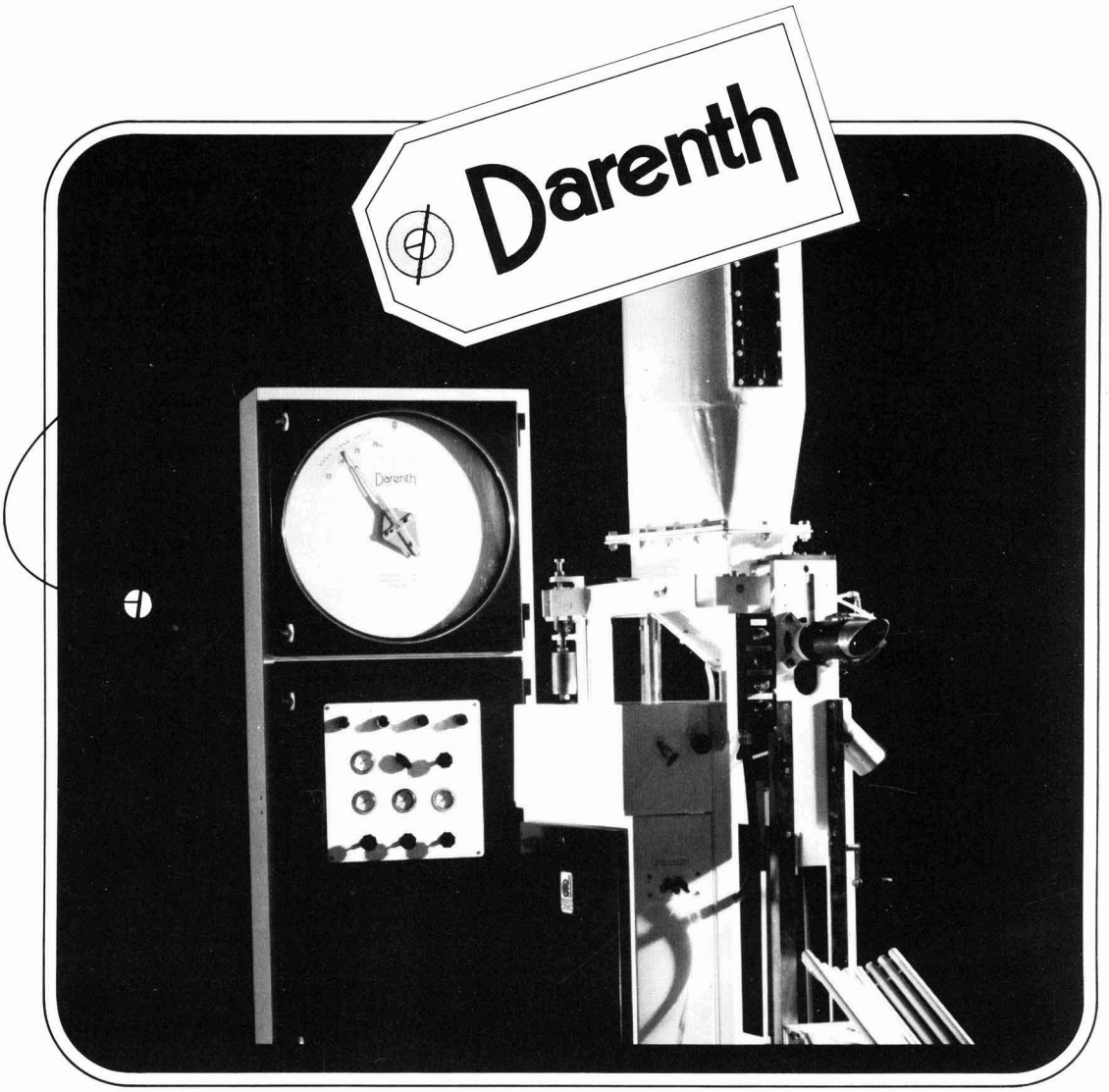

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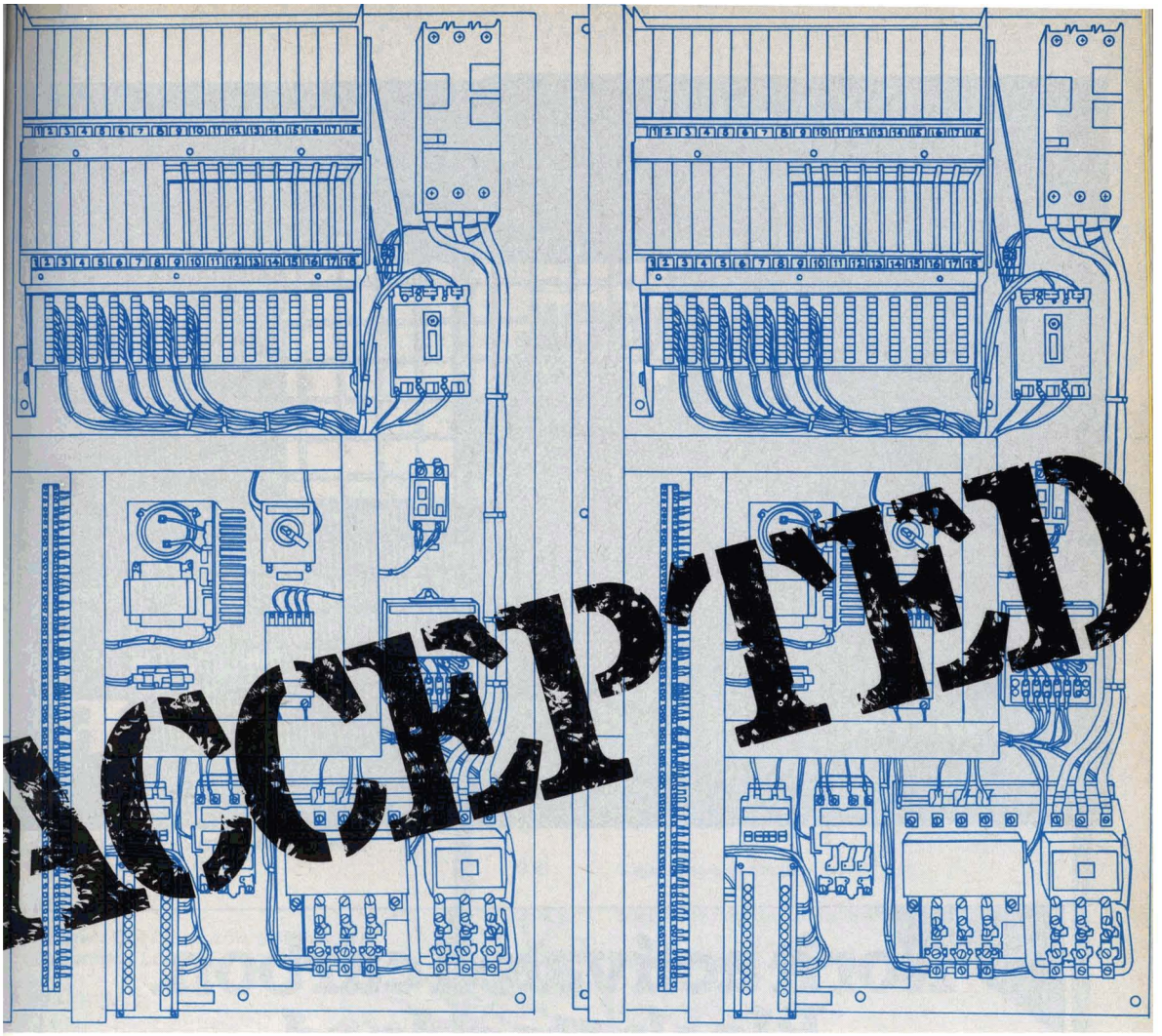

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NOTES AND COMMENTS

World sugar prices

During the first 11 days of September the LDP did not vary greatly from its initial figure of £317 per tonne; on September 12, however, it jumped by no less than £47 on news that the Soviet Union had purchased a substantial amount of sugar, believed to be between 1 and 1.65 million tonnes, from a number of trade houses. It had been anticipated that purchases of 2 million tonnes or more would be required eventually but these usually take place at the end of the year and the market was surprised by the timing which indicates pessimism about the 1980/81 beet sugar crop. The start of the campaign had been postponed to September 20 in order to gain benefit from a higher sugar content, and Cuban supplies to the USSR are expected to be 30% less than previously, owing to production shortfalls on that island. Some observers now believe that Soviet requirements could be higher than previously expected and this, together with reports of further purchases by the USSR, Venezuela, Poland and China, served to strengthen the market so that the LDP remained betweeen £345 and £374 during the rest of the month, ending at £370 on September 30.

White sugar prices followed the pattern of raw sugar prices but were at a discount to the LDP values during much of the month, reflecting the easier availability while white sugar purchasing interest converted this to a premium in the second half. From a level of £314 on September 1, the LDP(W) declined to as low as £305 on September 3, rising again to £314 by September 11 and then to £345 the following day. On September 19 it reached £380 but closed the month at £365.

Soviet sugar purchases[1]

Towards the end of September, after the reports of earlier purchases of sugar by the USSR, traders in London suggested that the Soviet Union was interested in additional supplies. Total requirements are thought likely to amount to between 3½ and 4 million tonnes in the next few months as the Russians may decide to use home-grown beet of lower sugar content as animal feed and purchase sugar from abroad. They are believed to be more concerned with harvesting their grain than their sugar beet and the decision to commence the beet harvest later than usual in order to allow more time for root growth may, in fact, be connected with shortages of transport needed for the grain harvest.

Reports have indicated that the USSR may be turning to Brazil as a possible source of supply. Whilst some kind of a deal may be made, traders feel that Brazil does not offer much hope if the Russians are looking for really large tonnages. There have been suggestions this year that Brazil might find it profitable to divert sugar from her alcohol program into export markets as prices move higher. But with consumption over 6 million tonnes and total availability put at between 8 and 8½ million tonnes, only around 200,000 uncommitted tonnes will be available for export if the alcohol program is to be maintained.

A large amount of capital – much of it foreign – has been invested in the alcohol program which Brazil does not want to jeopardize. Oil prices will undoubtedly rise in the years ahead, whereas sugar prices are much more of an unknown quantity. It therefore makes sense for Brazil to do her best to ensure that she has an adequate supply of petroleum products than to make a quick killing on the sugar market.

New sugar regime proposals by the EEC Commission

At the September 30 meeting of the Farm Ministers of the European Economic Community, the Commission put forward new proposals for a sugar regime to replace that which should have expired on June 30 last but was prolonged for a further year because of disagreement over the original proposals[2]. The new regime is to last to 1985/86.

The proposals feature a cut in quotas and increased contributions by producers to the cost of disposing of surpluses. The *A*-production quotas are left unchanged but the *B*-quotas are cut by more than 400,000 tonnes to bring them in line with past performance; this is achieved by increases in the quotas of Metropolitan France, Denmark and Germany but decreases in the other members' *B*-quotas. The figures are tabulated below:

	Proposed quotas 1981/82 – 1985/86			1980/81 quotas		
	A	B	Total	A	B	Total
	1000 tonnes, white value					
Belgium-Luxembourg	680	81	761	680	187	867
Denmark	328	97	425	328	90	418
France: Metropolitan	2,530	759	3,289	2,530	696	3,226
D.O.M.	466	23	489	466	128	594
Germany, West	1,990	611	2,601	1,990	547	2,537
Holland	690	168	858	690	90	880
Ireland	182	9	191	182	50	232
Italy	1,230	297	1,527	1,230	338	1,568
UK	1,040	52	1,092	1,040	286	1,326
	9,136	2,097	11,233	9,136	2,512	11,648

The Commission proposes the abolition of regional intervention prices for the French Overseas Departments, Italy, Ireland and the UK, and also of the present target price system. Italy and France would be allowed to continue their national aids but these would be reduced by one-fifth per year during the period and so phased out by the end of the life of the regime. While the *B*-quotas are reduced, it is thought that the redistribution to countries able to take up the entitlements would in practice produce a slightly higher amount of *B*-quota sugar.

During the period up to the relatively recent time when world prices overtook Community levels, the EEC budget has had to provide substantial funds to subsidize exports of quota sugar. The Commission proposes a basic production levy of 2.5% of the intervention price to be imposed on *A*- and *B*-quota sugar, the *B*-quota levy being variable to provide greater funds, and, should the levy income be insufficient to cover disposal losses, the balance could be carried over to the following year. The status of *C*-quota sugar would remain virtually unchanged.

The proposals are to be studied by the EEC Ministers but a prompt response came from Tate & Lyle whose Chairman, Lord Jellicoe, stated that they were unacceptable to his company since, at the proposed level of UK beet sugar production, there would be insufficient demand for refined cane sugar to permit the refineries to operate at a profitable throughput and this would mean a further reduction in refining capacity and the Company's ability to handle all the ACP raw sugar traditionally exported to the UK for refining.

[1] *Public Ledger Commodity Week*, September 27, 1980.
[2] *I.S.J.*, 1980, **82**, 1.

European beet sugar production, 1980/81

F.O. Licht GmbH recently published their first estimate of sugar production for the 1980/81 campaign[1]; of necessity this must be a crude approximation, subject to changes resulting from the vagaries of the weather, but it does give an early indication that sugar production may be 2% below that of 1979/80.

Early beet tests published in the different countries have been variable although in general terms they seem to indicate no better than average crops in most countries and somewhat poorer in many, especially that of West Germany. The Italian figure is set marginally higher by Licht, however, while, despite higher production anticipated in Spain and Turkey, both countries may need to import sugar to cover domestic requirements as also will Greece, where the beet area has been reduced.

In East Europe, poor crop prospects coupled with lower deliveries from Cuba have already forced some countries to buy sugar on the world market. For the region as a whole, however, the expectation is for a larger outturn, as a result of an anticipated recovery in the USSR. According to Licht, weather conditions, although not ideal, have not been as adverse as in 1979. The figures are reproduced below:

	1980/81	1979/80	1978/79
	tonnes, raw value		
Western Europe			
Belgium/Luxembourg	870,000	991,000	902,000
Denmark	455,000	492,000	442,000
France	4,150,000	4,313,000	4,063,000
Germany, West	2,705,000	3,088,000	2,997,000
Holland	870,000	927,000	1,034,000
Ireland	190,000	190,000	204,000
Italy	1,700,000	1,698,000	1,630,000
UK	1,200,000	1,255,000	1,109,000
Total EEC	*12,185,000*	*12,954,000*	*12,381,000*
Austria	435,000	408,000	357,000
Finland	95,000	100,000	104,000
Greece	220,000	319,000	354,000
Spain	900,000	714,000	1,128,000
Sweden	340,000	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 Western Europe	*16,250,000*	*16,883,000*	*16,646,000*
Eastern Europe			
Albania	40,000	40,000	20,000
Bulgaria	230,000	240,000	180,000
Czechoslovakia	840,000	920,000	885,000
Germany, East	650,000	720,000	780,000
Hungary	430,000	511,000	553,000
Poland	1,450,000	1,580,000	1,763,000
Rumania	550,000	570,000	603,000
USSR	8,000,000	7,500,000	9,100,000
Total Eastern Europe	*12,190,000*	*12,081,000*	*13,884,000*
Total Europe	*28,440,000*	*28,964,000*	*30,530,000*

US sugar consumption and exports[2]

Sugar consumption in the continental United States this year has been running behind the levels recorded in 1979. There are many factors contributing to this trend such as the higher prices for sugar and the general trade recession together with the poor weather in a number of areas at different times and the further steady growth of high fructose corn syrups. With no major swings in the level of supplies from domestic crops there might have been the prospect of a noticeable cutback in the activity of US refiners this year. As it is, there has been a significant expansion in the re-export of US refined sugar which could more than counterbalance the lower domestic demand and consequently the level of US refiners' melt has not suffered.

Estimates of the likely quantity of refined sugar exports from the USA this year are around 400-500,000 tonnes which compares with 20-21,000 tonnes in each of the previous two years. There are a number of customary exporters which this year have had to resort to imports, such as Peru and Mexico, but while these outlets have provided the demand for US sugar it has been the US drawback arrangements which have given refiners the chance of being competitive in the world market. Under these measures, a refiner is able to reclaim both the duty and fee paid on imported raw sugar on the re-export of a corresponding amount of refined within three years. The low prices which prevailed for much of last year resulted in duties/fees being levied up to totals of 6.1725 per lb.

West Indies sugar industries situation[3]

At the end of June, the Sugar Association of the Caribbean estimated sugar production at some 950,000 tonnes raw value. Reports since then, however, make it plain that total production will be well below that figure. Except in Guyana, the 1980 harvests are finished, and the final 1980 production, in round figures (tonnes, raw value), is likely to be:

Barbados	139,000
Guyana	320,000
Jamaica	254,000
St. Kitts	37,000
Trinidad	127,000
	877,000

This will be the lowest figure since 1950 and only some 60% of the peak production of 1965. The downward trend already noticed on several occasions thus continues.

In spite of heavy losses by cane fires and a shortage of field labour early in the crop, the Barbados production exceeded the earlier estimates by several thousand tonnes, owing to a good yield of cane resulting from good growing weather and an extension of the harvest being permitted by favourable weather. This was the highest production since 1970 and would have been higher but for the loss of thousands of tonnes of cane by fire which could not be reaped. In Guyana the spring crop was beset by cane fires and industrial problems and production was well below the estimates. At the end of May under 110,000 tonnes had been produced. Heavy rains have affected the beginning of the autumn crop and 1980 production is not likely to be very much, if any, higher than the poor 1979 figure.

Jamaica continues on the downward path with production likely to be the lowest in thirty years. A variety of causes has been quoted but it is to be feared that the general malaise of Jamaica is showing itself in the sugar industry. The St. Kitts production was adversely affected by labour shortages and cane fires and a final total of 37,000 tonnes has halted the promising trend of rising production which started in 1976/77. The Trinidad crop was a disaster, owing to cane fires, disease and industrial problems. The production of 127,000 tonnes was the lowest for over thirty years.

Local consumption at around 229,000 tonnes means that export availability from the 1980 crop will not reach 650,000 tonnes – again the worst performance for over thirty years.

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[1] *International Sugar Rpt.*, 1980, **112**, 495-498.
[2] C. Czarnikow Ltd., *Sugar Review*, 1980, (1511), 189-190.
[3] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 489.

Sugar losses and colour variations during clarification

By EUGENIO RUBIO, B.Chem.
(Cuban Sugar Research Institute, ICINAZ)

Introduction

In order to improve clarification it is necessary to make a study of the various parameters involved in the process. This operation is one of the most important in sugar production since the removal of impurities subsequently influencing the other stages of the production process depends on its efficiency.

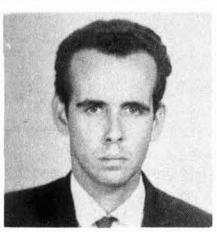
Interesting studies have been conducted by various institutions in Cuba working on three main lines: (a) development of new clarification equipment[1,2,3]; (b) study of new clarification techniques[4,5,6]; and (c) characterization studies on present clarification systems[7,8]. The improvement of clarification, however, calls for studies on the various chemico-physical reactions taking place.

During the 1979 campaign a characterization study with juices from Manuel Martínez Prieto sugar factory[9] was conducted at the Cuban Sugar Research Institute, the following results being obtained:

(a) The content of soluble solids was similar for mixed juice, limed juice and clarified juice; there was a slight tendency for a higher content in mixed juice.
(b) Polarization was similar for the three juices, with a slight tendency for lower polarization in limed juice.
(c) Similar observations were made in respect of purity, with a slight tendency for higher values in clarified juice.
(d) Colloid composition was similar in mixed and limed juices, with an apparent decrease in clarified juice.
(e) The clarifier bottom tray is where the colour of clarified juice increased the most.
(f) The calcium content of limed juice was greater than in clarified juice, and thus greater than in mixed juice. The order of magnesium contents was: limed juice > mixed juice > clarified juice.

A study on inversion losses in a clarifier[10] was also conducted at ICINAZ for which purpose one of the clarifiers in Manuel Martínez Prieto sugar factory was used. For the present work, the author followed the inversion losses calculation method whereby the calculation is made by means of tables recommended in the sugar literature[11] for this purpose and which have been previously used in other works related to the evaporation station[12,13].

This paper presents a comparative study of the behaviour of two fundamental parameters, i.e. pH and colour, during the 1978 and 1979 campaigns in one and the same clarifier (a modified DIAZCO model) at Manuel Martínez Prieto sugar factory.



Eugenio Rubio

These two parameters mentioned above have been selected because the study of pH is fundamental both for the quality of clarification and for the calculation of inversion losses, and because colour is one of the limitations to the quality of sugar to which paramount importance is attached.

Materials and methods

(a) *Materials:*
The industrial products used were juices taken from the overflow box of one clarifier at Manuel Martínez Prieto sugar factory. The equipment used were: refractometer, pH meter, hot plate and spectrophotometer. Some other auxiliary materials were used, i.e. beakers, thermometers, distilled water, buffer solution of pH 7, etc.
(b) The following techniques were used:
(1) Soluble solids: refractometric determination with subsequent temperature correction.
(2) pH: measurement of this parameter for each product at 30° and 70°C.
(3) colour: neutralization to pH 7 of the juices to be analysed and measurement as E_{560}.

Work and calculation method

In order to find the magnitude of inversion losses in clarification it is necessary to know the pH of the juices at the temperature of the clarifier and also the holding time.

For the calculation of the pH 20 experimental runs were made in each of the trays, calculating the pH of the product being processed by determining and dpH/dT coefficient from the pH readings at 30 and 70°C for each case. Having worked out the pH value, and knowing the working temperature, we can then find the percentage of sucrose inversion per hour.

The holding time for each of the campaigns mentioned before, i.e. 1978 and 1979, in both cases was calculated from the general data available from those two campaigns, since the holding time changes constantly depending upon the flow rate. It is calculated from the expression

$$t_r = \frac{V}{V_f}$$

where t_r = holding time,
V = usable volume of the clarifier, and

1 Avalo: *ATAC*, 1966, **21**, 50.
2 Ibáñez: "The DMI, 4 in 1 - MINAZ multiple clarifier system" (Division of Industrial Maintenance, Dept. of Process Equipment, MINAZ, Havana) 1977.
3 Galbán & Morales: "Evaluation of the DTC clarifier" (ICINAZ, Quivicán), 1976.
4 Cardet: *CubaAzúcar*, 1967 (May-June), 34.
5 Argudín: *ibid.*, 1968, (Jan.-Feb.), 27.
6 Morales: *ibid.*, 1975, (Jan.-March), 43.
7 Guerra, Valdés & Rodríguez: *Paper presented to 41st Conf. ATAC*, 1977.
8 Jover, Fajardo & Bobrovnik: *ibid.*
9 Rubio, Cervera & Janigova: *Report ICINAZ*, 1978.
10 Rubio & Cervera: *ibid.*
11 Honig: *ATAC*, 1968, **23**, (1), 50.
12 Rubio: *Report ICINAZ*, 1977.
13 Idem: *ibid.*, 1976.

V_f = flow rate per hour.

V is calculated by subtracting approximately 10% from the total volume of the clarifier to allow for internal components. V_f is obtained by means of the expression $V_f = V_{JM} + V_{JF}$

where V_{JM} = flow rate of mixed juice, and
V_{JF} = flow rate of filtered juice.

$$V_{JM} = \frac{\text{Tonnes of mixed juice during the campaign}}{\text{actual crushing time (hours)}}$$

= tonnes of mixed juice/hour

If the resulting figure is multiplied by 1000 we will find the mixed juice flow rate in $kg.hr^{-1}$ and then, by dividing by the concentration of the juice during the campaign (P_{JM}), we will have the volume of mixed juice per hour.

Although an empirical figure, 15% is quite acceptable as the amount of filtered juice that is recirculated, whence

$$V_f = V_{JM} + 0.15\, V_{JM}$$

Once the holding time has been calculated and the percentage of sucrose inversion/hour and the tonnes of pol in the mixed juice are found, we are in a position to establish the inversion losses experienced during the campaign.

The variation of colour during clarification was also studied during the 1978 and 1979 campaigns throughout all the trays in the clarifier at Manuel Martínez Prieto sugar factory in which the pH study was conducted. For this purpose 20 juice samples simultaneously taken from each tray were analysed with a spectrophotometer, measuring extinction at 560 nm.

Results

(a) *1978 campaign*

Table I shows the experimental pH values for 20 juice samples at 70°C from the trays of the clarifier at Manuel Martínez Prieto sugar factory; Table II shows the data obtained for a temperature of 30°C.

Table I. pH values at 70°C in one of the clarifiers of Manuel Martínez Prieto sugar factory, 1978 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	6.60	6.60	6.60	6.85	6.40	6.61
2	6.65	6.90	6.75	6.70	6.50	6.70
3	6.75	6.80	6.80	6.80	6.50	6.73
4	7.25	7.20	7.20	7.15	6.40	7.04
5	6.90	6.80	7.10	7.00	6.00	6.76
6	6.85	6.85	6.85	6.95	6.25	6.75
7	6.70	6.70	6.80	6.65	6.30	6.63
8	6.50	6.40	6.50	6.55	6.40	6.47
9	6.00	6.20	6.35	6.45	6.85	6.37
10	6.95	6.85	6.85	6.00	6.90	6.89
11	7.10	7.30	7.00	7.00	6.90	7.06
12	6.40	6.35	6.65	6.60	6.60	6.52
13	7.20	7.20	7.10	7.00	6.90	7.08
14	7.20	7.15	7.15	7.00	6.90	7.08
15	6.60	6.60	6.60	7.15	MJ*	6.74
16	6.75	6.85	6.80	6.85	6.60	6.77
17	6.80	6.50	6.40	6.55	6.40	6.53
18	5.90	5.90	6.40	7.40	MJ	6.40
19	7.00	6.75	6.80	6.35	6.55	6.69
20	6.00	6.30	6.30	6.30	6.30	6.24

* Muddy juice

The average pH value at 70°C was 6.703, and at 30°C it was 6.922 which gives us a dpH/dT value of −0.0055. With this coefficient a pH value of 6.54 was obtained for 100°C.

By using the sucrose inversion tables it was found that, under the conditions stated, there is a sucrose inversion of 0.061% per hour. The clarifier used has a rated capacity of 549,000 litres and, assuming 10% for internal components, then we have a usable volume of 494,000 litres.

Table II. pH values at 30°C of juice from one of the clarifiers of Manuel Martínez Prieto sugar factory, 1978 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	6.85	6.85	6.85	7.20	6.65	6.88
2	6.80	7.20	7.00	6.80	6.70	6.90
3	7.00	7.10	7.30	7.35	6.90	7.13
4	7.85	7.70	7.85	7.85	6.50	7.55
5	7.10	7.10	7.60	7.45	6.40	7.13
6	7.15	7.10	7.20	7.20	6.40	7.01
7	6.90	6.95	7.10	6.80	6.50	6.85
8	6.60	6.50	6.60	6.70	6.50	6.58
9	6.20	6.40	6.45	6.60	7.10	6.55
10	7.25	7.20	7.20	7.20	7.20	7.21
11	7.30	7.60	7.30	7.30	7.25	7.35
12	6.50	6.40	6.70	6.70	6.70	6.60
13	7.50	7.40	7.15	7.20	7.00	7.29
14	7.50	7.50	7.50	7.30	7.25	7.41
15	6.70	6.60	6.70	7.40	MJ	6.85
16	6.85	7.10	7.00	7.00	6.80	6.94
17	7.00	6.60	6.50	6.70	6.50	6.66
18	6.00	6.00	6.50	7.60	MJ	6.52
19	7.20	6.80	6.90	6.40	6.60	6.78
20	6.00	6.30	6.30	6.30	6.30	6.24

During the 1978 campaign 611,000 tonnes of mixed juice were processed, but this sugar factory has two clarifiers, the second having a total capacity of 235,000 litres which, allowing for internal components, is reduced to a usable volume of 212,000 litres. The statement above implies that the clarifier in which the present study was carried out processed 70% of the mixed juice of the factory, that is to say 427,000 tonnes.

The actual crushing time for the factory was 3,262.8 hours which represents 128.02 $tonnes.hr^{-1}$ of mixed juice or 128,020 $kg.hr^{-1}$ of mixed juice. Assuming a recirculation of 15% of the filtered juice, total flow to the clarifier is 147,223 $kg.hr^{-1}$.

Juice Brix during this campaign averaged 14.85°, which corresponds to a density of 1.06. The flow rate, in terms of litres/hour, was thus 138,889.6. The holding time, calculated by means of the formula stated before and the data obtained, was 3.56 hours.

Knowing the holding time and the rate of sucrose inversion we can thus calculate that the sucrose inversion in that clarifier during the 1978 campaign was 0.216%.

During that period 54,446 tonnes of pol were processed in that clarifier and, according to the inversion percentage obtained, we can calculate that 118 tonnes of sucrose were lost by inversion during clarification.

Table III shows the colour % Bx values for the various trays of the clarifier at Manuel Martínez sugar factory where the present study was carried out.

Table III. Colour % Bx of juice from one of the clarifiers of Manuel Martínez Prieto sugar factory, 1978 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	2.11	2.06	2.19	2.33	2.96	2.33
2	2.45	2.21	2.32	2.45	2.41	2.37
3	2.32	2.21	2.24	2.29	2.52	2.32
4	2.17	2.31	2.17	2.17	3.18	2.40
5	2.19	2.16	2.06	2.10	3.89	2.48
6	2.14	2.05	2.11	2.17	3.92	2.48
7	2.14	2.00	2.11	2.18	3.16	2.32
8	2.89	2.50	2.65	2.55	2.87	2.69
9	2.17	2.29	2.29	2.27	2.33	2.27
10	2.22	2.19	2.20	2.12	2.21	2.19
11	2.19	1.92	2.19	2.19	2.13	2.12
12	2.99	2.79	2.57	2.71	2.75	2.76
13	2.61	2.40	2.40	2.61	3.13	2.63
14	2.17	2.30	2.34	2.55	2.84	2.44
15	1.41	1.47	1.74	1.95	MJ	1.64
16	2.20	2.03	2.08	1.99	2.36	2.13
17	2.11	2.29	2.49	2.55	2.87	2.46
18	2.14	2.30	2.17	2.28	MJ	2.22
19	1.85	1.66	1.50	3.81	2.07	2.18
20	2.35	2.14	2.47	2.33	2.57	2.37

(b) *1979 campaign*

Tables IV and V show the pH values, at 70 and 30°C respectively, for all the trays of the same clarifier on which the study was conducted in 1978. The 1979 average pH value at 70°C was 6.62, and at 30°C it was

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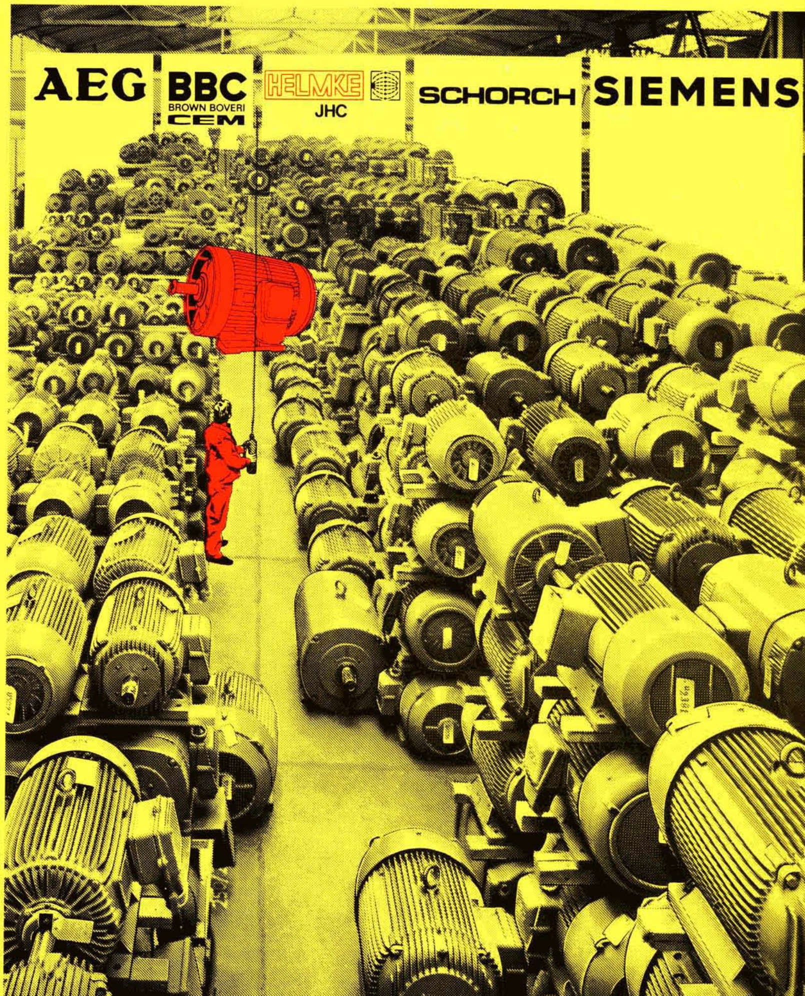

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6.74 which gives us a value of −0.0030 for the dpH/dT coefficient. With this coefficient we obtain a pH value of 6.53 for a temperature of 100°C. By using the inversion tables we find that for the conditions mentioned before there is 0.063% of sucrose inversion per hour.

Table IV. pH values at 70°C in one of the clarifiers of Manuel Martínez Prieto sugar factory, 1979 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	7.15	6.90	6.95	6.60	MJ	6.90
2	6.60	6.55	6.55	6.15	6.20	6.41
3	7.20	7.00	7.00	7.00	6.30	6.90
4	6.60	6.40	6.50	6.30	MJ	6.45
5	6.70	6.60	6.70	6.20	6.15	6.47
6	6.80	6.70	7.00	6.20	MJ	6.68
7	6.60	6.50	6.45	6.30	MJ	6.46
8	6.60	7.30	6.70	7.00	MJ	6.90
9	5.60	5.60	6.00	6.20	6.25	5.93
10	7.40	7.00	6.50	6.50	MJ	6.85
11	6.70	6.90	6.65	6.70	MJ	6.74
12	6.60	6.60	6.50	6.50	6.30	6.50
13	6.10	6.30	6.30	6.30	6.60	6.32
14	6.50	6.75	6.70	6.65	MJ	6.65
15	7.30	6.60	6.50	6.50	6.20	6.62
16	7.20	7.10	6.90	6.90	6.60	6.94
17	6.80	6.70	6.90	6.80	6.40	6.72
18	6.10	6.70	6.80	6.90	MJ	6.62
19	6.60	6.80	6.80	6.80	6.50	6.70
20	6.80	6.70	6.60	6.70	6.30	6.62

Table V. pH values at 30°C of juice from one of the clarifiers of Manuel Martínez Prieto sugar factory, 1979 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	7.70	7.15	7.25	6.70	MJ	7.20
2	6.65	6.60	6.65	6.20	6.25	6.47
3	7.60	7.30	7.15	7.30	6.50	7.17
4	6.50	6.40	6.70	6.40	MJ	6.50
5	6.80	6.70	6.80	6.25	6.20	6.55
6	6.95	6.80	7.20	6.25	MJ	6.80
7	6.70	6.65	6.55	6.50	MJ	6.60
8	6.70	7.80	6.80	7.10	MJ	7.10
9	5.70	5.70	5.70	6.30	6.30	5.94
10	7.70	7.20	6.60	6.60	MJ	7.03
11	6.90	7.05	6.75	6.80	MJ	6.88
12	6.70	6.55	6.45	6.45	6.40	6.51
13	6.20	6.45	6.40	6.40	6.70	6.43
14	6.55	6.80	6.85	6.70	MJ	6.73
15	7.55	6.70	6.70	6.55	6.25	6.75
16	7.60	7.50	7.15	7.10	6.65	7.20
17	6.90	6.80	7.10	7.10	6.30	6.84
18	6.15	6.80	7.00	7.25	MJ	6.80
19	6.70	6.90	6.90	7.00	6.55	6.61
20	6.90	6.95	6.70	6.90	6.40	6.77

As we have seen before, the usable volume of the clarifier being studied is 494,000 litres and, as we know, this accounts for 70% of the clarification capacity of the sugar factory. Since the campaign juice weight was 588,078 tonnes the clarifier handled 411,654 tonnes. The actual crushing time was 3146 hours so that flow rate was 130.85 tonnes.hr^{-1} of mixed juice or 130,850 kg.hr^{-1}. With 15% recirculation of filtered juice, the clarifier received a total flow rate of 150,478 kg.hr^{-1}.

The average juice Brix during the 1979 campaign was 15.56°, which corresponds to a density of 1.06. The flow rate, in terms of litres/hour, was therefore 141,960. The holding time, calculated in exactly the same way as for the previous campaign, was 3.48 hours. Knowing the holding time and the rate of sucrose inversion, we then calculate the inversion for the 1979 campaign as 0.224%.

During that period 53,515 tonnes of pol were processed in the clarifier and, according to the inversion percentage found, 119.9 tonnes of sucrose were lost owing to inversion.

Table VI shows the various colour % Bx values in the juices from the various trays of the clarifier. For both studies 20 juice samples were simultaneously taken from each tray.

Discussion

In order to make a statistical evaluation of the results obtained, the Student *t*-method (95% confidence) was applied to the values obtained both for pH and colour for the two campaigns.

Table VI. Colour % Bx of juice from one of the clarifiers in Manuel Martínez Prieto sugar factory, 1979 campaign

Sample	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5	Average
1	2.87	2.91	2.75	2.45	MJ	2.99
2	2.44	2.46	2.43	3.63	4.67	3.12
3	2.19	2.45	2.45	2.45	3.72	2.65
4	2.25	2.22	2.28	3.30	MJ	2.51
5	2.78	2.74	2.68	2.28	3.20	2.73
6	2.78	2.78	2.78	3.11	MJ	2.86
7	2.87	2.83	2.95	3.17	MJ	2.95
8	3.18	2.72	3.24	3.21	MJ	3.08
9	5.12	4.78	1.59	4.10	4.34	3.98
10	2.23	2.42	2.50	2.50	MJ	2.41
11	2.63	2.44	2.63	2.51	MJ	2.55
12	3.34	3.43	3.38	3.51	3.62	3.45
13	2.54	2.44	2.41	2.41	2.80	2.52
14	2.67	2.41	2.53	2.23	MJ	2.46
15	2.71	2.87	2.85	2.70	2.85	2.79
16	2.36	2.59	3.00	2.92	3.03	2.78
17	2.23	2.46	2.06	2.00	2.29	2.20
18	1.90	1.59	1.61	1.73	MJ	1.70
19	0.82	0.79	0.93	0.87	0.67	0.81
20	0.89	1.05	1.05	0.99	0.85	0.96

The statistical analysis of pH values for the 1978 and 1979 campaigns are shown in Tables VII and VIII, respectively.

Table VII. Statistical analysis of pH values at 30 and 70°C, 1978 campaign

Temperature, °C	Tray	$\bar{x}$	S	$\bar{x} \pm \frac{tS}{\sqrt{n}}$
70	1	6.71	0.38	6.71 ± 0.18
70	2	6.71	0.35	6.71 ± 0.16
70	3	6.75	0.27	6.75 ± 0.13
70	4	6.81	0.28	6.81 ± 0.13
70	5	6.54	0.26	6.54 ± 0.13
70	Average	6.70	0.24	6.70 ± 0.11
30	1	6.91	0.48	6.91 ± 0.22
30	2	6.97	0.45	6.97 ± 0.21
30	3	6.99	0.41	6.99 ± 0.19
30	4	7.05	0.40	7.05 ± 0.19
30	5	6.73	0.30	6.73 ± 0.15
30	Average	6.92	0.33	6.92 ± 0.15

Table VIII. Statistical analysis of pH values at 30 and 70°C, 1979 campaign

Temperature, °C	Tray	$\bar{x}$	S	$\bar{x} \pm \frac{tS}{\sqrt{n}}$
70	1	6.70	0.39	6.70 ± 0.18
70	2	6.69	0.22	6.69 ± 0.10
70	3	6.65	0.26	6.65 ± 0.12
70	4	6.56	0.30	6.56 ± 0.14
70	5	6.29	0.20	6.29 ± 0.14
70	Average	6.62	0.22	6.62 ± 0.10
30	1	6.86	0.51	6.86 ± 0.24
30	2	6.84	0.44	6.84 ± 0.21
30	3	6.77	0.36	6.77 ± 0.17
30	4	6.69	0.40	6.69 ± 0.19
30	5	6.41	0.10	6.41 ± 0.05
30	Average	6.74	0.39	6.74 ± 0.18

In the statistical analysis of the 1978 campaign a varying pH value was found in the various trays of the clarifier at both 30° and 70°C, although it became clear that minimum values correspond to the last tray (5th tray). For the 1979 campaign a constant drop of pH from tray 1 to tray 5 was observed. The pH is always lowest at tray 5, where inversion is thus greatest.

This emphasizes the need to comply with established technical parameters since, on many occasions, the pH value is not within the range recommended for minimum inversion (6.8 to 7.0).

A statistical comparison was made between the colour % Bx results obtained in 1978 and 1979; these results are shown in Tables IX and X.

From the analysis of colour variations it was observed that, in both campaigns, the juice in tray 5 was darker than in any of the other trays, the colour of the juice in the other trays being similar.

Conclusions

(1) The method for calculating inversion losses in clarifiers is simple and can be readily applied in any

Table IX. Statistical analysis of colour variation, 1978 campaign

Tray	$\bar{x}$	S	$\bar{x} \pm \frac{tS}{\sqrt{n}}$
1	2.24	0.33	2.24 ± 0.16
2	2.16	0.30	2.16 ± 0.14
3	2.21	0.32	2.21 ± 0.15
4	2.38	0.40	2.38 ± 0.19
5	2.79	0.53	2.79 ± 0.26
Average	2.34	0.22	2.34 ± 0.10

Table X. Statistical analysis of colour variation, 1979 campaign

Tray	$\bar{x}$	S	$\bar{x} \pm \frac{tS}{\sqrt{n}}$
1	2.54	0.88	2.54 ± 0.41
2	2.52	0.81	2.52 ± 0.38
3	2.41	0.64	2.41 ± 0.30
4	2.65	0.85	2.65 ± 0.39
5	2.91	1.27	2.91 ± 0.85
Average	2.58	0.77	2.58 ± 0.36

sugar factory since it requires no special resources.

(2) By this method it is possible to achieve an accurate control on the inversion reaction, and it is also possible to learn the pH variations in the various trays of the clarifier and to detect faults in its operation.

(3) The method can be used for comparative studies of different designs of clarification equipment and systems.

(4) The colour of the juice in the various trays had similar values except in tray 5 where colour was much darker during both campaigns. The lowest pH values for the two campaigns were always recorded in that tray.

Recommendations

(1) Research on long shut-downs and pH variations in the various trays of a clarifier should be conducted by using this method.

(2) A study on the various designs of clarifiers presently used or to be installed should be made by means of this method.

(3) A program for the strict control of pH during clarification should be set up. If need be, the possibility of liming with a soluble hydroxide in order to adjust to pH 7 should also be considered.

Summary

A study on inversion losses during clarification was conducted during the 1978 and 1979 campaigns using one and the same clarifier at Manuel Martínez Prieto sugar factory. For this purpose, the method based on the determination of sugar losses by means of inversion tables reported in the literature was used. The holding time of the clarifier was worked out from the data supplied by the Quality Control Laboratory of the factory. Analytical results were processed by Student's *t*-method for 95% confidence. Conclusions are drawn as to the feasibility of the application of this method, and the concrete results of the magnitude of such losses in the plant during the two campaigns are presented. A study was also carried out on the variations of colour in the different trays of the clarifier during the two campaigns. Both parameters, i.e. pH and colour, become critical at the 5th tray, and this fact should be further studied so as to standardize the working of clarifiers and clarification systems.

Pertes en sucre et variations de couleur au cours de la clarification

Une étude sur les pertes par inversion au cours de la clarification a été faite au cours des campagnes de 1978 et 1979 en opérant sur un seul et même clarificateur à la sucrerie Manuel Martínez Prieto. A cet effet on a utilisé la méthode basée sur la détermination des pertes sucre au moyen des tables d'inversion existantes dans la littérature. Le temps de séjour du clarificateur a été établi à partir des données fournies par le laboratoire de contrôle de qualité de l'usine. Les résultats analytiques ont été calculés à une fiabilité de 95% par la méthode *t* de Student. Des conclusions sont déduites quant à la possibilité d'application de cette méthode et les résultats concrets de l'importance de ces pertes dans cette usine au cours des deux campagnes sont donnés. On a également effectué une étude concernant les variations de coloration dans les différents compartiments du clarificateur au cours des deux campagnes. Les deux paramètres, c.à.d. le pH et la coloration, deviennent critiques dans le 5ème compartiment et ce phenomène devra être étudié de plus près de façon à standardiser le travail des clarificateurs et des systèmes de clarification.

Zuckerverluste und Farbvariationen während der Klärung

Untersuchungen über Inversionsverluste während der Klärung wurden in den Kampagnen 1978 und 1979 mit demselben Klärapparat in der Zuckerfabrik Manuel Martínez Prieto durchgeführt. Die Zuckerverluste wurden mit Hilfe der Inversionstabellen bestimmt, die in der Literatur angegeben sind. Die Verweilzeit im Dekanteur wurde aus den Daten des Qualitätskontrolle-Laboratoriums der Fabrik berechnet. Die analytischen Ergebnisse wurden nach der Student-*t*-Methode mit der statistischen Sicherheit von 95% weiterverarbeitet. In Bezug auf die Möglichkeit der Anwendung dieser Methode werden Schlüsse gezogen, und die konkreten Ergebnisse der Höhe dieser Verluste in der Fabrik während der zwei Kampagnen werden dargestellt. Weiterhin wurde eine Studie über die Variationen der Saftfarben in den Räumen zwischen den verschiedenen Böden des Dekanteurs in den beiden Kampagnen durchgeführt. Beide Parameter, pH-Wert und Farbe, werden beim 5. Boden kritisch, und diese Tatsache sollte weiterhin untersucht werden, um die Arbeitsbedingungen der Dekanteure und der Klärung zu standardisieren.

Pérdidas de azúcar y variaciones de color en la clarificación

Se ha conducido un estudio de pérdidas por inversión en la clarificación durante las zafras 1978 y 1979 usando el mismo clarificador en Central Manuel Martínez Prieto. Para este fín se ha aplicado el método basado en la determinación de pérdidas de azúcar por medio de tablas de inversión publicado en la literatura. El tiempo de retención del clarificador se ha calculado de los dados suministrado por el Laboratorio de Control de Calidad del central. Resultados analíticas se han tratado por el ensayo *t* de Student para una confianza de 95%. Conclusiones se sacan acerca de la factibilidad de la aplicación de este método, y se presentan los resultados concretos de la magnitud de tales pérdidas en esta fábrica durante las dos zafras. Se ha conducido también un estudio de las variaciones de color en las diferentes bandejas del clarificador durante las dos zafras. Ambos parametros, es decir, pH y color, llegan a ser críticos la bandeja No. 5, y este asunto en requiere estudio adicional para normalizar la operación de clarificadores y sistemas de clarificación.

On the fluid film surrounding a sucrose crystal immersed in syrup

By ANDREW VANHOOK (Department of Chemistry, College of the Holy Cross, Worcester, Mass., USA)

Introduction

The tremendous influence of motion on the rate of growth of sugar crystals is well known. The effect is considerably moderated at low temperatures[1], but under ordinary conditions rapid stirring[2] at least doubles the rate observed in free fall[3] while stationary crystal growth is still slower[4]. Particularly in this fixed situation the rate of growth also depends on the crystal orientation. These behaviours all indicate the role of transport of matter from the nutrient solution to the growing interface but even when this is expedited by forced circulation there remains the transfer through the truly stagnant boundary film surrounding the crystal faces.

Even under stationary conditions some circulation of mother liquor occurs by means of natural circulation – a condition demonstrated for heat by Count Rumford many years ago and, more recently, by H. E. C. Powers[5] with his sleeve of exhaustion of sugar syrups. Bunn[6] has actually recorded these layers in the form of the variable concentration profiles around several faces of many growing crystals – mostly ionic. The relative importance of transfer through this convective or hydrodynamic layer compared with true diffusion through the boundary or adsorbed layer may be estimated by means of the linear crystallization velocity technique of Tammann as used most recently by Simon[7] for sodium chlorate crystallization.

Experimental

Well grown, close fitting sucrose crystals were slipped into glass capillaries of various sizes. The truncated end of the crystal was always in contact with the sealed end of the tube and had been spotted with adhesive cement to prevent detachment when subsequently inverted. After filling the tubes centrifugally with syrup saturated for various temperatures, growth ensued in matched pairs – one upright, the other inverted – by lowering the temperature, usually by 5°C. This was followed by dissolution at about the same superheating. The advance and retreat of the prism end was quite sharp and could be measured within a few microns by means of a travelling microscope.

Results and Discussion

The first exploratory trial was actually performed in relatively large tubes (i.d. 8 mm) in which small single crystals (20 mg, 4 mm on b) could be suspended top and bottom respectively. At 30°C, in 10% supersaturated syrup, the bottom crystal grew almost twice as fast as the top one, whereas the ratio was reversed during the corresponding dissolution at 10% undersaturation. In this case, the top crystal dissolved three times as fast as the bottom one. This, of course, is in keeping with the well-known practice of dissolving solids from an elevated perforated platform within the solvent when mechanical stirring is not employed. Lineal measurements were employed in subsequent experiments on account of the difficulty of handling minute single crystals in confined spaces.

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In the first of these trials, 4 mm tubes with syrup saturated at 60°C, growth proceeded at 55°C (6% oversaturated) followed by dissolution at 65°C (6% undersaturated). The first averaged just about 100 $\mu m.hr^{-1}$ in the upright tube over a 4-hour period but was practically nil in the inverted case. The difference is reversed but not to such a great extent upon dissolution, namely, 50 $\mu m.hr^{-1}$ in the upright tube and 100 $\mu m.hr^{-1}$ in the inverted one. Similar results were observed in both 1 and 0.5 mm tubes, the rates being between 30 and 250 $\mu m.hr^{-1}$ in all cases. The lower values occurred in those instances of both growth and dissolution when natural convection was impeded according to the position of the tube and the higher values otherwise. Overall, the rates of growth and dissolution may be considered as being the same and at 100 $\mu m.hr^{-1}$ correspond to 5×10^{-6} $g.cm^{-2}.sec^{-1}$, exactly the same as the value obtained by Smythe[2] at 60°C and 6% supersaturation. The common rate attests to the domination of the same diffusional factor in both growth and dissolution.

At 30°C similar results were observed, although the differences in growth in the positions was less than 5-fold instead of the 8-fold observed at 60°C. It was also found possible at 30°C to substitute a thin deposit of milled seed (< 10 μm) for the single crystal without altering the results significantly. The growth was then polycrystalline and a sharp interface was maintained from which rates comparable to those in the literature were realised.

At low temperature, crystals, in 1 mm capillaries, were grown at 0°C and dissolved at 17.5°C in syrup saturated for 10°C. These correspond to 4% over- and under-saturation, respectively. In both positions, growth proceeded at about 3 $\mu m.hr^{-1}$ while dissolution was faster (9 $\mu m.hr^{-1}$) when impeded and still faster (20-30 $\mu m.hr^{-1}$) when free, natural convection prevailed. Here, again, we see the play of diffusion in the case of dissolution but not with growth, since the surface reaction dominates for this process at the lower temperature.

In all, then, there is no contradiction in these preliminary experiments to the proposal that transport is the kinetically important factor at all temperatures for dissolution but only at higher temperatures for growth. Likewise, the boundary or truly stagnant (adsorbed) part of the total diffusion field must be less than 15% of the total effective film thickness (δ), since the ratio of unimpeded to impeded rates is of the order of 5:1 or

1 VanHook: *Zuckerind.*, 1979, **104**, 511.
2 Smythe: *Sugar Tech. Rev.*, 1971, **1**, 101.
3 Kukharenko: *Planter & Sugar Manufacturer.*, 1928, **80**, 61-504.
4 Mantovani: *Ind. Sacc. Ital.*, 1966, **59**, 16.
5 Powers: *Sugar Tech. Rev.*, 1969/70, **1**, 85.
6 Bunn: *Disc. Faraday Soc.*, 1949, (5), 138.
7 Simon: *J. Cryst. Gr.*, 1978, **43**, 640.

higher. The resistance of the hydrodynamic part of the field (85%) is probably even higher, since no allowance has been made in this estimate for the concentration gradient which must have been set up during the course of these measurements. It is intended to attempt resolution of these contributions more exactly by investigating the behaviour of thin, flat plates – the only arrangement, to the writer's knowledge, for which the hydrodynamics have been worked out in detail[8].

Summary

Experiments are described on measurement of sucrose crystal growth and dissolution under stationary conditions, with small levels of over and under- saturation and at different temperatures. The measurements demonstrate the importance of convection. Diffusion of sucrose from the crystal surface is kinetically important at all temperatures in dissolution, while during growth, diffusion to the surface is important only at higher temperatures.

Sur la couche fluide qui entoure le cristal de saccharose immergé en sirop

On décrit des expériences sur la mesure du taux de croissance et de dissolution du cristal de saccharose sous les conditions statiques, à petits niveaux de sur- et sous-saturation et à différentes températures. Les mesures démontrent l'importance de la convection. La diffusion de la saccharose à partir de la surface du cristal est d'importance cinétiquement à toutes températures pendant la dissolution; par contre, dans le cas de croissance du cristal, la diffusion envers la surface n'est d'importance qu'à des températures plus hautes.

Zur Frage des flüssigen Schichts um einen in Sirop eingetauchten Saccharosekristall

Beschrieben werden Untersuchungen der Messung des Wachstums und der Auflösung von Saccharosekristallen unter stationären Bedingungen, bei kleiner Über- und Untersättigung und bei verschiedenen Temperaturen. Die Messungen weisen auf die Bedeutung von Konvektion hin. Während der Auflösung ist die Diffusion der Saccharose von der Kristalloberfläche herab von Bedeutung bei allen Temperaturen; anderseits, während des Wachstums ist die Diffusion zur Oberfläche nur bei höheren Temperaturen von Bedeutung.

Sobre la película flúida acerca de un cristal de sacarosa sumergido en siropa

Se describen experimentos sobre la medida de crecimiento y disolución de un cristal de sacarosa en condiciones estacionarias, con pequeños niveles de sub- y sobre-saturación, y a varias temperaturas. Las mediciones demuestran la importancia de convección. Difusión de sacarosa del superficie del cristal tiene importancia cinética a todas temperaturas en disolución, pero en crecimiento difusión al superficie tiene importancia solamente a las altas temperaturas.

[8] Levich: "Physicochemical hydrodynamics" (Prentice-Hall, Englewood Cliffs, N.J.), 1962.

Thermal degradation of sucrose in solution - a review

By LAURENCE PONCINI
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The problem of sucrose degradation in solution is of major concern to sugar and food technologists, because the majority of their processes involve the heating of sugar solutions.

The first significant study of sucrose solution degradation in sugar cane milling was carried out by Williams[1] in 1921. He studied two pairs of mills and showed that those having high extraction delivered less sugar per tonne of cane than those having low extraction, in spite of the fact that those having higher extraction were also handling richer cane. He thus concluded that sucrose had been lost by degradation in the milling process.

Since Williams' study of sucrose solution degradation very little progress was made in this area until recently. In contrast, thermal degradation in the crystalline phase and melt have been intensely studied and many of the reactions which occur in the melt may be expected to occur in hot concentrated aqueous solutions of sucrose, such as are commonly encountered in sugar milling and refining[2].

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Lyle[3] had shown that certain discrepancies in sugar refinery heat balances could be traced to heat effects originating from the sucrose in solution. He established an equation which enabled such heat effects to be calculated. Khomchuk & Tverdohklebov[4] reported that sucrose losses in juice heated in an evaporator could be reduced if the steam temperature was maintained below 135°C and the evaporator heating surface kept below 240 - 250 m^2 per 100 tonnes of beets. Reva and co-workers[5] had established equations for calculating sucrose losses in evaporators and showed that such losses amounted to five times the total losses in the whole juice purification. Bohn[6] has shown that sucrose solution losses in the first and second vessels are dependent on heating time, temperature, pH and sucrose concentration. Spengler & Tödt[7] concluded that under normal conditions in beet sugar manufacture only 0.05% of the sucrose in solution is destroyed during evaporation and boiling to grain. Zerban[8] has reported that similar

[1] *I.S.J.* 1921, **23**, 271-272.
[2] Richards & Shafizadeh: *Austral. J. Chem.*, 1978, **31**, 1825-1832.
[3] *I.S.J.*, 1939, **41**, 390-393.
[4] *Sakhar. Prom.*, 1958, **32**, (11), 19-21.
[5] Reva, Vakovenko & Khiltchuk: *Proc. 15th Congr. C.I.T.S.*, 1975, 373-381.
[6] *Zesz. Probl. Postepow. Nauk Roln.*, 1977, **187**, 95-104.
[7] *Z. Ver. deut. Zuckerind.*, 1930, **80**, 673-689.
[8] *Tech. Rpt. Sugar Research Foundation*, 1947, (2).

Sugar in lumps. A

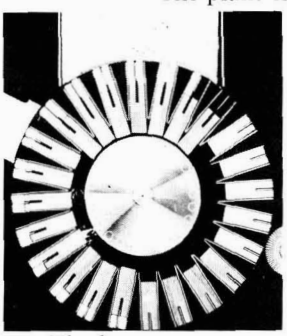
Sugar lumps are at present produced throughout the world by means of a technique perfected and modernised by MACHINES CHAMBON, who today offer entirely automatic lines for the moulding and conditioning of sugar lumps of all sizes.

The CHAMBON plants mould, dry and put into boxes according to type, 12, 24, 55, 80 or 100 tons* of sugar per day.

They are strongly built, reliable, completely automatic and only a few people are required to supervise their operation.

PLANT	PRODUCTION/24 h
EMR	12 or 24 t
1 DM	55 t
1 DMH	55 t
3 DM	100 t
4 DM	80 t (hard sugar)

A rotary moulding unit.



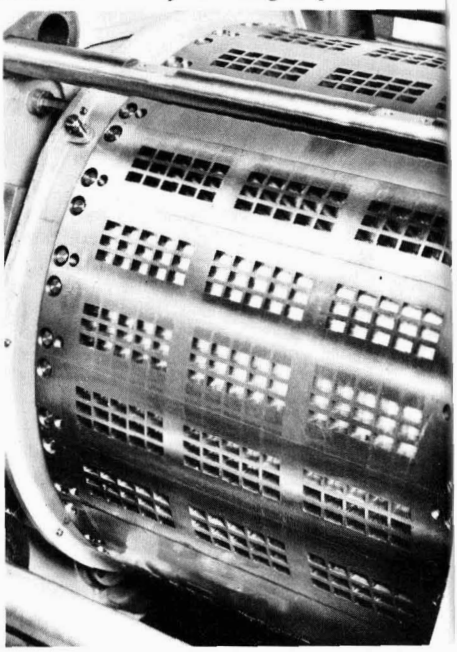
The plant is supplied with dry or humid sugar. Suitably mixed so as to be perfectly homogeneous, the sugar is fed evenly into moulds spead out around a rotary drum. The dimensions of these moulds vary according to whether one wishes to produce lumps of sugar of size 3, 4 or 5 or cubes.

A system of compression by mobile pistons produces lumps perfectly regular in shape and weight and of variable hardness according to the rate of compression.

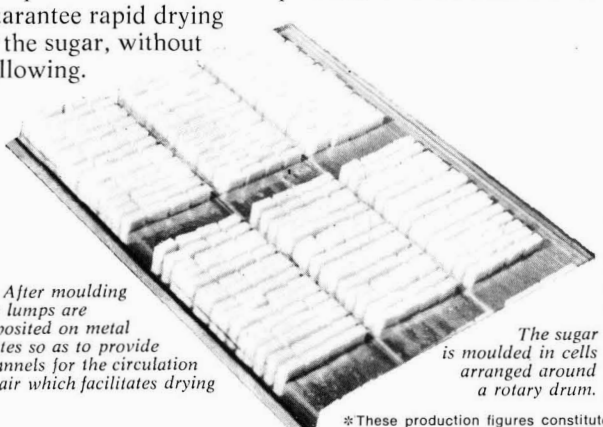
Rapid and perfect drying.

After moulding, the lumps are deposited on metal plates in groups corresponding to one horizontal layer (1/3 kg) of the finished box. The lumps are arranged to provide channels for the circulation of air which facilitates drying.

Driven by an endless chain, the plates are carried into a vertical or horizontal drying unit according to the power of the plant. The relatively low temperature, the good distribution of the air heated by low-pressure steam and the permanent renewal of this air guarantee rapid drying of the sugar, without yellowing.



The sugar is moulded in cells arranged around a rotary drum.



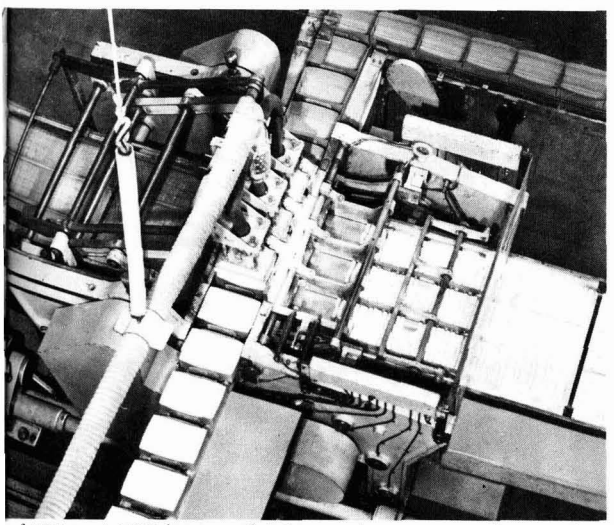
After moulding the lumps are deposited on metal plates so as to provide channels for the circulation of air which facilitates drying

*These production figures constitute minimum tonnages guaranteed under normal operating conditi and taking into account the down time for weekly cleaning.

simple product.

Automatic conditioning.

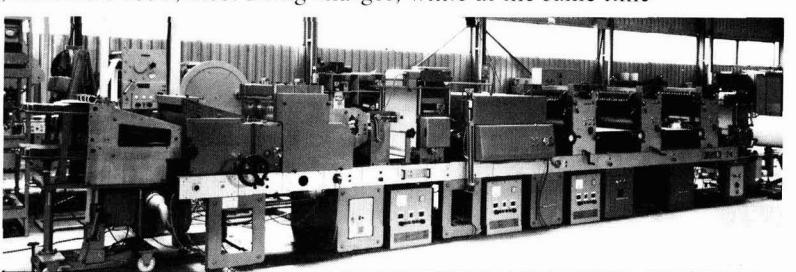
On leaving the drying units, the lumps are gathered and deposited by pneumatic fingers in three successive layers in the boxes, which are formed on a connected machine and automatically supplied to the conditioning line.
The full box is conveyed to the closing machine, which forms and glues the lid of the box.



A well-designed production unit.

A moulding and conditioning unit comprises certain basic inseparable elements synchronised with each other, all the functions of which are automatic, and optional elements (such as the machine for printing and forming the lids or the one-piece boxes, and the machine for parcelling in packets of 5 or 10 boxes).
Entirely automatic, it allows the production of 500 to 4,500 boxes of 1 kg per hour, according to the unit, without any manual intervention.
Four persons are sufficient to supervise all the operations.

To increase production, minimize costs, meet rising charges, while at the same time ensuring the supply of a product of exceptional quality, it is necessary to have automatic equipment, designed and manufactured by specialists. It is therefore not by mere chance that more than 95 % of the world production of lump sugar is carried out on CHAMBON plants. Today, more than 150 CHAMBON plants throughout the world each produce from 12 to 100 tons of moulded and packed sugar per day.



The boxes are printed and formed in a single operation.

CHAMBON

Bergère/Communication

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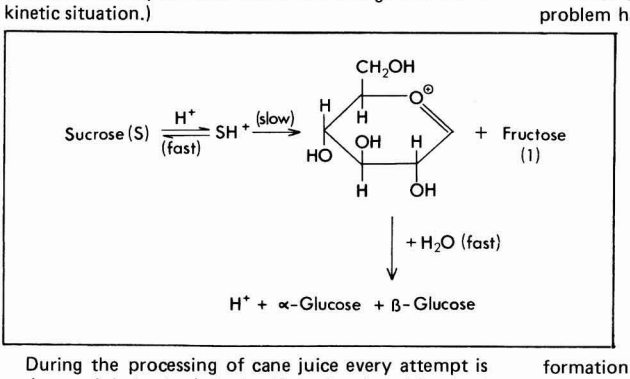
destruction occurs in cane sugar manufacture and points out that such losses occur when heavy magma comes into direct contact with the steam coils or calandria tubes.

Studies of thermal decomposition of sucrose in solution have in general been restricted to aqueous systems[9]. This, while being desirable in terms of solubility (saturation at 426.5 g sucrose/100 g water at 90°C)[10] and most technologically relevant, may prove in some cases to be undesirable since water may prevent or interfere with the desired reaction, or it may not be a good solvent for the decomposition products produced.

In this review no discussion will be entered into regarding alkaline degradation initiated by hydroxyl ion, but the generation of hydrogen ions will be discussed. Kharin & Palash[11] heated a 0.5M aqueous sucrose solution at 90°C for 70 hours and found that the pH fell to 3.93 and that 0.4894 mole per litre of sucrose had decomposed. The source of the H^+ ions causing the fall in pH is thought to include water, the sucrose molecule itself and its decomposition products. At high temperatures water is highly dissociated[12] (pK = 14.00 at 24°C and 12.23 at 100°C) and Ivanov & Lygin[13] have reported the pKa values for sucrose at various temperatures (12.43 at 20°C, 11.4 at 60°C and 11.07 at 90°C). Dawber *et al.*[14] have demonstrated that acid hydrolysis of sucrose is bimolecular in nature and a linear relationship exists, for constant initial sucrose concentration, between the rate constant and the hydrogen ion concentration. The following scheme for the hydrolysis is proposed[14]. (Obviously the glycosidic scission could equally well proceed in the opposite direction to yield a fructose cation, but this would not change the overall kinetic situation.)



During the processing of cane juice every attempt is made to minimize hydrolysis effects by the addition of lime to raise the pH (this has other beneficial effects also). However, those reducing sugars already present undergo alkaline degradation to form acids (mainly lactic acid) and also brown polymeric compounds[12].

The degree of hydration in concentrated aqueous sucrose solutions has been studied by Kharin & Kniga[15] who found only slight temperature dependence in the range 60 - 120°C and by increasing the concentration from 60 to 75% they claimed a decrease in the degree of hydration; but when a concentration of 80 - 90% was achieved the extent of hydration increased. They estimated the mean thermal effects of hydration for sucrose in the temperature range of 60 - 90°C to be 12.6 kilojoules.mole^{-1}.

Many workers[16-18] have reported that sucrose decomposition in aqueous solution during long term heating occurs as a series of reactions which are "autocatalytic" with respect to hydrogen ions. These ions may be derived from water and also from sucrose as well as from the products of sucrose decomposition. The system is obviously extremely complex however, and it has been shown[12] that the presence of buffering components in small concentrations is advantageous in sugar processing, especially in the raw sugar factory, because they are effective in reducing the induction period prior to hydrolysis. This buffering capacity has been shown by Mil'kova & Ivanov[19] to increase with increasing temperature.

Mil'kova *et al.*[20] and Ivanov *et al.*[21] have shown that sodium and potassium chlorides and glucose catalyse the degradation and that melanoidins, decomposition products from invert sugar, and glutamic acid inhibit the reaction. They did not find any relationship between sugar purity and buffering capacity of the sucrose solutions tested, but showed that the buffering capacity was governed by the nature of the impurities present and not their concentration. These findings to some extent contradict those reported earlier[17]. The hydrolysis reaction, apart from reducing the overall yield of sucrose, is commercially harmful also because of the secondary decomposition products formed, their effect on the product and their cost of removal[12].

Aqueous solutions of sucrose when heated over various temperature regimes have been reported[8,12] to undergo changes both in terms of colour production and product formation. Each of these occurrences will be briefly discussed.

From the manufacturing point of view the colour problem has been reviewed by numerous workers[8,12,15] and has in the main been restricted to crystalline sucrose. Reiss was one of the first investigators to study colour formation in aqueous sucrose solutions. In a series of papers[22-24] in the 1930's, Reiss was able to show that colour formation was temperature-dependent and that a temperature of 130°C was the critical temperature for rapid colour formation in an unbuffered aqueous sucrose solution, but the purity of his sucrose sample was unspecified. He also showed that under the same experimental conditions raw sugar liquors showed the formation of colour sooner and at a more rapid rate than solutions of refined sugars. In 1973 Katsurai & Makide[25] showed that colour formation in aqueous sucrose

[9] Kononenko & Herstein: *Chem. Ind. Data Series*, 1956, **1**, (1), 87-92.
[10] Honig: "Principles of Sugar Technology", Vol. I. (Elsevier, Amsterdam), 1953, p.229.
[11] *Sakhar. Prom.*, 1967, **41**, (12), 15-17.
[12] Kelly & Brown: *Sugar Technol. Rev.*, 1978, **6**, 1-47.
[13] *Zh. Prikl. Khim.*, 1968, **41**, 2722-2725.
[14] Dawber, Brown & Reed: *J. Chem. Educ.*, 1966, **43**, 34-35.
[15] *Izv. Vuzov, Pishch. Tekhnol.*, 1963, (5), 47-51.
[16] Kharin & Sapronov: *Sakhar. Prom.*, 1968, **42**, (3), 26-29.
[17] Mil'kova, Ivanov & Sapronov: *ibid.*, 1969, **43**, (9), 11-13.
[18] Golybin & Ivanov: *Zesz. Probl. Postepow Nauk Roln.*, 1977, **187**, 89-93.
[19] *Izv. Vuzov. Pishch. Tekhnol.*, 1968, (4), 36-38.
[20] Mil'kova, Ivanov & Sapronov: *ibid.*, 1969, (1), 45-48.
[21] Ivanov, Mil'kova & Sapronov: *Sakhar. Prom.*, 1970, **44**, (1), 31-34.
[22] *Listy Cukr.*, 1932, **51**, 9-11.
[23] *Z. Zuckerind. Czechoslovak. Rep.*, 1932, **57**, 89-92.
[24] *ibid.*, 1933, **58**, 116-119.
[25] *Bull. Chem. Soc. Japan*, 1973, **46**, 3293-3294.

solution is also a function of concentration as well as being temperature dependent.

The chemical reactions giving rise to colour formation in pure aqueous sucrose solution are not known, but are suspected as being similar to those found in sugar production where mono- and polyphenols, carbonyl compounds, reducing sugars and amino acids are all involved in colour formation. These compounds are found in trace amounts even in refined sucrose. Their formation in sugar production has been reviewed recently by Madsen *et al.*[26].

The identification and isolation of products from heated aqueous sucrose solutions has been little investigated until recently. Earlier investigations were concerned mainly with colour development; hence products associated with its formation were first to be isolated. The work of Montgomery & Wiggins[27] in 1947 and Bergdoll & Holmes[28] in 1951 identified 5-(hydroxymethyl)-furfural (HMF) as one of these products when aqueous sucrose solutions are heated above 150°C.

Only two major works have appeared since on the isolation and identification of the products formed in such systems. In the first, by Egorov *et al.*[29], sucrose solutions were heated at 185 - 190°C for 2 hours and both aliphatic and aromatic carbonyl compounds were identified. The major products were furfural, formaldehyde, acetaldehyde, butyraldehyde and acetone. In the second report, by H. Ito[30] in 1977, an aqueous sucrose solution was heated to 120°C for 5 hours, and eight products were positively identified using gas chromatography, infra-red and mass spectrometry (Table I). It is well known[8,12,31] that glucose and fructose form when sucrose solutions are first heated and these are the probable sources of the products identified by Egorov *et al.*[29] and Ito[30].

Table I. Products identified from an aqueous sucrose solution heated at 120°C for 5 hours[30]

Product	Identification Criteria
Ethyl lactate	A, B, C
Furfural	A, B
3-Hydroxypropionic acid	A, B, C
Isomaltol	A, B, C
5-Hydroxymethylfurfural	A, B
Maltol	A, B, C
Levulinic acid	A, C
2-Furoic acid	A, C

A = Gas chromatography
B = Mass spectrometry
C = Infra-red spectroscopy

The use of a liquid system to study the rate at which sucrose undergoes degradation by heat has a number of advantages over melt conditions. It has been stated by Richards & Shafizadeh[2,32] that kinetic studies of sucrose melts are subject to inaccuracies, especially near the melting point, owing to heats of fusion and uncertainties in measuring initial reaction times. Serevokova & Shlyapivikov[33] have studied the kinetics of thermal decomposition of sucrose melts at 164 - 196°C and have observed a rate increase between the solid and liquid phase as the melting point for sucrose is approached. Because of these problems encountered with sucrose melts, sucrose dissolved in dimethyl sulphoxide (DMSO) was used by Poncini & Richards[34] in order to obtain an accurate measure of the decomposition rate.

The choice of the aprotic solvent DMSO was based on several criteria, these being:

(a) Kononenko & Herstein[9] have reported that DMSO is the best non-protogenic solvent for sucrose,
(b) Traynelis & Hergenrother[35] have found that DMSO heated to its boiling point does not show any significant sign of decomposition, and only after refluxing for 3 days does decomposition become significant, with 3.7% volatile material produced. This volatile material consisted of paraformaldehyde (1.9%), dimethyl sulphide, dimethyl disulphide, bismethylthiomethane and water,
(c) DMSO remains a liquid over a wide range of temperatures and provides a homogeneous reaction medium[36].

The thermal degradation of sucrose in anhydrous DMSO solution is postulated to occur by an initial scission of the glycosidic linkage in the sucrose molecule[34] [pathway (i), Figure 1]. This is believed to be facilitated by hydrogen bonding between the 1′ and 3′ hydroxyl hydrogens of the fructose moiety and the glycosidic oxygen. The two major products from such a scission are α-D-glucopyranose and a fructose carbonium cation (F^+) intermediate [pathways (ii) and (iii)]. This latter carbonium cation (F^+) has been found to react with an alcohol (R-OH) to produce the anomeric fructofuranosides [pathway (v)], as well as being subjected to a small extent to an internal cyclization to form 2,6-anhydro-β-D-fructofuranose [pathway (iv)][37].

The carbonium cation intermediate (F^+) as well as the glucose and anhydrofructose may also undergo complex, less specific modes of degradation and are probable sources of much of the hydroxymethylfurfural (HMF) which is a significant product in such reactions[34,37].

Acknowledgement

The author wishes to dedicate this review to Professor G. N. Richards whose inspiration has made this work possible.

Summary

A review of the literature concerned with sucrose degradation in solution is presented with reference to the effects of pH and to colour formation. A mechanism for the degradation process in dimethyl sulphoxide solution is proposed.

Le problème de la dégradation thermique du saccharose en solution - une revue

On passe en revue la littérature sur la dégradation du saccharose en solution, au regard aux effets de pH et à la formation de couleur. Un mécanisme du procédé de dégradation dans une solution de diméthylsulphoxide est proposé.

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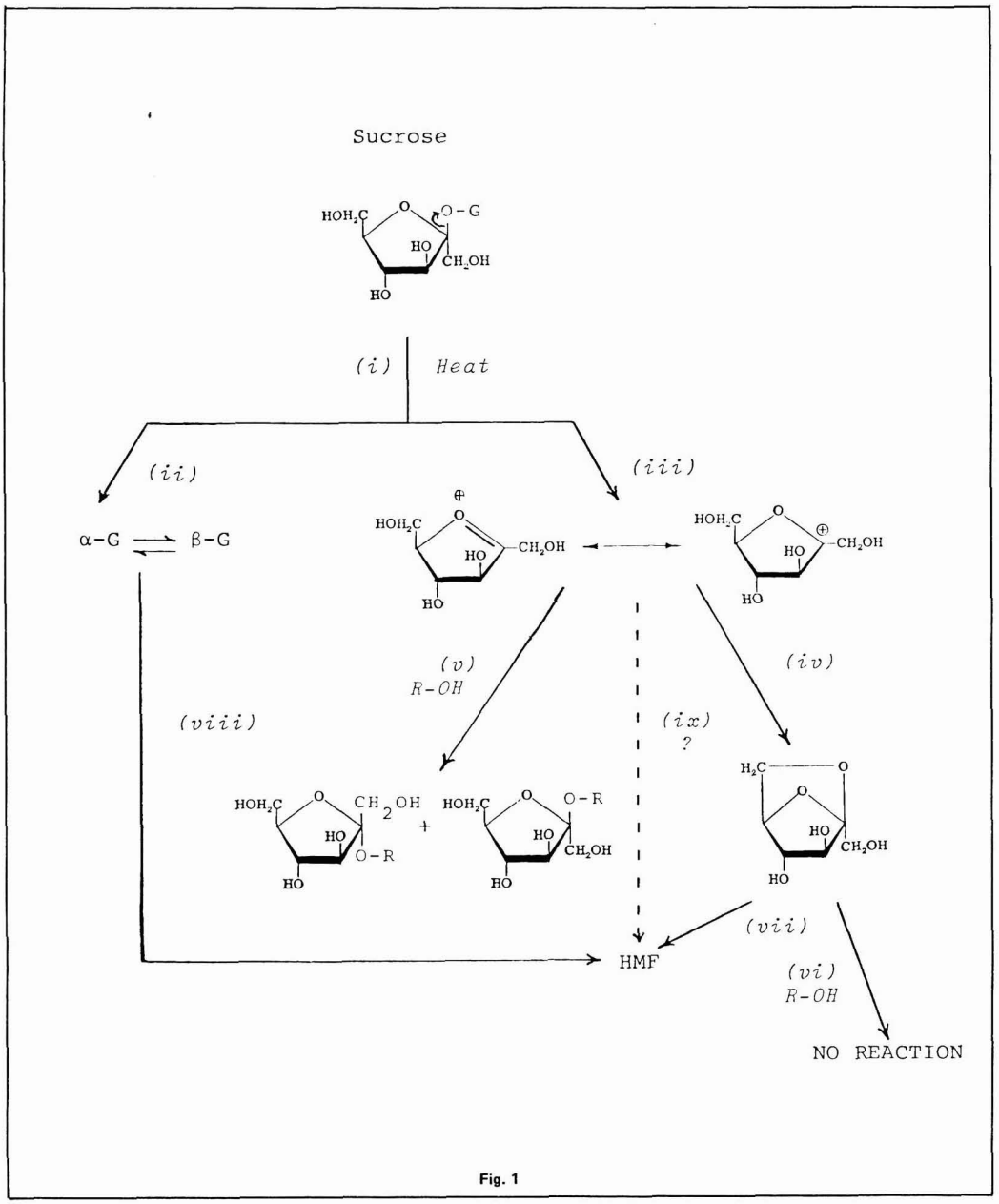

Fig. 1

Das Problem der thermische Saccharosezersetzung in einer Lösung – eine Übersicht

Man bringt eine Literaturübersicht über die Saccharosezersetzung in einer Lösung, mit Betrachtung über die Auswirkungen von pH und über die Farbbildung. Ein Mechanismus des Zersetzungsverfahrens in Dimethylsulphoxidlösung wird vorgeschlagen.

Degradación térmica de sacarosa en solution – una reseña

Se presenta una reseña de la literatura que concierne degradación de sacarosa en solución, con referencia a los efectos de pH y a la formación de color. Se propone un mecanismo para el proceso de degradación en un solución con dimetil sulfoxido como disolvente.

SUGAR CANE AGRONOMY

The regenerative capacity of the rhizomes of Torpedo grass (*Panicum repens* Linn.). S. Y. Peng. *Taiwan Sugar*, 1979, **26**, 48-54. – Studies have been made on the persistence of rhizomes of *P. repens* which is a serious competitor of cane in Taiwan fields. Cross-ploughing, treatment with various herbicides and moisture stress by withholding irrigation were examined and caused reductions of 75.7%, 90.2% and 84.1% in the weight of rhizomes. Applying all three gave a maximum reduction of 96.1%, but the rhizomes remaining were able to infest the field, reducing yield from about 132 tonnes.ha^{-1} to only 30-40 tonnes.ha^{-1} in second ratoons. The only technique which completely killed the grass was to cover the soil with black polyethylene sheet; the rhizomes sent up etiolated shoots which, since no photosynthesis could occur in the absence of light, used up all the carbohydrate content of the rhizomes. If herbicides were used in addition, some rhizomes survived because the chemicals prevented them from sending up shoots.

Studies on subsoiling and earthing-in. Anon. *Taiwan Sugar*, 1979, **26**, 59-61. – Experiments with different types of subsoiling implement used for different soils and under various conditions showed that the mole and vibrated subsoilers gave better ratoon cane yields than conventional subsoiling, and all gave higher yields than when subsoiling was omitted in the case of clay loam, a lower yield without rotary tillage but a higher yield with it at the first subsoiling in the case of clay, and variable results similar to but averaging slightly below the yield without subsoiling in the case of "red earth". In light soils, loam and gravel, ratoon yield was increased by all subsoiling treatments.

Manganese and zinc deficiencies in sugar cane grown in Entisols near Santa Cruz, Bolivia. T. T. Cochrane. *Trop. Agric.* (Trinidad), 1979, **56**, 219-224. – Mn deficiency was identified on an Ustifluvent in a replicated block trial in which 0, 22, 44, 66, 88 and 110 kg.ha^{-1} N was applied, respectively, to 3-month-old ratoons. Highly significant linear responses were obtained in terms of cane and sugar yield as well as leaf N and Mn levels, the last-named increasing from 23 to 43 ppm. A subsequent trial, in which manganese sulphate (equivalent to 8 kg.ha^{-1} Mn) was applied to the cane, confirmed the Mn response. Zn deficiency was found on a Mollic Ustipsamment in a N-P-K factorial trial. Application of Zn at 6 kg.ha^{-1} resulted in a significant yield response and a significant increase in leaf Zn from 9.5 to 11.0 ppm, while also causing a significant increase in leaf Mn from 48 to 56 ppm. It is pointed out that the reported deficiencies would probably have gone unnoticed had the trials not been monitored by way of leaf analysis.

Characteristics of molybdenum deficiency in sugar cane. J. E. Bowen. *Trop. Agric.* (Trinidad), 1979, **56**, 225-232. Symptoms suggestive of Mo deficiency were observed on 15 cane clones in a field near Hilo, Hawaii; the Mo concentration in the elongating leaf sheaths of the cane plants was below 0.05 μg per g dry weight. Applications of sodium molybdate at 0.56 kg.ha^{-1} alleviated the symptoms. Plants were grown hydroponically to confirm that the symptoms were indeed caused by Mo deficiency. Those plants grown in nutrient solutions having no Mo developed similar and severe symptoms within 20 weeks, and their root growth was significantly decreased. Application of 0.1 mg.litre^{-1} Mo was sufficient to satisfy the Mo requirement of the cane. Where the Mo level was adequate, the apical meristem, spindle and other immature tissues generally contained the highest concentrations, while mature internodes had the lowest Mo concentration. There was no clear pattern of Mo distribution in Mo-deficient cane.

Growth, sucrose content and regrowth in sugar cane treated with "Polaris" ripener. R. Julien, G. C. Soopramanien, J. F. Martiné and H. Médan. *Rev. Agric. Sucr. Maurice*, 1978, **57**, 172-187. – During a series of trials in 1977 it was found that reduction in cane stalk elongation following treatment with the ripener depends primarily on the variety as well as the environment and may not be translated in a proportional reduction in fresh weight yield at harvest. The results confirmed that sugar content was increased significantly in varieties M 13/56, M 377/56 and S 17 when applied at the rate of 4 kg.ha^{-1} about 9 weeks before harvest, while the response of variety M 93/48 was again less than that of the others. The stage of development of the plant and the presence of diseases at the time of spraying were shown to affect the increase in sugar content, especially in S 17 cane. Neither addition of a low-drift substance, Nalcotrol, nor use of spray volumes greater than 70 litres.ha^{-1} has any marked effect on response to the ripener. Symptoms of poor regrowth in the subsequent ratoon crop have been shown to be temporary, and even in severe cases the decrease in yield may be insignificant.

Factors affecting germination of sugar cane. W. G. Espada and M. O. Araneta. *Sugarland*, 1978, **15**, (5/6), 8-9, 12-13, 19. – In greenhouse studies, germination of 2-node setts was unaffected by the concentration of urea solution (up to 28 g.litre^{-1}) in which they were soaked for 24 hours, whereas the germination of setts soaked in ammonium phosphate (in a N:P ratio of 4:5) fell to zero at the lowest concentration of 7 g.litre^{-1}. Direct application of both fertilizers to the planted setts adversely affected germination at rates above 4 g per sett. Field experiments confirmed the greenhouse results, while KCl had no effect on germination. Ammonia and salt toxicity and hence reduced germination are best counteracted by using 3-node setts or placing the fertilizer 2 inches below 2-node setts.

A study on ripening of sugar cane plants. IV. Deterioration of cane quality during the ripening period. T. T. Yang, C. S. Yeh, T. C. Pang and T. S. Hsieh. *Rpt. Taiwan Sugar Research Inst.*, 1978, (82), 1-11 *(Chinese)*. Deterioration in cane during the ripening period occurs in harvested stalks or in unharvested stalks growing under moisture stress conditions, and is mainly due to sucrose inversion, so that minimization of moisture loss is necessary in order to prevent it. Moisture loss and inversion were greatly increased at temperatures above 30°C. Time also has effect on deterioration, and the upper part of cane stalks showed signs of deterioration within 2 days of harvest, which became serious within a further 1-2 days. Canes growing under moisture stress conditions always lost their green leaves. The tender portion of a stalk, root bands, sections about 2 cm

below the node and cutting edges were the points most susceptible to deterioration. Shading is the most effective and easy way of reducing post-harvest deterioration.

Herbicide trials in Réunion. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 36-41 *(French)*. – Details are given of the performances of specific pre- and post-emergence herbicides in controlling named weeds. Mention is made of the positive effect of non-ionic wetting agents on the action of herbicides such as Diuron and Sencoral.

Sugar cane-soybean rotation – does it work? S. Gauthier and S. Guilbeau. *Sugar Bull.*, 1979, **57**, (14), 18. – The case is quoted of a farm in Louisiana where about 30% of the total cane area was left idle each season to allow the land to be levelled and ploughed for weed control; since ploughing renders fallow land highly vulnerable to erosion, it was suggested that soybeans be grown in rotation with the cane. Details are given of the system used. Results have shown that the land planted to soybeans contains more broadleafed weeds than cane land, but a smaller amount of Johnson and itch grass; moreover, cultivating the beans costs less than fallow ploughing, while the crop helps prevent erosion while maintaining the inherent fertility and organic content of the soil through addition of crop residue.

Sugar cane planting: seed placement, double drill and wide furrows. C. Richard. *Sugar Bull.*, 1979, **57**, (15), 16, 19. – The importance of good seed placement and of use of the double-drill and wide-furrow planting techniques for high cane yields is discussed.

Fertilizing sugar cane. Anon. *Cane Growers' Quarterly Bull.*, 1979, **42**, 91-112. – Factors to be considered in determination of the quantity of fertilizer to apply to a particular cane block are briefly discussed, and fertilization practices for new cane land, plant cane, ratoons and where cane is ploughed-out and the area replanted are indicated. Recommended mixture ratios for P and K are shown. Responses of the cane crop to N, P, K and other plant foods are described. Soil formation, texture and acidity/alkalinity are explained, and the roles played by specific fertilizers are described. Sources of nutrients are indicated and the nutrients present in typical cane crops in various regions of Queensland tabulated. The forms of the various major fertilizers applied to cane are explained, and the value of legumes and factory by-products as fertilizers is indicated.

Studies on sugar cane irrigation. XI. Effects of irrigation frequency on evapotranspiration, growth and yield of autumn-planted sugar cane in medium textured soils. S. J. Yang, Y. T. Chang and Y. C. Lee. *Rpt. Taiwan Sugar Research Inst.*, 1979, (83), 1-14 *(Chinese)*. Experiments were conducted over two years to determine the response of cane to different irrigation frequencies, which were based on crop evapotranspiration:Class A pan evaporation ratios of 0.5, 0.75, 1.0, 1.25 and 1.5, the actual amount of water required being determined from the available soil moisture content in the root zone and the assumed consumptive rate. Striking similarity was found between the accumulated actual evapo-transpiration and pan evaporation, despite differences between the two years as regards growth and climatic conditions, linearity between the two factors being established with a slope of approx. 0.75. Although cane growth was closely related to the available water in the root zone, the differences in final yield between treatments were small and statistically non-significant. For economical use of water resources of limited availability, it was found practical to extend the interval between irrigations to 20-30 days in the dry season (January-June) in sandy loam soils under Taiwan climatic conditions. Lysimeter studies showed that much of the water was supplied by capillary action to the root zone from a water table 1.6 m below the surface, the estimated flow of up to 2 mm per day accounting for between one-half and one-third of the total consumptive use, suggesting that supplemental irrigation in regions having medium-to-high groundwater levels could be reduced for the sake of water economy.

Studies on the water well construction in medium-textured aquifers. I. Slot size and type of screen. T. M. Wang. *Rpt. Taiwan Sugar Research Inst.*, 1979, (83), 15-23 *(Chinese)*. – Studies were carried out with the aim of improving the screens of water wells so as to prevent clogging of the slots by fine sand and reduce corrosion and incrustation, thus giving a higher yield of clear groundwater. Of three materials used, copolymer (from which the screens were made by injection moulding of the element ring plates which were then piled-up to form a section of screen) proved the most promising. Stainless steel and PVC were the other materials tested.

Influence of soil moisture on germination of four sugar cane varieties. S. J. Yang and J. B. Chen. *Rpt. Taiwan Sugar Research Inst.*, 1979, (83), 25-34. – Seed cuttings of four varieties were covered with 1.5 cm of soil (a mixture of 35% clay, 35% sand and 30% silt) in germination boxes after the soil had been adjusted to moisture levels corresponding to saturation, field capacity, 50% available water and wilting point in a soil moisture extractor. Surface evaporation was reduced by covering the soil with a layer of plastic pellets. The germination boxes were placed in a growth chamber where the air temperature was maintained at 28°C and a R.H. of 75%. The numbers of emerging seedlings were counted daily during a 25-day period. Results showed that the optimum soil moisture was that corresponding to field capacity (–0.3 bar of matric potential), while rate and final % germination fell as the soil matric potential decreased and affected both water availability and movement. With increase in soil moisture stress, there was increase in the % buds that sprouted but did not emerge. At saturation, germination fell as a result of lack of oxygen, and the poor aeration conditions at a high matric potential affected germination more seriously than moisture stress. The varieties differed in their germination response to soil moisture.

Effect of compost and green manure on sugar cane production. C. C. Wei. *Rpt. Taiwan Sugar Research Inst.*, 1979, (83), 35-50 *(Chinese)*. – Results of experiments on clay, loamy and sandy soils showed that compost or green manure slightly affected soil pH and organic matter content but had little or no effect on soil properties and only slightly affected the total N. On the clay and loam soils there was no increase in cane or sugar yield, whereas there was a slight increase in yield on sandy soil. Generally, it appeared that application of less than 30 tonnes.ha^{-1} would hardly increase the yield on ordinary soils once the nutrient effect of the organic material was eliminated. The failure to increase yield was attributed to the considerable quantity of cane

residue incorporated in the soil, including roots, leaf trash, dry stalks and suckers; this maintained the soil organic matter content and other properties at a sufficient level to provide for normal cane growth and development.

A review of cane research on the Ord. T. O. Albertsen. *Australian Canegrower*, 1979, **1**, (2), 87-89. – Cane research in the Ord region of Western Australia is summarized for the periods 1950-57, 1964-68 and since 1974. Varietal trial results are tabulated, indicating sugar yields of up to 20.68 tonnes.ha^{-1} in 1977 and 22.29 tonnes.ha^{-1} in 1978. Results are also given for a 80-ha pilot cane farm operated by a Queensland farmer as part of a feasibility study. The preliminary results suggest that the Ord River Irrigation Project can provide plant and ratoon cane crops comparable to those of the Burdekin area of Queensland. Of advantage is the availability of cheap land, almost unlimited high-quality irrigation water and a 8-month rain-free season from March to October.

Time to fertilize. W. Jackson. *Sugar Bull.*, 1979, **57**, (13), 10-11. Recommendations are given on fertilizer application rates to plant and ratoon cane on light and heavy soils in the three main cane areas of Louisiana. Tabulated values of N, P, K and S differentiate between weak and strong stands of cane.

Modern aerial survey technology for the sugar industry. J. J. Ovington. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 51-54. – Techniques, problems and their solutions are discussed in relation to a study made by the Queensland State Department of Mapping and Surveying on ways in which aerial surveying could assist the sugar industry. Application in other sugar cane countries is referred to, and it is thought that advantages would lie in improvement of cane yield, drainage and irrigation as well as control of diseases and pests.

Aerial surveying of assigned land. B. Judd and J. B. Hayes. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 55-59. – Techniques and problems in aerial mapping are discussed and an account is given of a trial carried out for three farms in the Racecourse mill area. The maps produced are accurate, detailed and irrefutable, and cost less than the present system. Less outdoor work in inclement weather is required and additional information is automatically gathered on e.g. density and condition of the crop, terrain, vegetation on adjacent land, erosion and drainage.

Ash in juice – a supply area survey. G. Kingston and L. K. Kirby. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 61-69. – A survey of ground water in the Qunaba mill area has been conducted, and ash levels in different deliveries of cane were examined in relation to water management and other factors. Varietal effects were virtually eliminated since the cane was almost all N:Co 310, and this factor is particularly sensitive to ash-producing nutrients in the soil. From their observations, the authors conclude that ash is influenced by use of poor quality irrigation water, fertilizer policy, drainage, variety and the level of extraneous matter. The natural cation exchange capacity of the soil will dictate the base level of incoming ash, however, and will be unaffected by short-term measures adopted by management.

Bagasse trials at Bingera. N. McD. Smith. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 95-98. – The literature on the use of bagasse to improve soil is reviewed briefly and an account given of trials at Bingera. Under the dry conditions prevailing, a beneficial response was found to filter cake and bagasse applications, while it was found that fertilizer applications should be made before the bagasse. A bagasse blanket precludes irrigation by inter-row flooding. Filter cake was found to depress c.c.s. and this was also a trend experienced with bagasse.

Evaluating alternative irrigation systems for sugar cane in the Burdekin. G. J. Ham. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 111-116. - In spite of improvements in furrow irrigation methods, they are still wasteful of water and appear to result in infiltration problems arising from disruption of soil aggregates. Trials were therefore carried out on simulated solid set and conventional spray systems as well as four variants of trickle irrigation, with furrow irrigation as control. Cane and sugar yields were not significantly improved by the new techniques in plant and first ratoon cane, while there was a significant reduction in yields for trickle irrigation in second ratoons, when orifice blockage became a problem. Water in the submain system drained away after each irrigation, exaggerating water use, and this was consequently greater than with furrow irrigation. Problems arising are discussed; they include minor damage by animals and insects, while deposition from iron-bearing water in trickle irrigation tubing and orifices was a severe hindrance to its use. While water cost is low, it is unlikely that any change in the conventional furrow system will be adopted in the Burdekin area.

Soil erosion studies in the Mackay district. M. M. Sallaway. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 125-132. Soil erosion is in two stages: detachment from the soil mass and transport of the detached particles, of which the first is the critical mechanism. Soil erosion is subject to a number of factors including intensity and amount of rainfall, soil type, slope length, degree and shape, as well as management. Initial results from a study of erosion in the Mackay district revealed that rates of soil movement are very high, with losses commonly greater than 100 tonnes.ha^{-1}. In addition to land slope, soil texture proved to be a major contributor.

Trash retention as a soil conservation technique. M. M. Sallaway. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 133-137. – Green cane harvesting presents a problem of trash disposal, but it is pointed out that its conservation would be of benefit in marginal sloping cane land where soil erosion would be reduced and productivity could be maintained on a long-term basis. Use of trash conservation would present problems and the need to adapt current agricultural techniques; however, the problems are not insurmountable and the technique has been used successfully in other industries in Australia and by sugar industries in other countries.

Agricultural use of dunder. G. C. Bieske. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 139-141. – Dunder (vinasse) is being used as fertilizer in Brazil, and trials were carried out in Australia; responses in cane yield showed the vinasse to have a similar effect to its K equivalent as muriate of potash. The K and ash % juice were higher than the control for application of both vinasse and KCl. The difference in composition indicates that the application limit in Australia would be lower than in Brazil and, because of the year-round production of vinasse and seasonal use as fertilizer, a disposal problem would still remain.

SUGAR CANE MECHANIZATION

Costing mechanical cane harvesting. J. C. Hudson and C. A. Boycott. *Proc. 1976 Meeting W. Indies Sugar Tech.*, 37-47. – The cost of cane harvesting machines and their operation, with respect to output, is surveyed and key factors affecting cane harvesting are discussed briefly. Some of the difficulties of costing cane mechanization are emphasized, and it is concluded that the capital required to mechanize all field operations is of the same order as that required to purchase the land, to capitalize the factory and to provide alternative jobs for labour. Every effort should be made to evaluate "hidden" costs and benefits, e.g. in trash burning, chopping, soil compaction, etc., which may be higher than the "conventional" costs. It is pointed out that the quality of personnel in control of the equipment is crucial to success.

Waiting phenomena in sugar cane transportation. E. Capuñay G., M. Morales C. and E. Angulo A. *Saccharum* (Inst., Central Invest. Azuc., Peru), 1977, **5**, (2), 109-129 *(Spanish)*. – Statistical examination of the departures and arrivals of cane transport units at the feeder tables of the Cartavio sugar factory showed that they were affected by random phenomena along the routes and that deliveries had the form of a Poisson's distribution. The distribution of the operations of the scales and unloading conformed to an exponential distribution, while in the loading station the distribution followed an Erland model.

Mechanical planters. C. Richard. *Sugar Bull.*, 1979, **57**, (12), 14. – Descriptions are given of various modifications made to cane planters by individual farmers in Louisiana.

Report of the Mechanization Committee (Factory) of the Mauritius Chamber of Agriculture. J. D. de R. de St. Antoine *et al. Rev. Agric. Sucr. Maurice*, 1978, **57**, 143-156. – While mechanical cutting of cane increased from 1.0 to only 1.2% of the total between 1976 and 1977, grab-loading increased from 13.2% to 26.1%. Questionnaires were sent to factory managers and the responses analysed to determine the additional cost of factory repairs directly attributable to mechanization. It was concluded that the change had results in quite considerable additional costs and that these would increase as the proportion of mechanically handled cane grew. Conditions on each estate varied so much, however, that it was not possible to make any general recommendations to remedy the situation, and each case will have to be studied in its own context.

Cane transport systems meeting the challenge. J. P. Boyce and C. E. Dent. *The Condenser*, 1979, 46-49. – A system introduced in 1975 on part of the cane lands supplying Tongaat sugar factory in South Africa included the use of 4-tonne bins which are mounted on infield trailers and loaded by chopper-harvester. When full they are transferred to a skeletal rail trailer and brought in groups of five bins by narrow-gauge railway to another transfer point where they are winched onto road transport vehicles and taken to the factory to be discharged. A new system is recommended for introduction in place of the older one; it is similar to that used at Condong factory in Australia and employs self-loading, high-lift, side-tipping infield trailers which can be loaded with chopped cane but which are fitted with winches for loading bundles of whole-stalk cane. The trailers discharge into 20-tonne "canetainers" which are then winched onto road trailers for transport to the factory.

More on mechanical planting. C. Richard. *Sugar Bull.*, 1979, **57**, (14), 8-9. – Descriptions are given of modifications made by farmers to their planters in order to increase efficiency, and general trends in the Louisiana cane industry are indicated. A planting rate of 1 acre per hour is considered normal for the type of machine described.

Covering wide furrow sugar cane. B. Cochran and R. Ricaud. *Sugar Bull.*, 1979, **57**, (15), 10, 12-14. – Results of experiments at the Louisiana Agricultural Experiment Station have shown that planting cane in 36-inch or 20-inch wide furrows increased yield substantially by comparison with the conventional V-type furrow. However, wide-furrow planting necessitates modifications to machinery so that certain unconventional operations may be carried out: opening a wide furrow, covering the furrow without moving the widely spaced seed cane, and harvesting the cane on a wide-row surface. A powered disc implement, operated hydraulically using a separate hydraulic system or from the remote hydraulic couplings on the tractor, is described which has been developed at Louisiana State University to cover furrows wider than 18 inches.

The effect of harvester base cutter setting on dirt in the cane supply and cane left in the field. C. R. Henkel, T. G. Fuelling and D. R. Ridge. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 19-25. – The paper discusses the results of case studies designed to assess the effects of base cutter setting on the amount of dirt in the cane supply, the amount of cane left in the field, and c.c.s. of the cane. The studies involved erect and lodged cane under wet and dry conditions and in two types of soil. The quantity of dirt in the cane increased appreciably (e.g. from 0.31-0.68% for ground level cutting to 0.56-6.45% for cutting 50 mm below ground level). Higher dirt contents occurred during wet conditions and with lodged cane. Although there is an additional tonnage of cane obtained by cutting below ground, the lowering of c.c.s. owing to additional dirt can adversely affect the grower's return.

Tully system of cane billet quality monitoring and reporting. G. Patch, B. C. Bobbermein and R. P. Vicker. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 27-31. Random samples of 15-25 kg of billets are collected manually from bins so that each of 50 groups is sampled on an average of once a week through the season at Tully mill. The sample is weighed and separated into four fractions: extraneous matter, damaged billets, mutilated billets and sound billets. The last is then subdivided into fractions corresponding to different lengths. Use of a billet quality index derived from the analyses permits comparison between harvesters and growers.

CANE PESTS AND DISEASES

Quick and better germination as well as control of termites and shoot borers in a late-sown spring sugar cane crop. H. Singh and B. Singh. *Indian Sugar*, 1978, **28**, 609-614. – Germination was accelerated and the percentage increased by dipping setts in a mixture of 0.5% gamma-BHC and either 0.2% Agallol or 0.15% Aretan. The treatment of the setts also increased the number of tillers per mother shoot. While the mercurial compounds had no insecticidal properties, they did increase the effectiveness of gamma-BHC against termites and shoot borers, so that cane yield was increased by the treatment.

Rust of sugar cane in the Caribbean. H. Koike, F. G. Pollack, S. Lacy and J. L. Dean. *Plant Disease Reporter*, 1979, **63**, 253-255. – The occurrence of rust caused by *Puccinia melanocephala* in Jamaica, the Dominican Republic and Puerto Rico is reported. The variety most affected in Jamaica is B 4362, which is the third most widely grown and represents 12% of the total area; HJ 5741 and UCW 5465 (the first and second varieties in area planted in Jamaica) were not affected, but the former was to have been replaced by B 4362 because of its high susceptibility to smut. B 4362 represents some 30% of the cane area in the Dominican Republic.

Rust of sugar cane in Puerto Rico. L. J. Liu. *Plant Disease Reporter*, 1979, **63**, 256-258. – The occurrence of *Puccinia melanocephala* for the first time in Puerto Rico is reported. Thousands of seedlings from various sub-stations were severely affected. Of 18 varieties inoculated under controlled conditions, PR 63-1165 and PR 1124 proved to be highly susceptible to rust, PR 1148, PR 65-1128 and PR 67-3129 were moderately susceptible, while the rest were resistant. Microscope studies indicated that the infection is probably a short-cycle rust; so far the incidence has been restricted to the sub-stations but has not been found on commercial plantations. An emergency program is being carried out to eliminate the affected plants by roguing; sulphur as a wettable powder at 6 lb per 50 gal water is being used as a preventive spray.

Development and fertility of *Corcyra cephalonica* Stainton on various diets. W. Y. Cheng, T. H. Hung and J. K. Hung. *Rpt. Taiwan Sugar Research Inst.*, 1978, (82), 19-29 *(Chinese)*. – Details are given of rearing of *C. cephalonica* (rice moth), the laboratory host for *Trichogramma australicum* (an egg parasite of moth borers). The immature stages were completed most rapidly on rice germs and rice husks, the emerging adults producing the greatest number of eggs (up to 460) per mated female in single-pair mating; intermediate results were obtained with diets of unhusked rice, while poorest results were obtained with husked rice (cooking rice), used rice (remnants of unhusked rice used to feed the moth) and wheat flour.

Effect of hydrothermotherapy on the control of cane ratoon stunting disease (RSD) in variety H 32-8560. E. Pisfil D. *Saccharum* (Inst. Central Invest. Azuc., Peru), 1977, **5**, (2), 60-88 *(Spanish)*. – Trials were made on the effectiveness of hot water treatment of setts for control of RSD; immersion was for 30, 60, 90, 120, 150 or 180 minutes at 50°, 51° or 52°C. Treatment reduced infection by up to 92% and also increased yield, 51°C for 150 minutes giving a yield at 20 months of 199 tonnes.ha^{-1} against 149 tonnes.ha^{-1} for untreated cane.

Smut disease of sugar cane in Jamaica. R. Burgess. *ATAC*, 1978, **37**, (4), 16-25 *(Spanish)*. – The whips characteristic of smut disease were first observed in Jamaica in a block of HJ 5741 first ratoons in November 1976, and subsequent observations are reported. Control requires identification of infected fields, roguing of diseased stools and substitution of resistant for susceptible varieties. An account is given of the progress of this control program in the various regions of Jamaica up to the 1977/78 season.

The Louisiana sugar industry – on thinking the problem through. G. Arceneaux. *Sugar J.*, 1979, **41**, (11), 10-12. The problems of ratoon stunting disease and mosaic in Louisiana are discussed and comparison made with the situation in the Central Romana area of the Dominican Republic. The fact that RSD is of much smaller incidence at Central Romana is attributed to the up-down movement of machetes used to cut the cane; the knife is plunged into the soil, which is thought to have a scouring effect, whereas the much faster forward movement of the cutting blade of a cane harvester such as in Louisiana results in the cutter remaining a continuous source of infection. A continuous trickle of germicidal solution onto the cutter or spraying of the cane stumps with the same solution immediately behind the cutter would help combat infection. The milder strains of mosaic and the absence of vectors are suggested as reasons for the absence of mosaic at Central Romana, whereas Louisiana suffers from a high level of insect vector activity; this is attributed to the presence of Johnson grass, a major host of the corn leaf aphid (considered the principal mosaic vector). For eradication of Johnson grass, the author suggests flood-fallowing of fields, which would also destroy harmful soil insects and micro-organisms. Moreover, use of the Mississippi River for flood-fallowing would lead to silt deposition, providing additional plant food and improving soil texture.

Screening for sugar cane smut resistance in Florida. Second preliminary report. D. G. Holder and J. L. Dean. *Sugar J.*, 1979, **41**, (11), 18-19. – Information is given on screening tests conducted in Florida for varietal resistance to smut. Of 37 varieties grown in the state, 9 had gradings (6-9) which indicated susceptibility to the disease, while 22 (graded 1-4) were resistant or tolerant; the remaining 6 (graded 5) were intermediate in their response. Of 12 varieties grown in Louisiana, only one showed smut whips 5 months after planting. However, since the disease has been present in Florida for only a short period, there has not been sufficient time to correlate test results with natural infection in the field.

A new approach to genetic defence against red rot disease of sugar cane. K. C. Alexander, P. A. Kandasami, T. C. R. Rao, D. Mohandraj and M. M. Rao. *Indian Sugar*, 1979, **28**, 695-696. – A brief report is presented on breeding of cane for resistance to red rot, which is a major disease in the sub-tropical belt of India and is spreading to tropical areas.

CANE BREEDING AND VARIETIES

Co 6304 – an improved variety of sugar cane for Madhya Pradesh. R. A. Sharma and S. R. Sharma. *Indian Sugar Crops J.*, 1979, **6**, 13-15. – The performance of this mid-late ripening variety has been compared with that of four other varieties in the Co series in both plant and ratoon crops, and the results are tabulated.

Experimental behaviour of sugar cane clones in Tucumán. J. Scandaliaris and J. A. Mariotti. *Rev. Ind. Agríc. Tucumán*, 1978, **55**, (2), 15-33 *(Spanish)*. – Yield and quality data were obtained for 10 clones harvested at different dates through a season, and analysed statistically through variance analysis, paired comparisons and linear correlations, using parametric and non-parametric tests. Maturity habits were different for different clones, so that best harvesting times could be determined for each. Three clones – NA 56-79, Tuc 68-18 and Tuc 68-19 – gave higher yields than the others. There was an interaction between variety and age at harvest for cane yield, some clones declining more than others with late harvesting. The clones differed as to stability of quality traits, and variability of quality was also associated with sampling date. Locality had a strong influence on maturity. It was found that parametric and non-parametric tests were efficient in differentiating clonal characteristics for yield and quality.

Sugar cane varieties for the Province of Tucumán. J. Scandaliaris and J. A. Mariotti. *Bol. Est. Exp. Agríc. Tucumán*, 1978, (130), 15 pp *(Spanish)*. – Adoption of improved varieties has raised sugar yield by over 100% between 1953/57 and 1973/77, and varieties both old and new are compared as a guide to growers. This guide gives comparative data on yields and sugar content and also on the degrees of resistance or susceptibility to the three most important diseases prevalent in Tucumán, viz. red stripe, mosaic and smut. Other characteristics are discussed, including competition with weeds, sensitivity to herbicides and resistance to frost. Four varieties (NA 56-79, Tuc 68-19, NA 63-90 and Tuc 68-18) are recommended, as are a further four for specific conditions, and a number which should be eliminated are specified.

The outfield tests. W. Jackson. *Sugar Bull.*, 1979, **57**, (11), 8. – Details are given of the system of 15 outfield test locations operated in Louisiana. At each location, four test fields, each of about 3 acres, are used for testing up to 20 different cane varieties (including commercial controls), usually in plant, 1st and 2nd ratoon crops, with one field left fallow for the next planting. The farmer who owns the land voluntarily carries out all operations from planting to harvesting, using his own standard practices. After harvesting, the total cane per plot is weighed and the yield per acre thus established. From a 15-stalk sample taken from each plot and crushed by a sample mill at the USDA Sugar Cane Laboratory at Houma, the sugar yield per ton of cane is determined and, from this and the cane yield, the sugar yield per acre. Other varietal properties are also determined in the outfield tests, which are one of the last stages before a variety is released to growers from the secondary stations.

Studies on cultivation methods for the newly released sugar cane varieties F 176 and 177. Anon. *Taiwan Sugar*, 1979, **26**, 56-58. – From experiments in which planting date, row spacing and harvesting time were varied for spring- and autumn-planted crops, the best for the two new varieties were established for recommendation to growers.

The Louisiana cane variety census for 1978. H. P. Fanguy and L. L. McCormick. *Sugar Bull.*, 1979, **57**, (13), 12, 14. – Of the varieties grown on 296,000 acres in Louisiana in 1978, CP 65-357 occupied 50% of the area (a gain of 18% absolute on the 1977 level), while the varieties occupying second and third places were, respectively, CP 61-37 and N:Co 310 (occupying 16% and 10% of the total area, respectively, and representing a slight fall on the previous year).

Cane breeding in Réunion. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 1-26 *(French)*. – Hybridization work at La Bretagne involved 396 specific combinations, for which 1616 female stalks were cut and kept alive in an aseptic medium of a composition identical to one used in Hawaii. At the fecundation stage, some 12% of the female flowers were lost, while 42% of the remainder set seed, one-third of fuzz then being sown immediately. Problems arising with certain varieties in these early stages of hybridization are noted. The number of seedlings obtained per arrow and transplanted in the nursery averaged 417. Data are tabulated concerning these initial stages and subsequent selection trials.

Resistance of cane varieties to cyclones. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 31 *(French)*. – Brief reference is made to the effect of very high winds (of about 126 $km.hr^{-1}$) on varieties in Réunion. Of those mentioned, M 1453/59 and CRA 60/26 proved the most seriously affected, with large numbers of tops broken, while R 567, R 570 and R 549 were less affected, but still suffered from fractures at the growing point. At the other end of the scale, S 17 offers quite good wind resistance.

Altitude and cane varietal performance. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 33-35 *(French)*. – The performances of specific cane varieties at altitudes of up to 950 m in Réunion are discussed. Trials have demonstrated the tendencies for certain varieties to perform better at height than in the littoral, and vice versa.

Cane varietal trials in Réunion. Anon. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1978, 44-144 *(French)*. – Varietal trials at twenty locations on the island are reported, and the cane and sugar yields and sugar contents tabulated.

Sugar cane breeding and selection in Victorias Milling Co. Inc. R. R. Jalando-on and A. J. Barredo. *Sugar News* (Philippines), 1979, **55**, 12-16. – Details are given of the cane breeding program at Victorias and of the procedures used at various stages in breeding and selection.

CANE SUGAR MANUFACTURE

Trends in green cane processing. D. H. Foster. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 11-17. — To avoid losses through deterioration, cane burning must be carefully controlled as regards timing, which can be a disagreeable chore. The advent of green cane harvesters has met with a positive response, and their performance has been studied by the Sugar Research Institute. The harvesting rate was 60-90% of that in burnt cane but dropped to 50% where the cane was lodged. Colour formation in juice from clean green cane was lower than that from clean burnt cane, but the presence of leafy trash increased colour substantially and also reduced syrup filtrability. Green cane at Mulgrave tended to slip more on the steep carrier and the crushing rate was only 270 t.c.h. against 320 t.c.h. with burnt cane. Despite a slightly higher trash content (8.1% *vs.* 7.1%), the green cane gave better quality clear juice and syrup, and the c.c.s. was 15.35 against 14.58.

Technical staff for Australian sugar mills. J. R. Allen. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 41 - 43. Changes have occurred in the pattern of tertiary education in Australia, and it is indicated that the industry needs to adapt its methods of recruiting and developing the talents of new staff to ensure an adequate supply of technical, management and research personnel for the future.

The ongoing training of sugar technologists. R. J. Noakes. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 45-49. Training courses for cane testers, sugar analysts and sugar technologists in Queensland are briefly summarized and the influences of changes in school populations and modern technological developments are discussed. A modified technologist training course is proposed and additional courses recommended, including accounting, management organizational science, computing, etc.

The control of excess bagasse in mixed juice. P. Allen, R. Ames and R. Luxford. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 157-159. — With improvements in cane preparation and cell breakage, bagasse fines in screened juice had become a cause of occasional filtration problems. Attempts were made to improve fines removal while maintaining juice capacity, and a combined device tested in which juice is passed through a rotary screen turning at a rate to allow formation of a bed which traps fines and which is discharged onto a parabolic screen for separation of further juice. Up to 90% removal of fibre from the juice was achieved with a screen fitted with a woven wire mesh of 1.0 mm aperture and 0.6 mm wire thickness.

Juice heating by direct vapour contact. P. G. Wright. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 161-166. An examination of the process flow, design and economic implications of the replacement of traditional tubular juice heaters by direct contact heaters operated from evaporator vapours has shown that, under some circumstances, there may be definite advantages in their use.

Combined mill waste disposal. J. W. Watt and A. L. Morton. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 167-171. — At Macknade mill, boiler fly-ash, mill mud and effluent sludge are combined and the mixture sold to local farmers as a soil improver and plant nutrient. An account is given of the plant installed for handling of the wastes.

A microprocessor based control system for sugar industry applications. J. Hendry, R. Marshall and M. Webber. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 173-178. — A general-purpose process control system developed jointly by Batstone Hendry & Associates and Farleigh mill is described and discussed. It can be used by engineers, chemists and electricians without any formal computer training, and features high reliability, ease of use and low cost. Alarm and loop control functions are carried out automatically, while more complex sequencing and supervisory control may be programmed using a simple process control language.

Controllers — microprocessor or hardwired? A. C. Burns and S. R. Reichard. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 179-185. — The differences in nature and function of microprocessor and hardwired circuitry are discussed and the importance of throughput time for a program emphasized.

Innovations and change in sugar mill power electrics and control. K. A. Walshe and J. R. D. Pratten. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 187-192. — A survey is presented of developments during the past ten years of equipment for industrial control, especially of steam turbines, and an indication is given of likely future advances.

Computer control of pan boiling and sequencing. G. D. Maclean. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 193-203. — A detailed account is given of the computer control installation at Millaquin sugar factory where five pans are completely controlled and three others are under cut-over and limited sequence control. The system has proved successful, giving more effective utilization of capacity to increase throughput and exhaustion, while continual development of better procedures is in progress.

Proserpine mill sample tracking and control system. G. Taylor, J. Rigby and B. Powell. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 205-207. — Details are given of a sophisticated system for recording weights and chemical control data installed at Proserpine mill; it is provided with visual display units and also a printer for permanent records.

Power demand in rotating coil crystallizers. M. W. Webster, E. T. White and L. K. Kirby. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 211-215. — Measurements were made of power used in crystallizers and showed that, while the theoretical dimensionless correlation factor V_p relating power demand to the product of viscosity, square of rotational speed and cube of a linear size dimension (taken as the internal width of the shell) did appear as a constant for the same crystallizer and the same massecuite under varying conditions, the values of V_p were markedly different for different designs.

An evaluation of the BMA K1000 centre feed modification. R. J. Swindells and J. N. Ness. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 217-221. — During tests in 1977 it was found that, contrary to claims by the manufacturer, modification of side-feed centrifugals to a centre-feed system resulted in a lower throughput. Examination showed this to be due to a feed bell designed more for beet massecuites and, by use of a longer bell in 1978, massecuite distribution was improved and throughput raised above that of the unmodified machines.

Influence of molasses recirculation on exhaustion. R. Broadfoot, P. G. Wright and R. J. Steindl. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 223-230. Trials at Plane Creek showed that no improvement in molasses exhaustion resulted from massecuite dilution with final molasses or with molasses from a part of the massecuite cured after only a few hours' cooling. The first technique might be of benefit at week-end shutdown, however, or where crystallizer flow problems exist. Trials in an experimental crystallizer indicated that a rise in molasses purity was likely if molasses was recirculated early in the exhaustion cycle.

An unsuccessful test of a new concept in juice grooves. D. J. Nicklin and K. J. Nix. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 239-242. — The paper describes the testing of a new type of juice groove which allows the juice to flow radially toward the centre of the roll. The grooves link up via circumferential grooves with axial holes in the roll so that juice can eventually escape through holes in the end face of the roll. The logic behind the design of such grooves was to provide a mechanism of reducing the effect of reabsorption and so increase extraction. Such complicated grooves require that the roll be built up by threading a number of discs onto the shaft and bolting them together. A prototype roll was built with a test section of the new grooves alongside a section of conventional grooves. The prototype was tested as part of the milling train at Babinda in November 1977. Results were not encouraging and significant reductions in moisture were not achieved. It is hoped to carry out further tests with some modification of the test roll.

Mill hydraulics — a new approach. T. W. Gatley and R. K. Pearce. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 243-248. — A new device employs a stepped ram operating within a cylinder and providing separate circuits connecting hydraulic accumulator pressure to each side of a mill roll; movement of the stepped ram in either direction causes equal changes in volume of oil to flow to or from the mill cylinders and thus results in equal movement of each end of the roll. Regression analysis of bagasse moisture levels obtained with the new system installed on the last mill of the Fairymead tandem and with the conventional system indicated a resultant improvement but not conclusively, so that further testing is needed.

Corrosion of insulated surfaces in sugar mills. R. Willis. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 267-271. It has been demonstrated that corrosion of the furnace walls of boilers of spaced tube wall construction is due to the presence of water condensed from the products of combustion on the interior surface of the casing. This can be eliminated by using sufficient insulation, protected by weather-proof cladding, on the outside of the steel casing that it remains at above dew point tempera-ture under operating conditions. During a survey, all cases of corrosion of insulated surfaces were associated with damaged or badly installed cladding which permitted rain or hosing-down water to enter the insulating system. Corrosion was found to be independent of the type of mineral wool used.

Boiler water treatment in the Queensland sugar industry. P. C. Ivin. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 273-279. — Results of a survey on boiler water treatment in Queensland sugar factories are reported, with a discussion on alkali-phosphate treatments, chelant-polymer treatment (applicable where feed water hardness is negligible), costs, scaling problems and those with steam and condensate lines, the use of filming amines, raw water quality, feed water quality and capacity, control of boiler water treatment, boiler water quality targets, sampling and analytical procedures, dosing equipment, boiler water levels and blowdown, and slack period boiler storage.

Experience with boiler superheaters at Racecourse mill. W. A. Black, W. A. Greenwood and E. E. McDougall. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 281-287. A study was made to determine causes of the high failure rate of superheater tubes in a boiler commissioned only a year before. The failures were at the tube bends and occurred on Friday evenings; use of thermocouples revealed that deposition of scale occurred in the bends, and the temperatures rose from 300°C to a maximum of 750°C on Friday. Tube life at temperatures higher than 500°C is very short and hence the failures. Extension of a refractory baffle shifted the problem to a second lower bend zone.

Detection and collection of tramp iron. V. Mason, R. N. Cullen and S. R. Reichard. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 289-296. — Adoption of electromagnetic separators for tramp iron in recent years in Queensland was given impetus by major damage caused at Mulgrave mill by tramp iron mischievously placed in the cane supply. Characteristics of such magnets and their installation and use are discussed, as is the use of eddy current metal detectors and the use of a monitor of the vibration level on the bearings of a kicker or knife shaft which reacts to the shock occurring when tramp iron is encountered. Use of a magnetic separator is recommended as well as an eddy-current detector for protection against non-magnetic metal.

Performance of suspension fired boilers in the Central District. (A) History and furnace design. (B) Combustion and control. (C) Steam generation and dust collectors. Mackay Institute of Sugar Mill Engineers. (A) *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 297-303. (B) *ibid.*, 305-312. (C) *ibid.*, 313-322. — (A) A survey is presented in summary form of some of the major developments which have occurred in suspension fired boilers since 1962. (B) Subjects discussed include bagasse feeders and distributors, auxiliary oil firing, forced draught, secondary air and distributor air fans, and boiler control. (C) Steam drums and steam separation equipment, valving and storage of boilers, superheaters, feed water systems and feed water storage, efficiency control equipment, dust collectors and induced-draught fans employed in the Central district are surveyed and discussed.

BEET SUGAR MANUFACTURE

Reconstruction of the roof and sugar house at Hatvan sugar factory. L. Debrődi and J. Deák. *Cukoripar*, 1979, **32**, 57-62 *(Hungarian)*. — Details are given of the work involved in the re-roofing of this 90-year-old sugar factory and of the reconstruction of the sugar house, with installation of new equipment, a list of which is given.

Twenty years of experience and research concerning waste water control at CSM 1960-1980. R. de Vletter. *Proc. 16th Gen. Assembly CITS*, 1979, 1-16, 27-28. The research program at CSM Suiker B.V. described involved first finding the most suitable method for determining sugar losses in waste water, followed by actual measurements made in large numbers over several campaigns, leading to establishment of means of reducing the pollution load to within legal limits (and thereby also reducing the monetary penalties imposed by the authorities for every unit of solids discharged). Methods used for waste water treatment are described and future prospects are discussed.

Anaerobic waste water treatment at CSM sugar factories. K. C. Pette. *Proc. 16th Gen. Assembly CITS*, 1979, 17-28. — Research work on effluent treatment at CSM factories in Holland is discussed and results of treatment by anaerobic fermentation at Halfweg in 1977 (using a 200-m^3 tank) and in 1978 (using a 800-m^3 tank) are reported. The larger tank was designed for a daily organic (COD) load of 13,000 kg, with an influent COD concentration of 3000 mg.litre^{-1} and an average flow of 180 $m^3.hr^{-1}$. At a residence time of 6-10 hr, COD was reduced by 80-95% and methane was produced at the rate of 0.39 m^3 per kg of COD removed, or 100 $m^3.hr^{-1}$. Investment and operating costs of the plant are indicated, and a substantial saving is considered possible once the gas is utilized.

Sugar factory water treatment by mesophilic methane fermentation. J. P. Lescure and P. Bourlet. *Proc. 16th Gen. Assembly CITS*, 1979, 29-78 *(French)*. — The composition of the various waste waters occurring in a sugar factory and their origin are discussed, and the fundamentals of anaerobic fermentation as a means of effluent treatment are explained. Details are given of the process used in the experimental plant at a flow rate of 30 $m^3.hr^{-1}$ at Vauciennes[1,2].

Sugar factory waste waters. Physico-chemical and biological parameters to give maximum purification at minimum energy consumption. F. Zama, C. A. Accorsi and G. Mantovani. *Proc. 16th Gen. Assembly CITS*, 1979, 119-150 *(French)*. — The effluent treatment scheme used at Jesi beet sugar factory in Italy (which has a daily slice of 6000 tonnes of beet) is described. It is designed to handle 2000 m^3 of waste water daily, at a COD of 5500 mg.litre^{-1} and BOD_5 of 3600 mg.litre^{-1}. The scheme used is a conventional one in which the water is treated by mechanical settler and then subjected to anaerobic followed by aerobic conditions with activated sludge, and a final mechanical settling. Flume-wash water is initially treated in a centrifugal decanter to reduce the soil and suspended solids content and hence the solids load on the plant. At a speed of 2000 rpm the dry solids content is reduced by 50-65% without use of polyelectrolyte, or by 70-75% with addition of an economically optimum 15-20 g.m^{-3} polyelectrolyte, while in addition 5-15 tonnes of soil (of 50-60% dry solids content) is removed per hour. Typical COD reduction is 96.8% and BOD_5 reduction 98%, giving sufficiently low levels to permit the treated water to be discharged directly into the river.

Investigations on activated sludge degeneration in the treatment of sugar factory waste waters and on poorly degradable constituents. E. Reinefeld, H. P. Hoffmann-Walbeck, A. Pellegrini and J. Wittek. *Proc. 16th Gen. Assembly CITS*, 1979, 151-177 *(German)*. — Investigations at five sugar factories using the activated sludge process of effluent treatment are reported. These showed that purification efficiencies of approx. 99% to give a BOD_5 of 30 mg.litre^{-1} were obtainable only when the load was low, e.g. 0.06-0.12 kg BOD_5 per kg dry solids/day, but that efficiency fell with rise in the load as a result of activated sludge degradation by filamentous bacteria: *Sphaerotilus natans, Thiothrix* sp. and *Haliscomenobacter hydrossis*. Formation of slime in the activated sludge also occurred, and analysis showed that it mainly consisted of acid heteropolysaccharides probably present as a complex of mucopolysaccharides and proteins. In model tests, such slime was formed when there was a deficiency of phosphate and, to a lesser extent, of nitrogen. High COD:BOD_5 ratios in highly degraded effluents indicated the presence of poorly degradable substances. Some 60% of the residual load was methanol-precipitable; gel chromatography showed that the organic fraction of the precipitate (approx. 50% on dry solids) had molecular weights up to $>$ 20,000 and averaged 9000, 18% of this comprising polysaccharides with a rather high galactose and rhamnose content, and 11% consisting of protein. The remainder was difficult to analyse. The presence of humins or their precursors was considered probable.

System for recycling water supply at sugar plants. N. A. Arkhipovich and V. A. Lagoda. *Proc. 16th Gen. Assembly CITS*, 1979, 179-188. — Details are given of a waste water treatment and recycling scheme which includes electroflotation[3,4] for treatment of flume-wash water, and electrodialysis for ammonia removal from condensate. Fresh water consumption is reduced to 49% on beet by the scheme.

Recalcination of carbonatation mud — experiences and results with an experimental plant at the Rain factory of Süddeutsche Zucker-AG. H. Schiweck, T. Cronewitz and F. Schoppe. *Proc. 16th Gen. Assembly CITS*, 1979, 189-209, 229-230 *(German)*. — Recalcination methods are reviewed and advantages and disadvantages of the process discussed. Details are given of an experimental plant for drying and recalcining carbonatation mud; it has an hourly output of 370 kg CaO from a mud mix of 20% moisture content which is calcined in a special

[1] Lescure & Bourlet: *I.S.J.*, 1979, **81**, 121.
[2] Idem: *ibid.*, 1980, **82**, 182.
[3] Krivchun *et al.*: *ibid.*, 1976, **78**, 89.
[4] Arkhipovich & Lagoda: *ibid.*, 1980, **82**, 284.

chamber with gas at approx. 900°C. A recalcination level greater than 97% is obtainable at an energy consumption of 4.52×10^6 kJ per tonne of CaO produced, which is the lowest known consumption for such a plant.

Recalcination of carbonatation mud in a high-velocity reaction chamber. F. Schoppe, H. Schiweck and T. Cronewitz. *Proc. 16th Gen. Assembly CITS,* 1979, 211-230 *(German).* — High reaction velocities in carbonatation mud recalcination are desirable for two reasons: the high costs argue in favour of as small a plant as possible for a given capacity, and the particle size of the recalcined lime must be such that it can be easily removed from the hot gas stream without risk of a back reaction between the CaO and CO_2. By heating the mud at a rate of 2000°C per sec, the pressure of the CO_2 inside the calcium carbonate crystals rises faster than the rate at which the gas can diffuse out, so that the crystals burst. The fragments have a highly active surface and agglomerate to form secondary particles, which remain mechanically stable for a sufficient length of time to be removed (92-94%) by cyclones. Application of this principle to the special reaction chamber mentioned in the previous abstract is demonstrated.

Sugar losses associated with mechanical damage to beet. K. Vukov and G. Pátkai. *Proc. 16th Gen. Assembly CITS,* 1979, 387-395, 428-429 *(German).* — The relative damaged surface area of beets was determined by immersing the roots in a 0.5% potassium permanganate solution for 20 min to allow development of brown spots, then rolling the beets in thin, transparent paper and marking the outline of the spots as well as the conical portion of the root; the area of paper used and of the marked spots was then determined planimetrically. Application of the method to determination of the weight losses in beet loading, and weight and sugar losses in fluming and washing is demonstrated, and results are compared with those reported in the literature. It was found that the sugar content of severely damaged beet was reduced by at least 0.3% in fluming and washing, and could be as much as 0.7-0.8% lower than before fluming. The sugar losses in badly damaged beet stored for 40-80 days were more than double those in undamaged beet.

Assessment and reduction of sugar losses in beet sugar processing. J. F. T. Oldfield, M. Shore, J. V. Dutton and H. J. Teague. *Proc. 16th Gen. Assembly CITS,* 1979, 431-469. — Losses in British Sugar Corporation factories and means of reducing them are discussed. Storage losses normally range from 0.15 to 0.30% of total sugar. The highest losses at most factories occur in fluming and washing; estimates of the losses based on sugar recovery from the water gave values of 0.30-3.10% (averaging 1.10%), but beet particulate material discharged to mud ponds represented between 0.5 and 4.3% of the beet processed (averaging 2.2%); since this was beet tissue, it is considered probable that the sugar losses were of a similar order of magnitude. Lactic acid production in diffusion has been reduced to an average of 0.15% of total sugar over successive campaigns; at some factories, which had previously relied on lactic acid production to assist pulp pressing, the reduction was achieved by the introduction of midbay acidification[1]. Additional losses of sucrose were attributed to thermophilic activity and inversion by invertase. In an investigation of losses in discarded lime sludge a negative correlation was found between "ease of washing" of 1st carbonatation mud and the content of "clay-type solids". Details are given of the method used to determine the "ease of washing", which is considered useful in investigations of high mud sugar losses. It is stressed that, since invert sugar is degraded as well as produced during evaporation and at the sugar end, changes in its concentration are not a suitable guide to sugar loss, although they may be used to identify regions where excessive losses occur. The importance of satisfactory pH control in evaporation and the sugar end as a means of minimizing sugar losses is stressed; for minimum losses in evaporation, sufficient soda ash must be applied at 2nd carbonatation, while for the sugar end, excessive losses may be avoided by ensuring a final massecuite pH of 7-8.

Microbiological sugar losses in diffusion and their estimation by cost analysis. T. Cronewitz, H. Schiweck and R. Strauss. *Proc. 16th Gen. Assembly CITS,* 1979, 471-493 *(German).* — pH measurement is inadequate for microbiological control of diffusion, while bacterial counts are too unspecific. Hence, for an accurate estimation of sugar losses by microbial action, a metabolic balance must be carried out. For L- and D-lactic acid, nitrate and nitrite, the balances can be determined on daily average samples, from which the degree and location of infection can also be found. While the activity of nitrate-reducing bacteria affects the non-sugar composition, lactic acid formation is associated with sucrose degradation and increase in the melassigenic non-sugars, so that lactic acid-forming bacteria are the most important for cost analysis, which must also incorporate the purchase price and handling costs of disinfectants, which also increase molasses losses. A cost analysis is demonstrated, from which it is possible to establish the most economical conditions for diffusion; the importance of pulp pressability and associated drying costs is also discussed. The question of suitability of disinfectants other than formalin is discussed, with reference to tests conducted at Süddeutsche Zucker-AG.

Experimental investigations of bacterial degradation of sugar in raw juice and predefecation juice. F. Hollaus and L. Wieninger. *Proc. 16th Gen. Assembly CITS,* 1979, 495-514 *(German).* — Investigations of bacterial degradation of sugar and lactic acid formation in slide cultures of raw and predefecation juice under aerobic and anaerobic conditions at varying incubation temperatures are reported. Under aerobic conditions, only a small quantity of lactic acid was formed as a result of sugar degradation, while dextrose and levulose contents increased markedly as a result of sucrose molecule cleavage by *Bacillus licheniformis,* which simultaneously caused formation of levan. Sucrose hydrolysis was also caused by highly thermophilic bacteria, as indicated by increase in dextrose and levulose contents in the upper part of a BMA tower diffuser and particularly in press water. Under highly anaerobic conditions, sucrose hydrolysis proceeded at a more rapid rate than degradation of the liberated hexoses only when nitrate was added to the culture, and not all of the degraded sugar was transformed into lactic acid.

Some problems concerning abnormal sugar content in molasses and ways of reducing it. G. K. Posessor. *Sakhar Prom.*, 1979, (6), 43-46 *(Russian).* — The abnormally high sugar content of molasses at six Soviet sugar factories and reasons for it are discussed, and remedial measures indicated.

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[1] Oldfield *et al.: I.S.J.*, 1979, **81**, 279.

NEW BOOKS

Australian Sugar Producers Association Ltd. 1980 annual report. 28 pp; 21 x 27.5 cm. (A.S.P.A., G.P.O. Box 608, Brisbane, Australia 4001). 1980.

This report is not a record of the activities of the Association but presents an outline and commentary on the main factors influencing the structure, economics and operation of the Australian raw sugar industry and its members during 1979. It provides an illustrated account of the 1979 season with statistical data, records prices set for sugar and discusses the report of the Committee of Enquiry into the Commonwealth-Queensland Sugar Agreement. The changes occurring in the world market during 1979 are described as is the operation of the International Sugar Agreement.

Export marketing of Australian sugar in 1979 is surveyed and a description given of developments in bulk sugar terminal facilities. Interest in the production of fuel alcohol is reported, and a number of other factors discussed, including industrial relations, changes in membership of industry boards, personal items, etc.

Environmental protection. Sugar losses. (Comptes Rendus de la 16e Assemblée Générale de la Commission Internationale Technique de Sucrerie.) xxxi + 876 pp; 16.2 x 24.9 cm. (Secrétariat Général de la Commission Internationale Technique de Sucrerie, Aandorenstraat 1, B-3300 Tienen, Belgium.) 1980. Price: 1800 Belgian francs.

The work is a collection of 36 papers on the main themes of environmental protection and sugar losses, as well as on other topics such as continuous boiling, colour problems, sugar factory automation, etc., presented at the 1979 Meeting of the CITS General Assembly in Amsterdam. Discussions which followed the presentation of the papers at the Meeting are also given verbatim. The papers are published in the language in which they were presented, viz. English, French or German. The book represents a valuable contribution to the latest knowledge on subjects of great importance within the beet sugar industry.

Australian sugar year book 1980. 320 pp; 18.6 x 24.6 cm. (Strand Publishing Pty. Ltd., G.P.O. Box 1185, Brisbane, Australia 4001.) 1980. Price: A$ 19.10.

The 320 pp. of the 1980 Australian sugar year book are packed with all kinds of information on one of the foremost cane sugar industries of the world. It opens with "Twenty facts about the Australian sugar industry" accompanied by a map of the industry; next come details of sugar industry organisations, with names of officers, and this section is followed by a sugar factory directory, which provides information on personnel, equipment and results for the years 1968-78. A review of the 1979 season is followed by comments from three leading representatives of the industry, a sugar industry review and potted biographies of certain sugar industry personalities, reports from annual conferences, extracts from the Sugar Board Annual Report, a review of activities and events in the various cane-growing regions, reports of field days held by the Bureau of Sugar Experiment Stations, conclusions from the McKinnon Report on the sugar industry, a review of sugar research, and sugar industry statistics. In all, this is a very good reference work which is to be recommended to those readers interested in the Australian sugar industry.

Cane sugar industry in USA. Tour report. 67 pp; 14 x 22.2 cm. (Fauji Foundation, Harley St., Rawalpindi, Pakistan.) 1980.

Three senior officers of the Fauji Foundation visited the USA in 1979 to study the field and factory practices used in the sugar industries of Hawaii, Texas, Louisiana and Florida. The resultant report describes the agronomy of the four states, with brief mention of processing, and then examines the Pakistan sugar industry under three headings: agriculture, harvest and mill delivery, and factory operations. Appended are the study tour program in the USA, common weeds of sugar cane, and the typical arrangement of a 10,000-tcd factory in the USA.

Les variétés réunionnaises cultivées en 1980 (Réunion cane varieties cultivated in 1980). 19 x 26 cm. (Centre d'Essai de Recherche et de Formation, La Bretagne, 97490 Ste.-Clotilde, Réunion.) 1980.

Colour photographs, parentage, botanical descriptions and agronomic characteristics are given for a number of cane varieties in the R series: R 447 (= R 476), R 469, R 472, R 526, R 541, R 549, R 557, R 565, R 567, R 568, R 569, R 570, R 571 and R 572. A key to identification of a variety precedes the main section. The book coincides with the 50th anniversary of the founding of the C.E.R.F., and homage is paid to M. Donald d'Emmerez de Charmoy, who was responsible for many of the varieties described and thus paved the way for breeding of varieties of long-standing superiority. The contents are very well laid out, with very clear photographs and type, making the work a praiseworthy contribution from what must be regarded as a foremost cane breeding station.

Annual Report 1978-79. 55 pp; 19.5 x 17.5 cm. (Taiwan Sugar Research Institute, Tainan, Taiwan.) 1980.

The 1978-79 Annual Report of the Taiwan Sugar Research Institute is a well produced survey of the Institute's work, coverng many aspects of cane research as well as research on sugar technology and by-product utilization. The text is interspersed with colour illustrations, diagrams and tables, all very clearly reproduced, as is the text. Particularly mentioned is the change in the naming system used for Taiwan-bred cane varieties, which are now known as the ROC series instead of the F series; four new varieties were released in 1979 (ROC 1, ROC 2, ROC 3 and ROC 4). A portable gated polyethylene hose developed by the Agronomy Dept. is provided with a polyethylene valve which can be operated manually; the hose, only 0.4-0.6 mm thick, has rectangular orifices at regular intervals and can easily be laid out and rolled up like a fire hose for use in furrow irrigation. The system has reduced water consumption, while economic benefits have also come from an improved subsurface drainage system for fields having a high water table, which has raised cane yield by 16.7-39.9%. Among pathology observations is a root and basal stem rot which in imperfect state resembles *Xylaria hypoxylon*; no perfect state has been found. Details are given of the symptoms.

LABORATORY STUDIES

Phosphorus determination in sugar beet and raw juices. N. Kubadinow and W. Braunsteiner. *Ernährung*, 1979, **3**, 219-221 *(German)*. – Of five methods compared, the most suitable was one in which 2.5 g of beet brei or 0.5 g dried leaf sample is heated to boiling with 25 cm^3 of a 85:15 v/v nitric acid:perchloric acid mixture of 65% and 70% acid concentrations, respectively, to give a clear, colourless solution within 30 min. After cooling, dilution with a little water and further boiling for some min, possibly followed by filtration to remove any turbidity, 5-10 cm^3 is mixed with 10 cm^3 of 10% sulphuric acid and 10 cm^3 of a 1:1 mixture of ammonium vanadate and molybdate solutions in a 50-cm^3 flask and made up to the mark with distilled water; after 5 min, photometric measurement is carried out at 405 nm against a blank. The vanadate solution is prepared by dissolving 2.5 g ammonium vanadate in 500 cm^3 boiling water, cooling, adding 20 cm^3 nitric acid and diluting to 1000 cm^3; the molybdate solution is prepared by dissolving 100 g in 500 cm^3 water at 50°C, cooling, adding 100 cm^3 of sulphuric acid and diluting to 1000 cm^3.

Determination of fermentable sugars in wort by high-performance liquid chromatography. M. Moll, D. Bazard and R. Flayeux. *Bios*, 1978, **9**, (9), 23-26; through *Anal. Abs.*, 1979, **36**, Abs. 5F37. – The sample is centrifuged and filtered through a Millipore filter (0.45 μm). The filtrate (5 μlitre), containing rhamnose as internal standard, is injected onto a column (30 cm x 4 mm) of μBondapak Carbohydrate for separation of sugars at 20°C, with 7:3 acetonitrile:water as mobile phase and detection with a differential refractometer at 20°C. Chromatographic parameters are given for levulose, dextrose, sucrose, maltose, maltotriose and rhamnose. These fermentable sugars can be determined within 15 min with a precision of ± 2%, and the method can be automated by the use of an automatic injector and an integrator, so allowing 30 analyses per day.

Composition of waste gases from a sugar beet pulp dryer and their relation to the process conditions. B. C. Huisman, L. H. de Nie, J. Schaefer, H. Maarse and F. de Vrijer. *Proc. 16th Gen. Assembly CITS*, 1979, 253-272. – In a study of the nature and quantity of volatile compounds in gases emitted from pulp dryers, 38 compounds were identified by gas-liquid chromatography and mass spectrometry. They included a number of furan-type components as well as some pyrazines, which probably make an important contribution to the resultant odour. Nitrosamines were not present in detectable quantities, while the concentrations of the polycyclic hydrocarbons were no higher than in the air upwind from the factory. Of the 38 compounds, 10 of them have been found to have no perceptible toxicity; however, while 1-pentanol and phenol appear to present no real danger to health, it seems desirable to monitor them in residential areas. For 7 of the compounds there is insufficient information to judge their health aspects, while nothing at all is known about the remaining 19 compounds. In a study of the possible effects of drying temperature and time on the emission of volatile compounds, no significant difference in volume was found at temperatures in the range 800-1200°C, while at 700-800°C there was a significant reduction in volume, but the drying capacity was considerably reduced, so that there appears to be no reason to set limits for the drying temperature.

Pulp dryer volatiles. I. Some constituents of factory pulp dryer exhaust vapours. J. F. T. Oldfield, M. Shore, N. W. Broughton, C. W. Harvey and R. Parslow. *Proc. 16th Gen. Assembly CITS*, 1979, 273-324, 354. **II. Formation of volatile acids and carbonyl compounds in pulp drying.** *Idem ibid.*, 325-354.

(I) The exhaust vapours from oil-, gas- and coal-fired rotary pulp dryers at five British Sugar Corporation factories were analysed by gas-liquid chromatography, thin-layer chromatography and mass spectroscopy to reveal large numbers of different types of organic compounds, including amines, hydrocarbons, lactones, furans, esters, ethers, pyridines, pyrazines, volatile fatty acids (VFA) and carbonyl compounds. Organic sulphur compounds were absent. The samples from all the dryers had very similar qualitative distribution of compounds. Dryers handling plain pressed pulp, or molassed pressed pulp with calcined magnesite added, gave lower VFA levels than those handling normal molassed pressed pulp. The similarities tended to confirm chemically the subjective assessment that there was little difference between factories as regards the nature of the odours.

(II) In investigations on the compounds contributing to the odour of pulp dryer exhaust vapour, studies were made of the effects of various process conditions on the formation of carbonyl compounds and VFA as the predominant classes of organic compounds present. Reduction in reaction time and temperature, particularly to below 175°C for VFA and below 200°C for carbonyl, reduced production of the respective compounds, decrease in VFA also being obtained by reducing the molasses content and by adding alkali to the pulp (NaOH in laboratory experiments and MgO in factory trials). A reduction in the oxygen content of the dryer gases also reduced formation of VFA, of which acetic acid was the chief representative. From consideration of the chemistry of the main constituents of pulp and molasses, the two most probable major routes to carbonyl and VFA formation are via thermal degradation of carbohydrates and via the Maillard reaction. It was indicated that heating pulp and molasses separately or together would be expected to give a similar qualitative mixture of compounds. The Maillard reaction was also considered the most likely contributor to formation of pyrazines, a group of powerful odorants. The odour threshold concentrations of carbonyls and pyrazines indicated that, while both types of compounds contribute to the odour at short distances from the exhaust stack, it is pyrazines that contribute more to the odour at much greater distances.

Detection and properties of sucrose-splitting enzymes in sugar beet. M. Burba and U. Nitzschke. *Proc. 16th Gen. Assembly CITS*, 1979, 397-418 *(German)*. – The sucrose-degrading enzymes and their activities in stored beet were determined in raw extracts and tissue slices by an *in vivo* method at different pH values. In addition to acid invertase and sucrose synthase, an alkaline invertase was also found which had maximum activity at pH 7.5.

Certain properties of the enzymes were determined, and reference is made to other disaccharide-splitting enzymes. It is concluded from investigations on other higher plants that the alkaline invertase catalyses sucrose hydrolysis in fully developed storage organs, but further investigations are necessary to determine whether the enzyme fulfils this function in stored beet.

Reduction of crystallizable sugar losses. Crystallization kinetics of low-grade boiling. V. Maurandi and G. Mantovani. *Proc. 16th Gen. Assembly CITS*, 1979, 571-594. Present knowledge on the theory of crystallization kinetics is summarized, a surface reaction of the *n*th order being used as generalized model. It is shown theoretically that the dependence of crystallization rate isotherms on supersaturation has a maximum which is independent of *n* and of crystal formation. Crystallization rates were measured on single large-surfaced rotating or agitated crystals immersed in Quentin molasses. The experimental data were statistically processed to show that the effect of diffusion on the molasses was very considerable at $n \simeq 1$. It was also found that increase in the relative movement of crystal and mother liquor from stationary to 0.16 rpm caused considerable increase in the crystallization rate, a finding of practical value for low-grade boiling. An equation is presented for calculation of the isotherms of crystallization rate as a function of supersaturation at $n \simeq 1$. Very small differences found between the experimental and calculated values were within experimental error.

Fundamentals for improving molasses exhaustion. E. Reinefeld, A. Emmerich, N. Fantar and M. Gerlach. *Proc. 16th Gen. Assembly CITS*, 1979, 595-622, 653-654 *(German)*. — Using measured values of the saturation concentration of sucrose in molasses over a wide range of non-sugar concentrations as reference, a comparison was made between the saturation values found by the Polish test using the Wiklund equation and those established from the non-sugar composition by Schneider *et al.* The methods were of approx. identical average accuracy, although the Wiklund equation gave greater error with Quentin molasses. A formula was developed for calculation of the saturation concentration in terms of the alkali and alkaline earth fractions of the non-sugars and from the non-sugars:water ratio, allowance being made for temperature. The formula gives values accurate to within ± 0.03 (standard deviation) (± 2.5% C.V.). Determination of refractometric dry solids, pol, ash content and Ca + Mg will give sufficient accuracy for routine purposes. Estimation of the exhaustion obtainable requires not only knowledge of molasses composition but also information on the effect of crystallization rate in low-grade boiling, and this is discussed.

Diminution of sugar losses in molasses and the increase in crystallization rate due to the decolorization of thin juice. H. Zaorska. *Proc. 16th Gen. Assembly CITS*, 1979, 655-668. — The crystallization rates in 1st, 2nd and low-grade massecuite mother liquor samples taken directly from the vacuum pan as well as in mother liquor from refined sugar massecuite were determined in a laboratory crystallizer[1] and the values compared (for all but the refined sugar massecuite) with those obtained for products from active carbon-treated juice. The retarding effect of non-sugars and colouring matter on crystallization was evaluated, and the advantages of active carbon treatment shown to be increases in massecuite purity, white sugar yield, sugar quality and particularly in crystallization rate, which rose by 20% in all products.

The relationship between the corrected sugar content and chemical composition of sugar beet. O. C. Akyar, M. Çagatay, E. Kayimoglu, A. Özbek and S. Titiz. *Proc. 16th Gen. Assembly CITS*, 669-701 *(German)*. — Processing of experimental data on molasses solubility and thick juice analysis was used to derive equations for corrected beet purity (recoverable white sugar). The inclusion of press juice invert sugar in the equations was of great advantage, while incorporation of losses at the beet end of the factory (taken as 0.6% on beet) was of value for extreme cases. Application to molasses samples from Turkish factories and from the farm at the Etimesgut sugar industry research institute showed close agreement between calculated and experimental values. The equations for calculation of recoverable white sugar, S_{cr}, take the following forms:

$$S_{cr} = P_B - [0.576 + 0.19\ (Na + K) + 0.274\ N_{bl} + 1.146\ Inv]$$

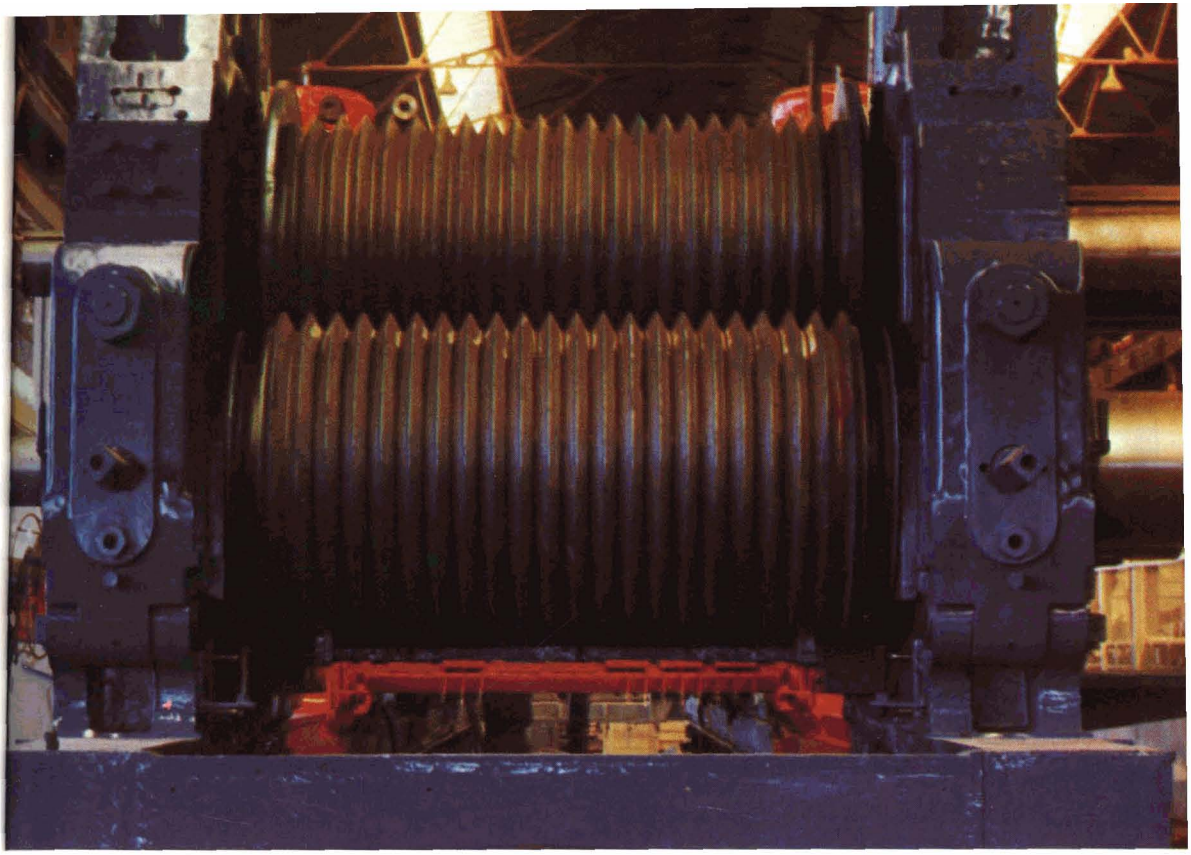
$$S_{cr} = (P_B - V)\ [0.992 - 0.0182\ (Na + K) - 0.0028\ N_{bl} - 0.012\ Inv]$$

$$S_{cr} = (P_B - V)\ [0.974 - 0.0175A - 0.0028\ N_{bl} - 0.015\ Inv]$$

where P_B = beet pol, N_{bl} = blue number of press juice, V = losses, and A = press juice ash content. Further equations were developed for calculation of thick juice purity from beet analysis.

Cation and anion balances in juice purification and evaporator stations. P. W. van der Poel, J. Blok, N. H. M. de Visser, M. A. M. de Schutter, J. Konings and W. A. Fenstra. *Proc. 16th Gen. Assembly CITS*, 1979, 721-741. — Changes in pH occurring in evaporation were studied in relation to the ammonia and carbonate concentrations in the juice and their behaviour during 2nd carbonatation. The dissociation constants of both impurities given in the literature were extrapolated to 85°C; it is shown that at the pH of 2nd carbonatation at 85°C, 20% of the ammonia is in NH_4^+ form, while the rest is in NH_3 form and does not contribute to the cation balance. Since ammonia occurs as a result of amide decomposition, 80% of the amino-acids or pyrrolidone carboxylic acid do not have an ammonium ion available, so that this fraction contributes to the lime salts in the juice. In evaporation, the NH_3 is eliminated, causing a fall in pH. Sulphitation to a pH slightly below 9 (at 20°C) increases the NH_4^+ fraction to about 30% at 85°C. At the pH of 2nd carbonatation at 85°C some 98% of the carbonate is present as HCO_3^- ions. Elimination of CO_2 during evaporation liberates OH^- ions, which neutralize the H^+ ions in the ammonia system. From titration curves obtained by determining the NH_3 and CO_2 contents in thin juice, it is possible to estimate the quantity of alkali necessary for maintenance of an optimum pH. It was found that addition of ammonium bicarbonate to diluted thick juice to give a carbonate content identical to that of the thin juice, and addition of ammonia to give the same content as in the thin juice, resulted in thick juice pH values that were very close to the original pH of the thin juice. Any fall in pH not caused by elimination of ammonia and carbonate is due to acid formation, and gas-liquid chromatography was used to show the increases in organic acid during evaporation.

[1] Zagrodzki & Zaorska: *I.S.J.*, 1965, **67**, 300-303, 337-338.



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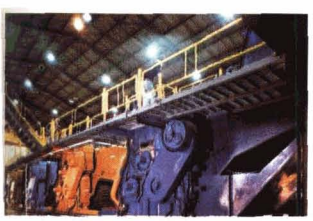

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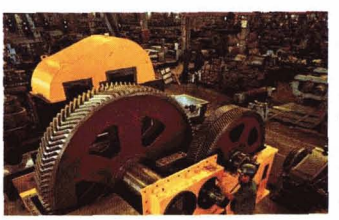

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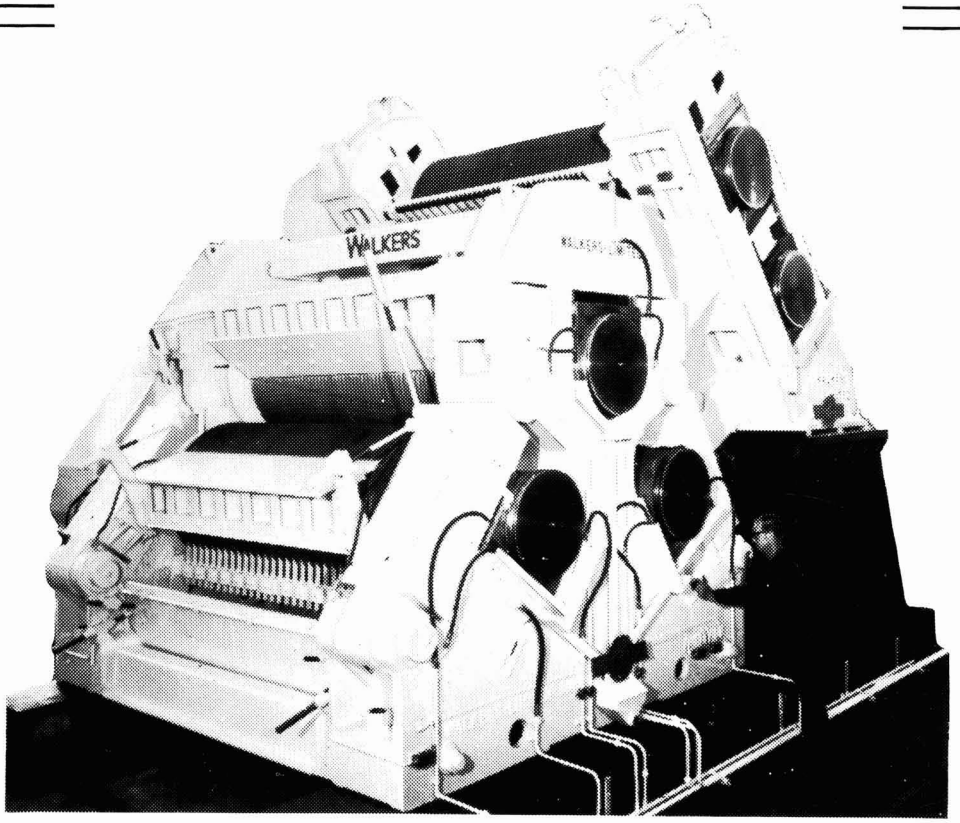

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BY-PRODUCTS

Products of photosynthesis as raw material for the chemical industry. P. Dupuy. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 16 pp. — Manufacture of chemicals from ethanol, methanol and furfural obtained from biomass of various forms, including molasses and cellulose-, hemicellulose-, starch- and lignin-containing sources, is described.

The present situation on the utilization of by-products of the sugar industry in Mauritius. R. Antoine. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 8 pp. — The feed value of cane tops, bagasse, molasses and filter cake is discussed. Experiments have been restricted to fresh cane tops from unburnt fields, whereas there is an increasing tendency to burn fields where mechanical harvesting and loading are used. Bagasse has the drawback of requiring supplementary molasses, while the digestible crude protein content of filter cake is inadequate. Of the molasses produced in Mauritius, 87% is exported, and most of the remainder is used for rum production, while some is also used for manufacture of industrial alcohol, a very small quantity of which is exported. Examination of the economics shows that it is more justifiable to continue to export molasses than use it for anhydrous alcohol production, unless there is a substantial fall in the price of molasses and a rise in distillery efficiency to make domestic power alcohol competitive with imported petrol.

Possibilities of developing a nationwide program for power alcohol in Peru. P. A. Hernandez. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 10 pp. — The author examines the crude oil and gasoline consumption in Peru as well as sugar and alcohol requirement predictions, assuming a 80:20 gasoline:alcohol blend. It is concluded that there would be insufficient sugar or molasses to meet the alcohol requirements unless the cane area were doubled. However, it is also stated that the Peruvian oil industry is running at below installed capacity as a result of fall in demand for its various products, so that there has been a proportionate increase in production of gasoline, excess of which is exported at marginal prices. Hence, substitution of alcohol for gasoline is regarded as illogical, although manufacture of alcohol as chemical feedstock is considered a more attractive proposition.

Alcoholic fermentation. G. Panuschka. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 25 pp. — Alcoholic fermentation of sugar- and starch-containing raw materials is discussed, and a scheme described, with the aid of a flowsheet, for manufacture of 10,000 litres of 100% alcohol from molasses (plus production of dried fodder yeast). A parallel scheme for starch-containing material is also given. Energy input, production and losses are indicated, as well as the raw material input and losses and steam, electricity and water consumption in raw material preparation in the case of molasses, sugar cane and corn. Alcohol yield and losses as a percentage of the theoretical yield are also given.

Perspective of ethanol usage as fuel in the Dominican Republic. A. A. Pena. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 6 pp. — Comparison of production costs and ethanol yields showed that sugar cane was best by comparison with yucca, sweet potato and potato. Molasses was discounted as suitable material because of its dependence on sugar production and high demand, while the cost of ethanol production from cane was not appreciably higher than from molasses. The costs of a project to produce ethanol for use in a 20:80 blend with gasoline are calculated, from which it is estimated that such a scheme would be of benefit.

Molasses production and utilization potential in Tanzania. J. J. Mungai. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 12 pp. — Although sugar production in Tanzania is approx. 120,000 tonnes per year, and this is to be increased to 500,000 tonnes by 1990 as a result of a proposed expansion program, molasses export and domestic utilization are unsatisfactory; hence, manufacture of alcohol, polyvinyl chloride and polyethylene is regarded as an attractive possibility, particularly in view of the potential economic benefit of replacing imported gasoline imports with the alcohol and using the polymerization products mentioned for manufacture of piping to be used to carry potable and irrigation water. Other possible uses of molasses are briefly mentioned.

The potential of sugar cane-derived alcohol as a fuel in Jamaica. I. Sangster. *Paper presented at UNIDO Fermentation Alcohol Workshop*, 1979, 14 pp. — A study of the economics of rum production from molasses in Jamaica shows that it would be better to continue to produce rum rather than fuel alcohol. Examination of the economics of anhydrous alcohol manufacture from cane shows that the costs would be prohibitive where a new central factory/distillery was set up, but that the capital investment involved could be reduced by using surplus existing sugar factory/distillery capacity.

A triple-pass drum dryer for pulp. V. Ya. Valuiskii, M. G. Parfenopulo and V. E. Apasov. *Nauch. Tekh. Ref. Sbornik Sakhar. Prom.*, 1976, (10), 1-5 *(Russian)*. Details are given of a beet pulp dryer comprising three concentric drums rotating as one. Vanes are located on the inside walls of all three. Pulp is fed into the inner drum, passes along it with a co-current of hot air to the end, and then enters the middle drum along which it passes in the opposite direction to that in the inner drum, after which it enters the outer drum and flows back along this to discharge. The vanes help to break up the pulp into finer material. The heat loss to the surroundings is calculated to be lower than in a single-pass drum dryer by a factor of 2.6, and the fuel consumption some 38% lower based on an output of 3630 tonnes of dry pulp per year.

The bagasse handling and storage system at Pingtung pulp factory. J. S. I. Wang and H. Y. Tao. *Taiwan Sugar*, 1979, **26**, 12-18. — Details are given of the bagasse handling and storage system at Pingtung pulp plant, which has been undergoing modification, so that the storage capacity is 300,000 tonnes at a moisture content

of 40%. Comparison between wet and dry storage has shown that the former is better as regards cooking and bleaching while consuming less chemicals in the pulping process.

A direct air cooling system for the Torula yeast broth. M. C. Chung. *Taiwan Sugar*, 1979, **26**, 19-21. – A description is given of a direct air cooling system developed to maintain the molasses fermentation temperature at an optimum of 32-34°C; it was to replace a refrigerated water system which had a number of disadvantages, including high power consumption and the high cost of refrigerant replenishment. While the new system gave satisfactory results in trials with a small-scale fermenter, with a large-scale fermenter the fermentation temperature rose above the optimum, resulting in poor yeast propagation and interruption of the fermentation process. The tests are continuing, and some adjustments are being made to the equipment.

Sugar crops for fuel use. E. S. Lipinsky. *Proc. Tech. Session Cane Sugar Refining Res.*, 1978, 158-171. – An account is given of studies by the Battelle Institute on the potential in the USA for fuel production from sugar cane, sorghum and other crops.

New products from sugar. R. C. Righelato. *S. African Sugar J.*, 1979, **63**, 146-151. – The Director of Research & Development Programmes, Tate & Lyle Ltd., examines the trends whereby sugar is being replaced by other sweeteners, and suggests ways in which sales of sugar could be improved by modifying the product to adjust the sweetness or by producing a range of specialty sugars by making use of different process techniques. However, particular attention is drawn to the use of sucrose as a raw material for production of detergents, as in the TAL process, and a range of chemicals by anaerobic fermentation, while fuel alcohol distillation from sugar or cane (as well as other plants) is also reviewed.

Study on cane wax resin. II. Characterization of the soluble hydroxylic fraction. N. Martínez and J. Fernández B. *CubaAzúcar*, 1979, (Jan./March), 38 - 41 *(Spanish)*. Crude cane wax from which waxy material is extracted by solvent yields a black brittle resin, infusible below 200°C. This material exhaustively extracted with *iso*-propanol and then with 1:1 ethanol:acetone, when hydrolysed by boiling for 1 hr with 1N HCl, yields a soluble fraction and residue, each about 50% of the original. The soluble fraction, recovered by lyophilization against cold water and concentration, provides an acid fraction; alternatively, neutralization of the acid solution with NaOH gives a precipitated salt form. Both forms have been subjected to gel filtration and ion exchange chromatography on a DEAE-cellulose column. The infrared spectra of the eluates are reproduced and discussed. The soluble fraction has a high content of hydroxyl groups and is similar in nature to the products of dextrose degradation in alkaline medium; it appears to correspond to unsaturated hydroxy acids of 500-1000 average M.W.

Chemicals from sucrose. Preparation of lactic acid and oxalic acid from cane waste molasses by chemical means. S. Bose, K. C. Gupta and S. Mukherjee. *Indian Sugar*, 1978, **28**, 405-409. – Experiments were conducted on lactic acid production from cane molasses by the method developed at the National Sugar Institute [1-3]. Treatment of the acid with anhydrous ethanol at 130-135°C after its liberation from impurities by addition of sulphuric acid gave a product which, on decolorization with active carbon, became water-white lactic acid in a yield of 95% on the impure product. Treatment of diluted molasses at 45-65°C with nitric acid in the presence of vanadium pentoxide and sodium nitrite gave a 62-65% yield of oxalic acid dihydrate of 93.7% purity; however, the economics of the process depend on nitric acid recovery and recycling, and it is considered necessary to continue investigations so as to increase the amount recovered above the 30% achieved.

A new method for increasing dry substance in lime sludge. R. F. Madsen, W. Kofold Nielsen and A. F. Johnsen. *Proc. 16th Gen. Assembly CITS*, 1979, 231-252. – The DDS vacuum-operated filter press for increasing the dry solids content of filter cake to 67-69% and thus providing an easily transportable fertilizer is described with the aid of diagrams and illustrations. The model in question has nine discs instead of the eight in the model previously described[4]. Operation and performance of the press are discussed, whereby it is shown that the press gives a lower filter cake pol than does conventional rotary filtration. Economic aspects are also discussed.

Pulp drying with low-grade heat recovery. A. Bausier. *Proc. 16th Gen. Assembly CITS*, 1979, 355-385 *(French)*. The energy consumption of a sugar factory, including pulp drying, and the amount of heat recoverable are indicated, and means of reducing the net heat consumption in pulp drying examined. Use of boiler waste gas will give a 10% energy saving, while 8% saving is possible with recycling of dryer gas. Using heat recovered from hot water and vapour to dry pulp in a special RT dryer, as installed at Hoegaarden in 1977, is described. The dryer comprises a series of polyamide mats in vertical layers on which the pulp is exposed to a current of air heated to about 68°C. Performance data are presented. A low-temperature dryer using heat from the waste gas of a conventional drum dryer is also of advantage and can be used as a pre-dryer, or operated in parallel with a conventional drum dryer, or can be used after the conventional dryer. A heat balance is given, and the economics indicated. The energy requirements of a conventional scheme can be reduced by 20-40% by using the low-temperature dryer, and still further reductions are possible if the pulp is pressed to more than 23% dry solids.

Accumulation of 1-*trans*-2,3-epoxysuccinic acid and succinic acid by *Paecilomyces varioti*. E. T. M. Ling, J. T. Dibble, M. R. Houston *et al. Appl. Environ. Microbiol.*, 1978, **35**, 1213-1215; through *S.I.A.*, 1979, **41**, Abs. 79-522. – *Paecilomyces varioti* NRRL 1123 was cultured in media based on refiner's cane molasses which had been decationized and to which known amounts of ions had been added; the medium used for each culture contained 6.0 g hexose equivalents in 50 cm^3. The maximum yield of 1-*trans*-2,3-epoxysuccinic acid, 2.47 g/culture, occurred in media in which the Cu^{++} and Fe^{+++} concentrations were 1 mM and 2mM, respectively. The maximum yield of succinic acid, 0.043 g/culture, occurred in media containing 0.01 mM Cu^{++} and 1 mM Fe^{+++}.

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[1] Bhargava & Mukherjee: *I.S.J.*, 1962, **64**, 310.
[2] Idem: *ibid.*, 1963, **65**, 213.
[3] Mukherjee & Ovasisi: *ibid.*, 1973, **75**, 154.
[4] Madsen: *ibid.*, 1978, **80**, 314.

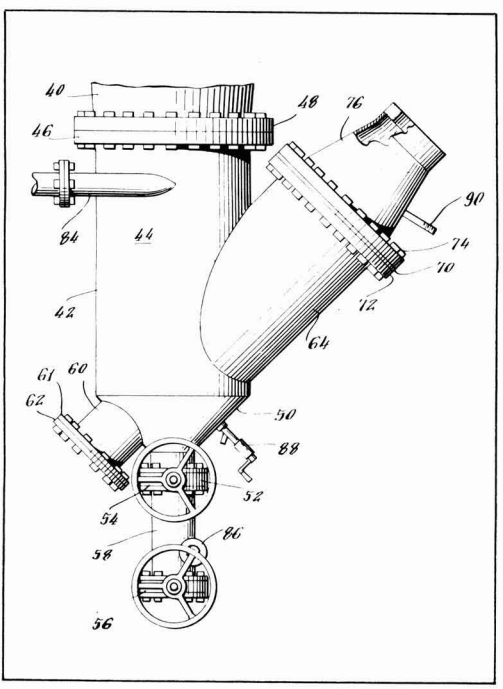
PATENTS

UNITED STATES

Beet pulp pelleting. J. S. Wortham and E. C. Johnson, *assrs.* W. R. Grace & Co., of Cambridge, MA., USA. **4,034,120.** October 28, 1975; July 5, 1977. – The pelleting of beet pulp is facilitated by incorporation of a mixture of animal fat or cotton seed oil with an equal weight of expanded vermiculite or with nine parts by weight of finely-divided vermiculite ore, such that the pulp contains 0.1 – 0.3% by weight of the fat or oil.

Cane harvester. C. M. Cruz F., R. Rodriguez V. and D. Perez A. **4,035,996.** May 15, 1975; July 19, 1977.

Bagasse pulp digester discharge. J. L. Michelsen, of Minnetonka, MN, USA, *assr.* American Defibrator Inc. **4,039,373.** December 31, 1975; August 2, 1977.



Bagasse pulp produced in a continuous pressured digester is withdrawn in a manner to prevent loss of pressure within the digester and without blockage of valves by use of a discharge comprising a vertical tube 44 fitted with a conical transition piece 50 terminating in a flange 52. Two gate valves 54, 56, with a cylindrical chamber 58 between them, are connected to the bottom flange 52. A large-diameter pipe 64 is connected to tube 44 at an angle and the aperture in the joint between the pipe 64 and tube 44 is closed by a screen following the curvature of tube 44 and with perforations angled so that the tube-side area of each hole is smaller than the discharge-side area, ensuring that the screen does not clog.

Pulp from the digester passes down into tube 44 and is agitated by a tangential stream of black liquor admitted through pipe 84. Metal, rocks, and other heavy impurities fall into chamber 58 (and are removed at intervals by closing valve 52 and opening valve 56). The suspension of pulp passes through the screen into the pipe 64 and a reducer 76 which delivers to a blow-valve. If the pulp consistency is greater than 8% it is desirable to fit a stirrer within tube 44 to maintain the suspension. A sampling probe 88 is provided as is a temperature-sensing device 90. Another tube 60 is provided with a flange 61 and cover plate 62 for cleaning out the discharger when necessary.

Cane harvester conveyor roller. K. W. Croucher, of North Bundaberg, Australia, *assr.* Massey-Ferguson Services N.V. **4,039,434.** January 8, 1976; August 2, 1977.

Purifying enzymatically-produced levulose syrups. R. G. P. Walon, of Brussels, Belgium, *assr.* CPC International Inc. **4,040,861.** September 9, 1976; August 9, 1977. – An enzymatically produced levulose syrup is purified by treating with a (strongly acid) cation exchanger and a (weakly basic) anion exchanger to remove ions and with sulphonated coal to remove colour and colour precursors. The decolorization treatment may be carried out between the cation exchange and anion exchange treatments, and the sulphonated coal may be activated by treatment with strong alkali and then strong acid. A (final) treatment may also be made using activated carbon.

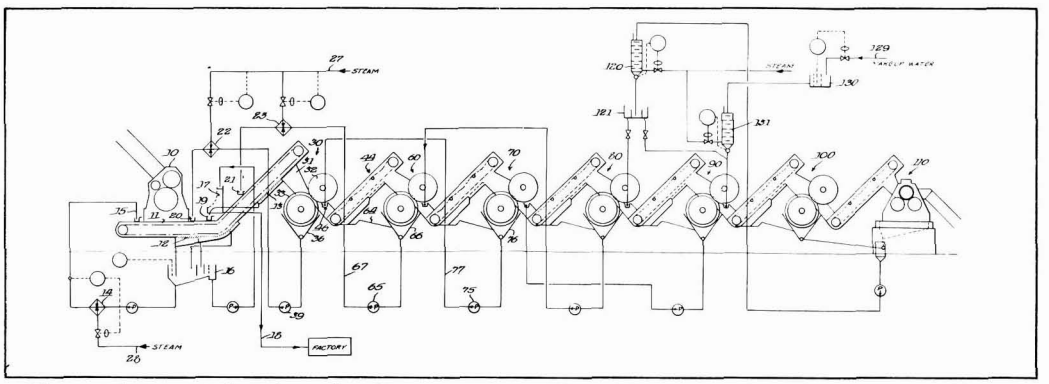
Method of producing a carbon source for citric acid fermentation. R. Uchio, K. Kikuchi, S. Asai and K. Yarita, *assrs.* Ajinomoto Co. Inc., of Tokyo, Japan. **4,040,906.** April 23, 1976; August 9, 1977. – A neutral hydrolysate of beet juice, cane juice, raw sugar or molasses (molasses, at pH 1.5 – 2, hydrolysed at 60 – 100°C for 0.5 – 4 hr) containing dextrose and levulose, is cooled to below 10°C and mixed with $Ca(OH)_2$ to give a Ca levulosate precipitate. This is separated and the mother liquor neutralized with simultaneous elimination of Ca^{++} ions (by passage of CO_2 or addition of H_2SO_4) and the product used as a carbon source for fermentation with *Aspergillus niger* or *A. awamori* to produce citric acid.

Improving the yield of sugar beets using low intensity light. J. I. Krugler and W. F. Nelson, *assrs.* GTE Laboratories Inc., of Waltham, MA, USA. **4,041,642.** June 9, 1976; August 16, 1977. – The yield of beet is increased by illuminating during at least part of the night (4 hr) with low intensity light (0.5 $\mu W.cm^{-2}$) of wavelength 560 – 700 nm sufficient to provide optical energy at the rate of 70 $Joules.m^{-2}$.

Method of producing dextrose isomerase. I. V. Diers, of Lille Vaerlose, Denmark, *assr.* Novo Industri A/S. **4,042,460.** July 20, 1976; August 16, 1977. – An enzyme-producing micro-organism (*Bacillus coagulans*; a strain of *B. coagulans* growing only on inorganic sources of N and at 65°C) is (continuously) fermented in conditions of a growth-limiting oxygen supply but with a (1-20%) excess of dextrose as a source of carbon and energy.

Cane juice extraction. W. J. Leibig, C. R. Steele and F. B. Price, *assrs.* CF & I Engineers Inc., of Denver, CO, USA. **4,043,832.** April 5, 1976; August 23, 1977.

Cane is passed through a fiberizer 10 which disintegrates it and delivers in onto the carrier 11. Circulating juice, heated to 170°F by heater 14, is delivered through conduit 15 and mixed with the prepared cane. The carrier takes it over a sieve area 12 where some of its juice content drains into a weir box 16; part of this juice is pumped to heater 14 for recirculation and some to the screen 17. Juice passing through the screen goes through line 18 to process while the fines are returned to the carrier 11. Cane passing along the elevating section of carrier 11 passes over a second sieve area 13 and the juice passing through drains to distributor 19 which delivers it onto the cane blanket.



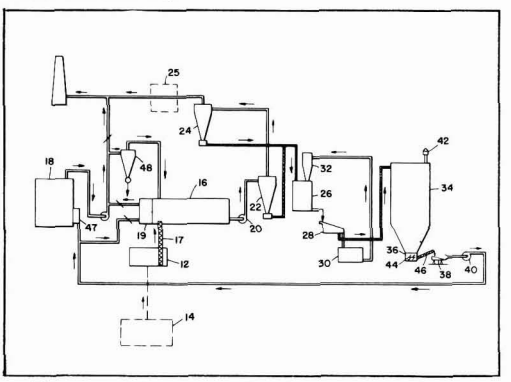
The cane then passes through a series of low-pressure devices, 30, 60, etc., being fed via chutes (e.g. 31) between pairs of cylindrical rollers (e.g. 32, 33) which are motor-driven and reduce the volume of the bed, so extracting a certain amount of liquid. The lower rollers are perforated and the extracted juices collect in trays 36, 66, etc. Immediately after passing through the gap between the rollers, the bagasse blanket is soaked with imbibition juice distributed onto the blanket from troughs (e.g. 46) supplied from the juice trays further along the tandem. Juice from tray 66 is returned to distribution trough 21 above the elevating portion of carrier 11 and juice from tray 36 to trough 20 above the horizontal portion. The bagasse enters the chutes which conduct it to the next elevating carrier after each pair of rollers for delivery to the subsequent pair. A sieve area in each allows juice to drain and this is delivered by pipes (e.g. 64) to the juice tray of the next unit. The bagasse leaves the last low-pressure unit 100 and is dewatered in a conventional high-pressure mill 110 or alternatively a cone press. Expressed juice is passed through heater 120 before returning it to unit 90, while make-up water is passed through heater 131 before delivery to unit 100.

Cane harvester. V. M. Alexandrino, of Fajardo, Puerto Rico. **4,044,535.** December 19, 1975; August 30, 1977.

Beet juice purification. K. W. R. Schoenrock and H. G. Rounds, of Ogden, Utah, USA. **4,045,242.** December 3, 1976; August 30, 1977. – Beet juice of low or negative effective alkalinity is treated with an alkaline earth metal oxide and carbon dioxide to overcarbonatate to an alkalinity of 0.0 – 0.02% CaO equivalent during final carbonatation, adding sufficient active MgO to raise the effective akalinity to around zero and then adding more MgO to an alkalinity of 0.01 – 0.03% CaO equivalent before separating precipitated solids.

Preparing and firing bagasse for steam generation. T. S. Voorheis and J. H. White, *assrs.* Coen Company Inc., of Burlingame, CA, USA. **4,047,489.** January 7, 1976; September 13, 1977.

Bagasse (or bagacillo from a pith separator 14) of around 50% moisture content is delivered from a feed bin 12 by a screw conveyor 17 into a dryer 16. Here it is dried by the action of flue gas from a boiler 18 which passes first through an ash-separating cyclone 48. The temperature of the flue gas is reduced in the dryer from, typically, 650°F to 240°F while the bagasse is dried to 15 – 20% (preferably 17%) moisture. The gas/bagasse mixture is drawn by fan 20 and sent to primary cyclone 22, and the gas which is separated sent to a secondary cyclone 24 where the last particulate matter is removed before passing to the stack (if necessary via a wet scrubber 25). The solid dried bagasse from the two cyclones is carried to a surge bin 26 and thence over a screen classifier 28.



Fine material passes to the storage bin 34 while over-size particles are delivered to the hammer mill 30 and the milled dried bagasse sent back to the surge bin by way of collector 32. An agitator 44 in the bottom of the storage bin 34 prevents the discharge being clogged by arching of the fibrous bagasse, and the latter is then delivered by screw conveyor 46 to a shaker table 38 and thence sent by fan 40 to feed boiler 18. If the bagasse feed is too wet, or if the boiler is of insufficient capacity to provide sufficient flue gas, additional heat may be provided by a bagasse-fired supplementary air heater 19.

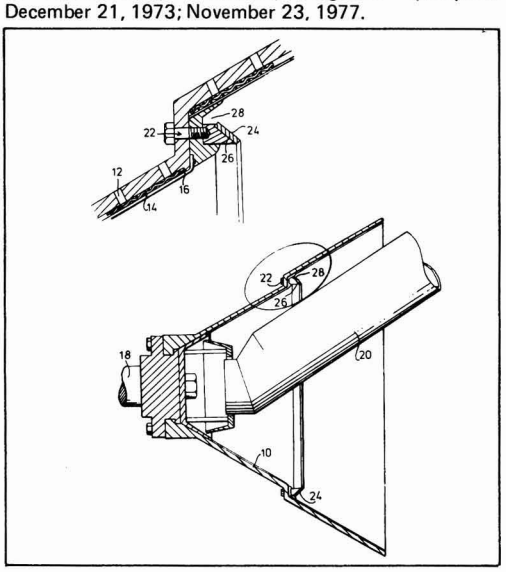
Obtaining sugar crystals from a solution. Stork-Werkspoor Sugar B.V. and Suiker Unie Holdings B.V. **1,487,500.** June 16, 1975; September 28, 1977. — See US Patent 4,016,001[1].

Production of dextrose isomerase. Imperial Chemical Industries Ltd., of London, England. **1,492,258.** July 30, 1974; November 16, 1977. — The enzyme is produced by continuously cultivating (at 20° — 55°C and pH 6.0 — 8.0) a dextrose isomerase-producing micro-organism (a species of *Streptomyces, Arthrobacter, Mycobacterium* or *Curtobacterium*) in a medium comprising (0.05 — 10% of) a source of assimilable carbon (dextrose or xylose) and inorganic nutrients (0.001 — 3% N, 0.01 — 0.5% P, 0.001 — 0.2% Mg, 0.01 — 0.25% S, 0.01 — 0.25% K and 0.01 — 5% organic N) (plus Co or Mn ions), maintaining the nutrients at a level such as to limit growth, and continuously removing the enzyme. It is added to dextrose solution at 20° — 90°C and pH 5 — 9 to bring about isomerization to levulose.

Reduction of steam consumption in sugar manufacture. Fives-Cail Babcock, of Paris, France. **1,492,270.** July 4, 1975; November 16, 1977. — At least part of the vapour from the (continuous) vacuum pan station is re-compressed and supplied to a descending-type pre-evaporator to concentrate the juice entering the multiple-effect evaporator. Alternatively two pre-evaporators may be used in series, the first heated by vapour from the last vessel of the multiple-effect evaporator and the second by vapour from the vacuum pans. The balance of the recompressed pan vapour is used in the manufacturing process, e.g. heating of the diffuser, press liquors, limed juice, etc.

Sucrose derivatives. Tate & Lyle Ltd., of London, England. **1,492,791.** March 5, 1974; November 23, 1977. See US Patent 4,002,609[2].

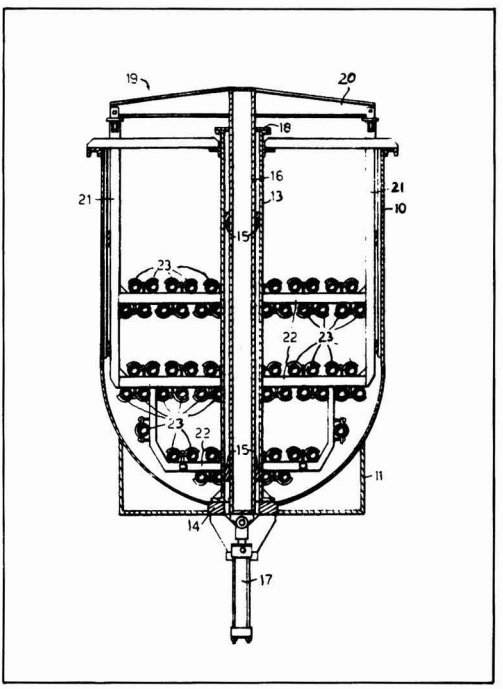
Continuous centrifugal. Thomas Broadbent & Sons Ltd., of Huddersfield, Yorkshire, England. **1,493,108.** December 21, 1973; November 23, 1977.



Massecuite is admitted to a continuous centrifugal through pipe 20 and passes onto a conical basket 10 suitably rotated about a horizontal axis. It passes along and outwardly over a screen 16 supported by mesh 14, molasses passing through ducts 12. In order to ensure adequate residence time for good separation, one or more interruptor rings 24 are located in the basket at places where the basket itself is provided with steps.

The rings, held on brackets at intervals around the basket by bolts 22, cause the massecuite to change direction under the surface 26 and to pass through gap 28 onto the next section of the screen.

Crystallizer. Bundaberg Foundry Co. Ltd., of North Bundaberg, Queensland, Australia. **1,495,196.** October 27, 1975; December 14, 1977.



The crystallizer includes a shell 10 of conventional form with a number of tubes 13 extending from the bottom to above the level of the top of the shell. Within each tube is a concentric tube 16, provided with glands 15 and raised and lowered by means of a double-acting hydraulic cylinder 17. The top of tube 16 is connected to a cruciform carrier 19 the arms 20 of which support hangers 21 to which are fitted support frames 22 on which are located metal tube sections 23 joined by U-bends and elbows to give a continuous tubular assembly. From the ends of this flexible hoses lead to sources of cooling (and heating) water and an outlet. The tube sections 23 are staggered so that reciprocation of the tube 16 causes stirring and cooling of massecuite in the crystallizer which may be a batch-type unit or, with suitable partitioning, a continuous unit.

[1] *I.S.J.*, 1980, **82**, 320.
[2] *ibid.*, 289.

TRADE NOTICES

PUBLICATIONS RECEIVED

Molasses desugaring. Finnish Sugar Co. Ltd., SF-02460 Kantvik, Finland.

The Finnsugar-Pfeifer & Langen chromatographic process for sugar recovery from beet and cane molasses[1] is clearly described in literature which also provides data for calculating the feasibility of the process.

Bagasse briquetting. Fred Hausmann Ltd., Hammerstrasse 46, CH-4005 Basel, Switzerland.

Fred Hausmann have released a leaflet describing the various types of briquetting press for application with a wide range of materials including bagasse.

Guide to conveyor chain selection. Mechanical Handling Engineers' Association, 16 Dartmouth St., London SW1H 9BL, England.

A new 28-page bulletin entitled "Conveyor chain selection procedure" is available from the MHEA at a cost of £2.00. It covers chain tension calculation, chain and sprocket selection for steel bushed roller chains and procedures for selection of cast link conveyor chains; appendices provide further information on chain types and their usage, assessment of roller friction, friction values for chains and scrapers, and friction values for typical materials. Ewart Chainbelt Co. Ltd. and Renold Ltd., both well known within the sugar industry, are MHEA member firms which have collaborated with others in the preparation of the bulletin.

Farrel gears and gear units. Farrel Connecticut Division, 25 Main St., Ansonia, CT 06401, USA.

A new 16-page brochure, Bulletin 611, describes Farrel gears and gear units as used in a wide range of applications including cane mill drives. Useful information such as helical gear nomenclature, a hardness conversion table, methods of lubrication, types of wear and advice on installation is also included.

Water-tube boilers. Yoshimine Boiler Industry Co. Ltd., Horse Building, 4-10 Azuchimachi, Higashi-ku, Osaka, Japan.

A well-presented 26-page brochure from Yoshimine describes the outstanding features of their water-tube boiler and provides data on the H type, which can be used for any kind of fuel. The standard layout for a bagasse boiler in the series is explained as well as the combustion method.

ASEA-Weibull centrifugals. ASEA Industrial Division, S-721 83 Västerås, Sweden.

Pamphlet AX 11-105 E describes ASEA-Weibull high-capacity, fully automatic sugar centrifugals of massecuite capacities ranging from 560 to 1200 kg, applicable for low-grade work as well as white sugar and *A* and *B* massecuites. The modern thyristor-based speed control used is also described.

Tate & Lyle Process Technology. Tate & Lyle Process Technology, Cosmos House, Bromley Common, Bromley BR2 9NA, England.

A new colour brochure illustrates how Tate & Lyle Process Technology plan to tackle the future with new products and processes, covering sugar processing, industrial and biochemical engineering, control and instrumentation and new technology.

Turbine generators. Shinko Electric Co. Ltd., 3-12-2 Nihonbashi, Chuo-ku, Tokyo, Japan.

A 10-page brochure describes the salient features of and provides data on Shinko turbine generators, which are designed for use in thermal power stations such as in a sugar factory; they are durable and give excellent performance at high speed and under conditions of severe vibration.

Power transmission. Renold Ltd., Renold House, Styal Rd., Wythenshawe, Manchester M22 5WL, England.

A recent issue of Renold "Review of power transmission" carries information on, amongst other items, a new range of heavy-duty helical and bevel/helical gear units which have been designed especially for tough, high-power applications but which are compact and offer a choice of mounting positions (the filter and drain plugs being located to suit possible alternatives). Units in parallel-shaft versions can be supplied for up to 9000 hp (6700 kW) and right-angle shaft units up to 1750 hp (1300 kW). Renold also announce another hydraulic motor, the HMO5R, which is a low-speed, high-torque motor having a capacity of 0.150 litres/rev, giving a maximum power and speed of 20 kW (27 hp) and 750 rpm, respectively, with a maximum continuous pressure of 210 bar.

Anti-foam agents. Chemische Fabrik Stockhausen & Cie., Postfach 570, D-4150 Krefeld 1, Germany.

A recently published colourful brochure from Stockhausen traces the history of the company from 100 years ago to the present day and outlines the various chemical auxiliaries manufactured for different industries as well as other products, including Antispumin anti-foam agents as used widely in the sugar industry.

Renold products. Renold Ltd., Renold House, Styal Rd., Wythenshawe, Manchester M22 5WL, England.

New products announced by Renold Ltd. include the VT10 2.2 kW thyristor-controlled D.C. motor of infinitely variable speed, which gives constant torque over the full speed range of 20:1 with a starting torque capability of 150% of full load, the Carter Hydrostatic variable-speed drive available with pneumatic control, and the VT31 and VT41 drives which have tacho-generator feedback and can cover a wide variety of demanding applications, covering a range of 0.37-7.5 kW. Also mentioned in a recent issue of the Renold "Review of power transmission" is use of Renold chains in Claas cane harvesters.

Steam turbines. APE-Allen Ltd., P.O. Box 43, Queens Engineering Works, Bedford MK40 4JB, England.

A recent brochure to celebrate the centenary of APE-Allen Ltd. illustrates the various activities of the company, including the manufacture of steam turbines for which it is well known in the sugar industry.

Dust control. Head Wrightson Process Engineering Ltd., 16/22 Baltic St., London EC1Y 0TD, England.

Literature is available describing the Flex-Kleen pulse-jet bag filters recently introduced by Head Wrightson for dust control in various types of plant; the filters have air handling capacities of 4000-150,000 $ft^3.min^{-1}$ (approx. 113-4250 $m^3.min^{-1}$).

Oil seals for rotating shafts. British Gear Manufacturers Association, P.O. Box 121, Sheffield S10 2HN, England.

The latest technical memorandum from the BGMA is entitled "Guidance on the use of oil seals for rotating shafts". It indicates the major types of seals for rotating shafts and, for elastomeric lip-type seals, gives guidance to designers on the factors influencing seal selection, material choice, basic application data and examples of sealing arrangements. Seal fitting and life are also discussed, and tables are given showing recommended tolerances for the machining of shafts and housings for use with elastomeric seals. Indications are given of the types of flat bearing seals incorporated in bearings, and the parameters pertaining to the use of mechanical seals. The publication is available from the BGMA at a cost of £2.50 (including postage in the UK).

Pressure switches. LOBA (Industrial Products) Ltd., P.O. Box 7, London E15 1JQ, England.

LOBA have issued a new catalogue describing their SOR/BETA range of process pressure switches which combine the ability to react to very low working pressures with a capacity to withstand very high static pressures. Widely used in a number of industries, the switches can be fitted directly into process systems without any additional chemical seals.

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[1] *I.S.J.*, 1977, **79**, 100-104, 131-134; 1979, **81**, 181.

Statements published in this section are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Sweden sugar statistics[1]

	1979		1978		1977	
			tonnes, raw value			
Initial stocks		331,986		342,939		385,027
Production		351,042		327,988		338,760
Imports						
Brazil	0		0		20,268	
Cuba	0		14,405		12,537	
Dominican Republic	0		0		11,520	
France	25,037		0		0	
Germany, East	0		1,939		1,616	
Germany, West	5,316		10,824		7,356	
Poland	4		23		5,700	
Thailand	12,625		0		0	
Other countries	7,262		606		410	
		50,244		27,797		59,407
		733,272		698,724		783,194
Exports						
Algeria	28,088		7,821		4,717	
Denmark	7		9,009		14	
Iran	0		3,391		12,826	
Ivory Coast	0		3,587		0	
Morocco	0		0		4,674	
Norway	13,703		3,309		4	
Other countries	4		776		7	
		41,802		27,893		22,242
Consumption		363,819		338,841		343,683
Final stocks		327,651		331,986		342,939

Rust disease fear in Mexico[2]. — Mexican sugar industry officials are concerned that, like the Cuban crop, the Mexican cane crop may be affected by rust. The Mexican Institute for the Improvement of Sugar Production said that rust could present serious problems as some Mexican varieties are not resistant to the disease. The President of the National Sugar Cane Growers Union said that the threat of rust disease is growing; it has already been observed in the area supplying the Alvaro Obregón sugar factory in the state of Quintana Roo and it is feared that it could spread to mills in Campeche, Tabasco and other cane growing areas of Mexico. There have also been signs of rust disease in the Cardenas (Tabasco) zone and adjacent to the Potrero, Providencia and San Pedro factories in the state of Veracruz.

Indian Government permission for sugar factory construction[3]. The Indian Government has lifted its ban on the private sector building new sugar factories or expanding existing capacities. Such new units will be allowed to be set up in areas of abundant sugar cane and not falling within a radius of 30 km from an existing sugar factory.

Thailand domestic white sugar requirements. — For the second time in 1980, the Thai Ministry of Commerce has ordered sugar mills to produce an additional 30,000 tonnes of white sugar for domestic consumption[4]. In May the original allocation of white sugar for internal use was raised from 550,000 to 600,000 tonnes and resumption of raw sugar production for export has only recently been permitted. Increase in white sugar supplies to 630,000 tonnes should be sufficient for the domestic market until the new season starts in November. Under a swap arrangement, Tate & Lyle are to supply Thailand with 200,000 tonnes of refined sugar of which 60,000 tonnes is for prompt delivery and the balance for delivery before end-March 1981. In return, Thailand will supply 220,000 tonnes of raws, but Tate & Lyle have said it would not be shipped to Britain for refining. A further arrangement has also been made for the import of 255,000 tonnes of white sugar for delivery in the next few months.

South African sugar group ownership[5]. — Anglo American Corporation of South Africa has bought joint control of Huletts Corporation, one of the country's leading sugar conglomerates, from Barlow Rand at a price of 97.6 million Rand (£43 million). Anglo American acquired its interest in Huletts by buying a 50% stake in S & T Investments, which was owned by C. G. Smith Investments, a Barlow subsidiary. S & T Investments controls 53.3% of Huletts. The other half of S & T Investments is held by the Tongaat Group; Anglo American already owns 18% of Tongaat and also has a direct interest of 6% in Huletts. Barlows retains a large interest in the sugar industry through its control of C. G. Smith Sugar, South Africa's biggest sugar producer. Anglo American and Tongaat will ensure that Huletts sells its packaging interests to C. G. Smith for 39 million Rand cash and then, after two years notice but not later than the 1985/86 season, the transfer by Huletts to C. G. Smith of sugar equal to 50% of the quota from the Mount Edgcombe mill for a negotiated consideration.

Tunisia sugar imports[6]. — Sugar imports in calendar year 1979 totalled 164,249 tonnes against 175,305 tonnes in 1978, according to the Central Statistics Office. The value of the imports declined from 16.5 million dinars (US $40 million) in 1978 to 16.3 million dinars ($39.6 million) in 1979.

Indonesia sugar imports[7]

	1979	1978	1977
		tonnes, tel quel	
Argentina	25,996	0	0
Brazil	23,600	120,000	145,311
Cuba	132,531	60,000	140,991
Czechoslovakia	0	23,098	25,107
EEC	14,047	25,500	24,973
Germany, East	0	26,650	14,837
India	206,690	136,361	106,818
Korea	59,907	23,700	9,000
Malaysia	530	2,772	54
Philippines	0	10,000	13,125
Poland	0	21,750	43,118
Taiwan	0	10,000	11,000
Thailand	0	4,750	10,260
Vietnam	0	5,701	0
Other countries	61	0	59
	463,362	470,282	544,653

Indian sugar production expansion[8]. — At a symposium on the future of the Indian sugar industry, it was stated that the installed capacity would have to be increased by about 1.7 million tonnes between now and 1983/84, calling for an investment of 5500 million rupees. By 1978/88, with a projected population of 751 million, internal sugar requirements will have grown to 8 million tonnes, while projected demand for 1982/83 and 1983/84 are 5.8 and 6.2 million tonnes, respectively. The number of factories is expected to rise from the present 300 to 370

USDA 1980 sugar crop price support proposals[9]. — Beet and cane producers have been invited to comment on a USDA proposal whereby they will receive price supports on their 1980 crops, either through purchase agreements or non-recourse loans with processors. The basic loan or purchase agreement rates would be 14.5 cents per pound for raw cane sugar and 16.87 cents per pound for white beet sugar. These rates represent the same "real" level of support as the 1979 crop rates. Department officials prefer the purchase agreement option under which processors could at no cost lock in a price for optional future delivery. Under a non-recourse loan program, payment of loan interest is proposed in the case of forfeiture of loan collateral to the Commodity Credit Corporation. The Corporation held 653,849 short tons, raw value, of sugar as at August 12, including 404,246 tons of cane sugar and 249,603 tons of beet sugar. At its previous tender the CCC had rejected all bids on 3000 tons of beet sugar. The bids, rejected owing to price, ranged from 29.02 to 32.55 cents/lb.

USSR beet mechanization[10]. — Beet growing is one of the most labour-intensive agricultural crops but Soviet industry is now producing a complete range of machinery needed for the crop and, within the next five years, beet growers will receive another 175,000 sowing machines, automatic thinners and cultivators, over 50,000 automatic combine harvesters and other machinery. In addition, Soviet plant breeders are working successfully on new strains of sugar beet; at present the average sugar content is 12 — 14% but new varieties have appeared containing up to 20% of sugar.

Czechoslovakia sugar industry contraction[11]. — A number of sugar factories in Czechoslovakia have been closed in the past decade or so. In 1968 a survey showed there to be a total of 86 factories processing beet, as well as two refineries. By 1980 both refineries have closed and the number of sugar factories has fallen to 69, of which 40 produce white sugar and 29 raws. Factories which have closed include those at Kralupy, Libochovice, Kropáčová, Rozd'alvice, Uhříněves, Dašice, Beroun, Kouřim, Louny, Přelouc, Slatinařy and Čerekvice in Bohemia, Velká Bystrice, Kelčany, Pohořelice and Kroměříž in Moravia, and Vlčkovice in Slovakia.

Mauritania sugar study[12]. — SCEF International has been awarded a contract for a feasibility study for the erection of a new sugar project in Koundi, to be financed by the French Development Fund. The factory is to have an annual production capacity of 40,000 tonnes of white sugar.

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1 *I.S.O. Stat. Bull.*, 1980, **39**, (7), 84-85.
2 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 468.
3 *Reuter's Sugar Rpt.*, July 8, 1980.
4 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 471.
5 *The Times*, August 6, 1980.
6 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 486.
7 *I.S.O. Stat. Bull.*, 1980, **39**, (7), 51.
8 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 552.
9 *Lamborn*, 1980, **58**, 103, 107.
10 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 486.
11 *Zuckerind.*, 1980, **105**, 795.
12 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 512.

BREVITIES

Indonesia sugar expansion[1]. — According to the Department of Agriculture, construction of seven sugar factories is to begin within 1980/81, as follows:

Location	Capacity	Construction to begin	Production to begin
Takalar, S. Sulawesi	3000 t.c.d.	1980	1981
Cauing, S. Sulawesi	6000 t.c.d.	1980	1982
Pleihari, S. Kalimantan	6000 t.c.d.	1980	1982
Muripi, W. Sumatra	4000 t.c.d.	1981	1982
Sei Semayan, N. Sumatra	4000 t.c.d.	1981	1982
Tinanggea, S.E. Sulawesi	4000 t.c.d.	1981	1982
Mengalla, Lampung	6000 t.c.d.	1981	1983

Hungary HFCS plant[2]. — The high fructose corn syrup and corn starch plant at Szabadegyhaza in West Hungary is to be completed in the first quarter of 1981.

Thailand crop damage by locusts[3]. — Some 50,000 acres of sugar cane plantation areas in the central part of Thailand have been destroyed by swarms of locusts and grasshoppers, dashing hopes of increasing sugar output in the forthcoming season, according to Unicom. The government recently approved an emergency budget of 10 million Baht (US $488,000) for spraying insecticides over the affected plantations. Previous estimates indicated that sugar production in Thailand would recover to 1.3 million tonnes in 1980/81 against an annual production of 1.1 million tonnes, raw value in 1979/80; however, the extent of the damage to the 1980/81 crop is not yet clear.

Indian sugar shortage[4]. — India is one of the world's largest producers of cane sugar but this year has had to import sugar at a cost of £62 million in foreign exchange. Under official policy 65% of sugar produced must be sold to the government at controlled prices and is distributed through government outlets at a price of about 2.80 rupees per kg, ration card holders being entitled to 900 g of sugar per month per person. These stocks are being rapidly depleted, however, and the open market price of the remaining sugar outturn has increased in recent weeks from 7 to more than 22 rupees per kg and in some areas it has been unavailable.

Sri Lanka sugar expansion[5]. — In addition to the Sevanagala sugar project[6], which covers 12,000 acres, the Sri Lanka government has decided to start two other projects in Moneragala district, covering 14,000 and 6000 acres, respectively. The Sri Lanka Sugar Corporation has called for tenders on a turn-key basis for the design, supply and construction of a conventional vacuum pan factory for the production of raw sugar with an initial capacity of 1250 tonnes of cane per day (ultimately to be expanded to 2000 t.c.d.), together with a distillery to process the molasses output into potable, industrial and/or anhydrous alcohol. Sri Lanka's annual sugar production averages 20,000 tonnes against consumption in the region of 240,000 tonnes. The government has raised the price of cane by a third with a view to increasing the cane supply and sugar outturn.

Pakistan sugar production, 1979/80. — The total cane crushed by the 31 sugar factories in Pakistan in the 1979/80 season amounted to 5,792,000 tonnes or only 21% of the total crop of 27,200,000 tonnes, grown on a total area of 710,000 hectares. The major portion of the country's cane was used to make 1.5 million tonnes of gur. The quantity of white sugar made during the season was 574,057 tonnes, and some 200,000 tonnes of white sugar have had to be imported to meet the high demand for sugar. The cane area of 1978/79 was 752,500 hectares yielding 27,326,000 tonnes of cane and of this, 6,174,457 tonnes was crushed to produce 609,128 tonnes of white sugar. In addition to cane, 339,000 tonnes of beet were sliced in 1979/80 to produce 29,849 tonnes of white sugar, against 31,005 tonnes produced in 1978/79.

A/S De Danske Sukkerfabrikker 1979/80 report. — Sugar production from the 1979/80 campaign reached 392,000 tonnes, 32,000 tonnes more than the total EEC quota. The beet was easily processed and the sugar yield high so that daily production of sugar reached record levels at several factories. Nakskov and Sakskøbing factories, while processing beets, also refined 11,500 tonnes of imported raw cane sugar with a view to exporting to Norway. The factories have a capacity fully able to handle quotas likely to be allocated by the EEC, while energy-saving features have been put into effect which have counteracted to some degree the rising cost of energy; energy consumption per kg of sugar produced is one of the lowest, if not the lowest, in the world. Environmental protection measures have demanded substantial investment for some years, including 17 million D.Kr. in 1979/80 (approx. £1.28 million). Beet seed sales have been satisfactory while breeding activities are producing promising new strains. The engineering division has concentrated on the design and construction of a cane sugar factory for Vietnam, while a new small-scale cane sugar factory for processing 150–300 t.c.d., constructed and shipped to site in special containers which are then "plugged" together, has been introduced. DDS-Krøyer A/S, an engineering subsidiary, has again received an important number of orders for glucose and HFCS plants, while the US sales office opened in 1977 has been closed when it became apparent that the unfavourable economic conditions facing the American sugar industry were such that no manufacturer was embarking on long-term investment.

Taiwan sugar exports suspension[7]. — Owing to increased domestic demand, Taiwan has suspended the export of 50,000 tonnes of sugar scheduled for the 1979/80 crop year ended in October and will instead ship half in December and the rest in January 1981.

East Europe beet campaign delays[8]. — The sugar industries of East Europe have been suffering from the effects of heavy rains which have lowered production prospects in these countries. In both East Germany and Poland it was decided to postpone the start of the 1980/81 campaigns from the middle of September to mid-October in the hope that the delay could help to improve the sugar content in the beets, while it is reported[9] that the Soviet Union also delayed the start of the campaign to September 20, by which date about one third of the crop has normally been harvested. This would be a dangerous game to play, considering that continued cool weather and early frost could do serious damage to the crop. Furthermore, such a decision would further shorten the already short processing season in the USSR, putting additional pressure on harvesting and delivery of the beets to the factories, an operation which is not known to have been run efficiently in the past.

New US HFCS plant[10]. — The A. E. Staley Manufacturing Co. announced on August 27 that it planned to construct a corn processing plant at Loudon, Tennessee, capable of producing 300,000 short tons of high fructose corn syrup and 40 million US gallons of alcohol annually. The plant, to be located 15 miles south-west of Knoxville, is scheduled for completion in early 1983.

UK 1981 sugar beet contract. — The Agriculture Ministers have been informed by the British Sugar Corporation Ltd. and the National Farmers' Union that they have been unable to agree the prices, terms and conditions under which the Corporation will buy the 1981 UK beet crop. No details of the terms offered by the Corporation have been revealed, but the NFU is reported to have claimed that they took no account of cost increases and would yield only slightly more than the 1980 contract and less than in 1979. On the other hand, BSC claims that its offer would give British growers a higher price than other EEC growers were getting, as it had last year. It now falls to the Ministers to appoint someone to determine prices and conditions and the person chosen is Professor D. K. Britton of the Agricultural Economics Dept., Wye College, London University.

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1 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 493.
2 *Zuckerind.*, 1980, **105**, 796.
3 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 512.
4 *The Times*, September 10, 1980.
5 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 493.
6 *I.S.J.*, 1980, **82**, 228, 292.
7 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 513.
8 *World Sugar J.*, 1980, **3**, (3), 17.
9 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 527.
10 *Lamborn*, 1980, **58**, 117.

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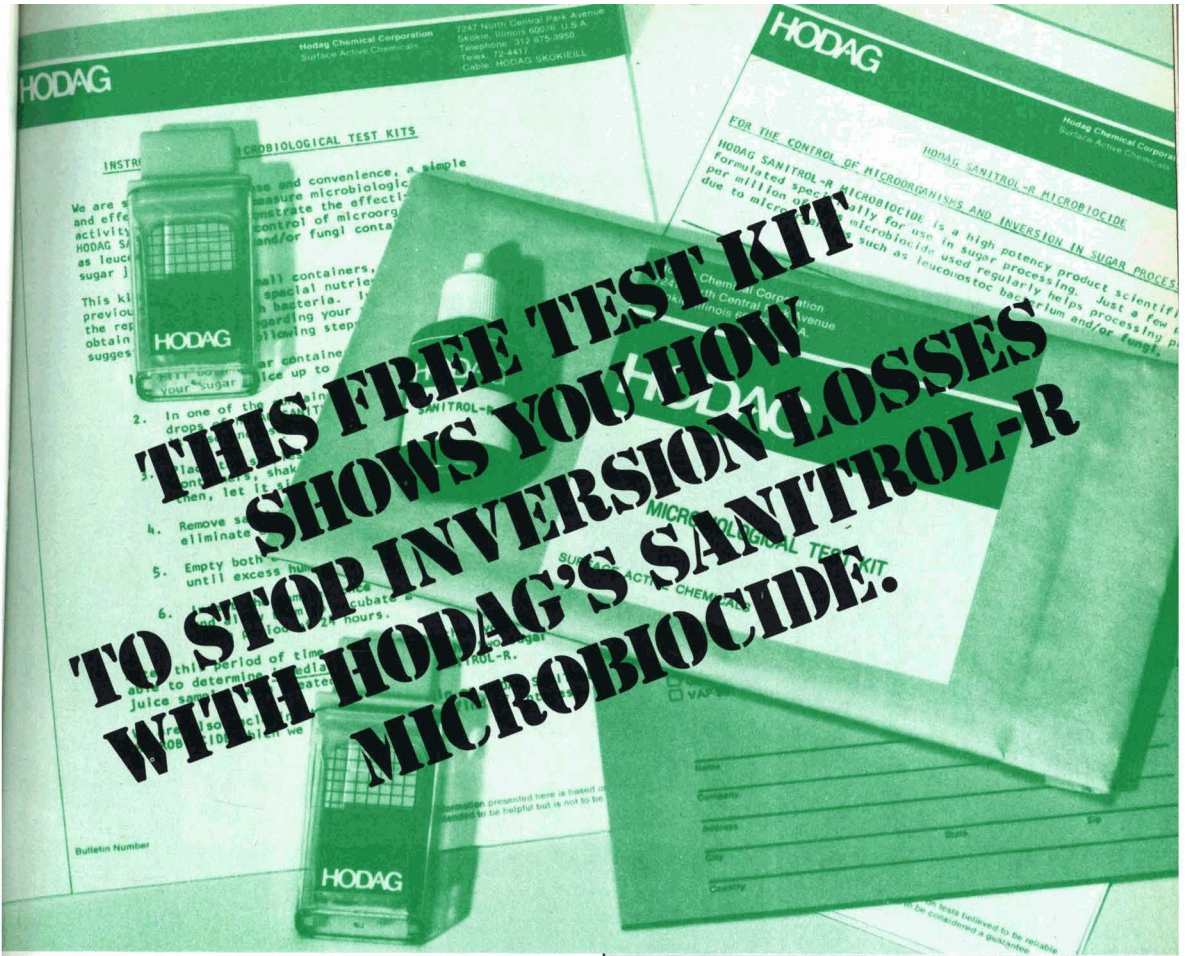

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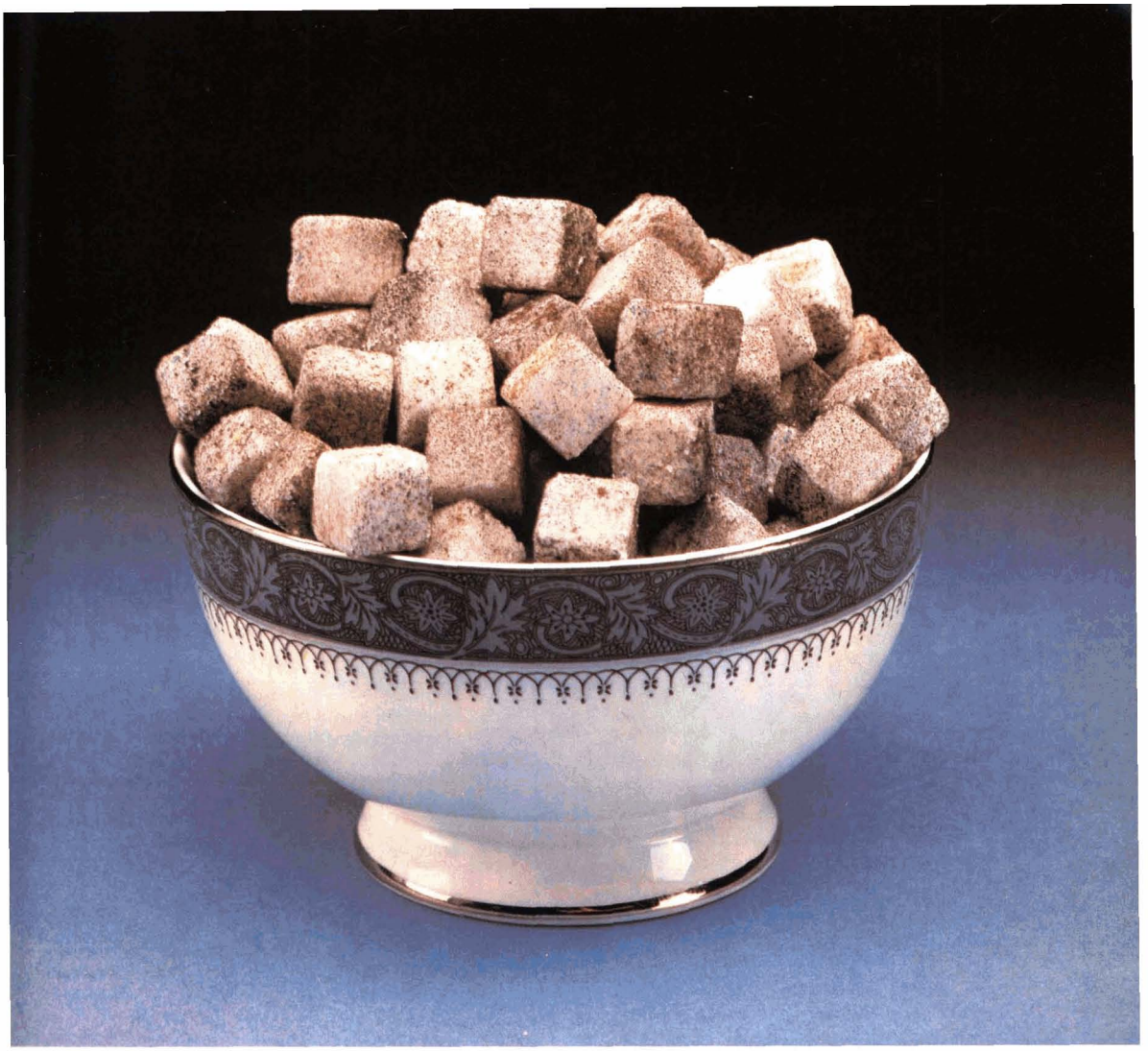

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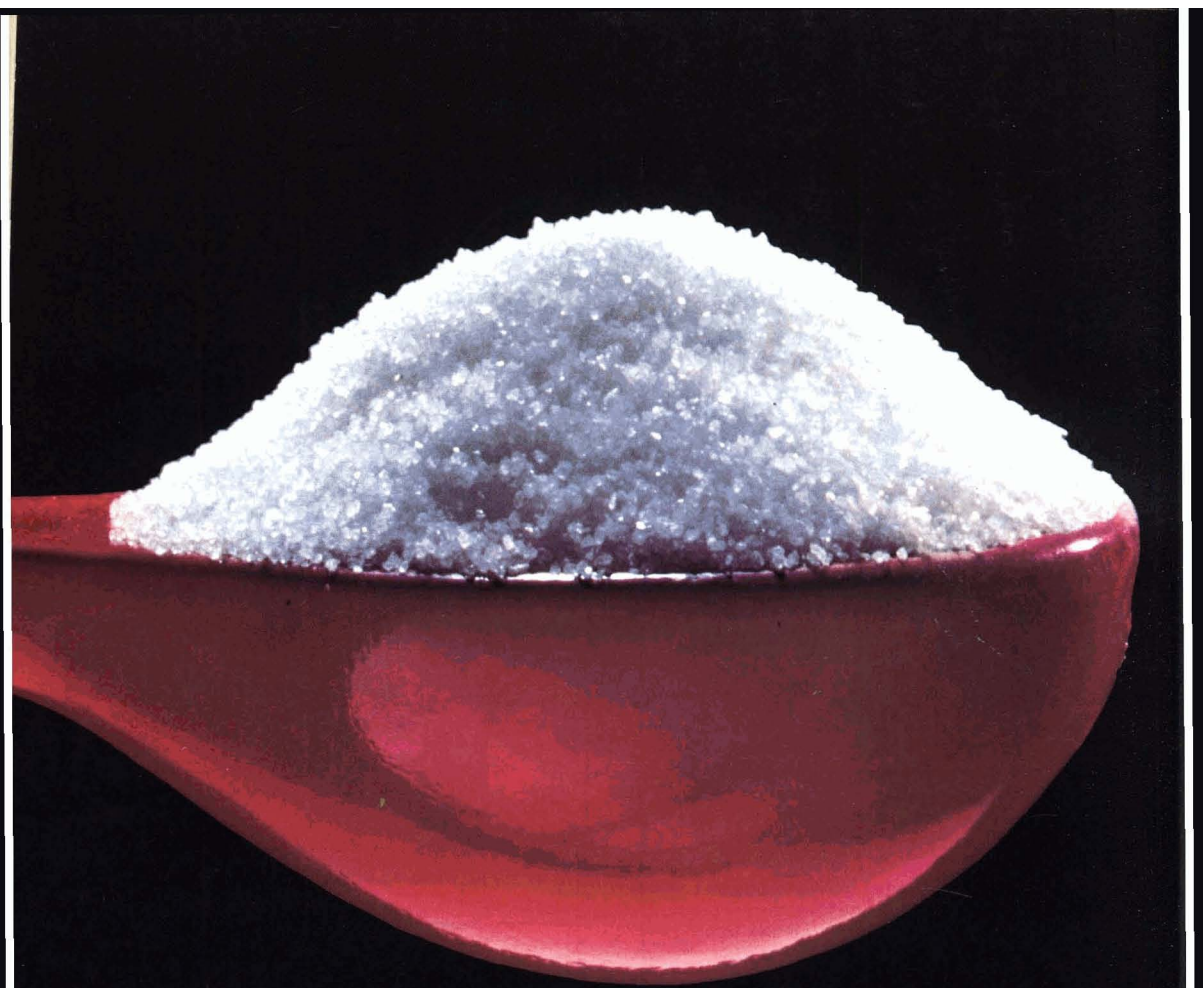

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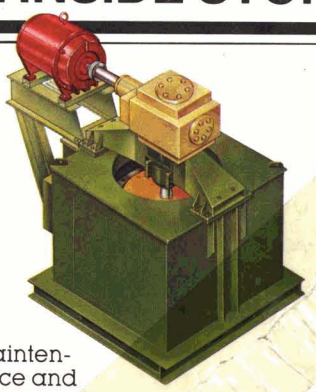

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