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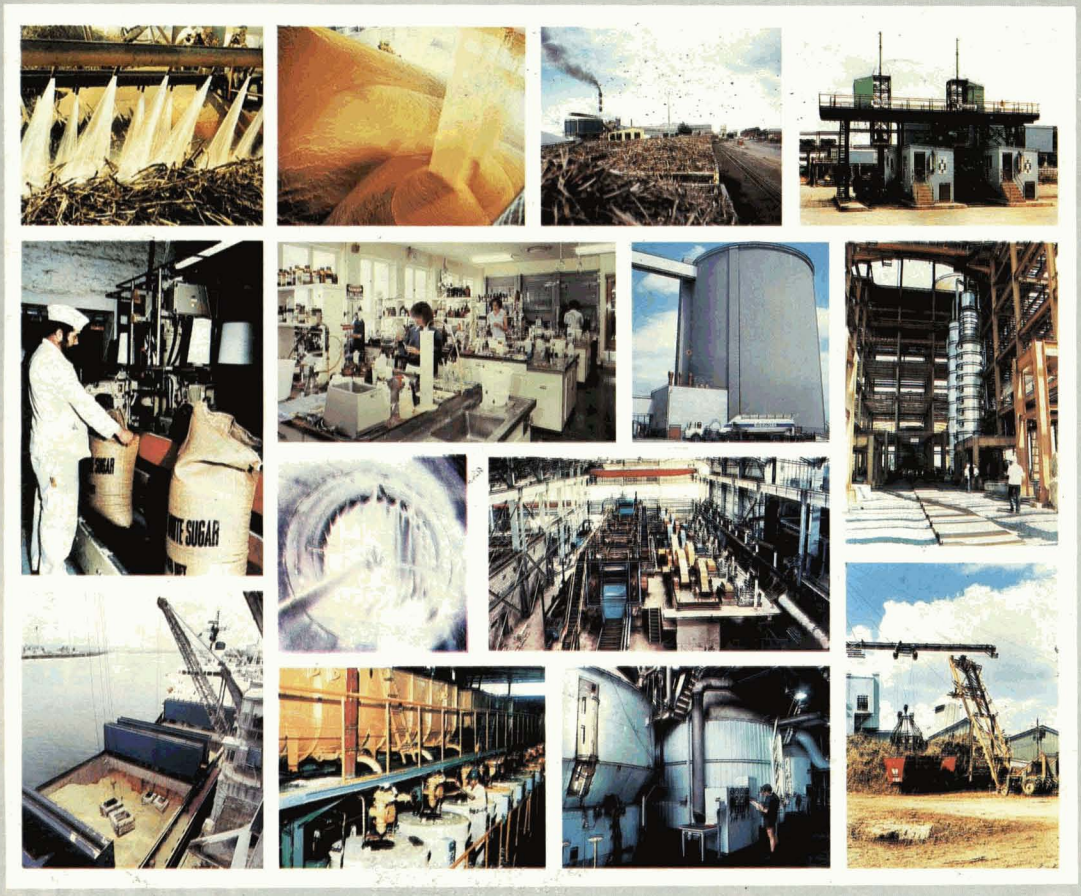

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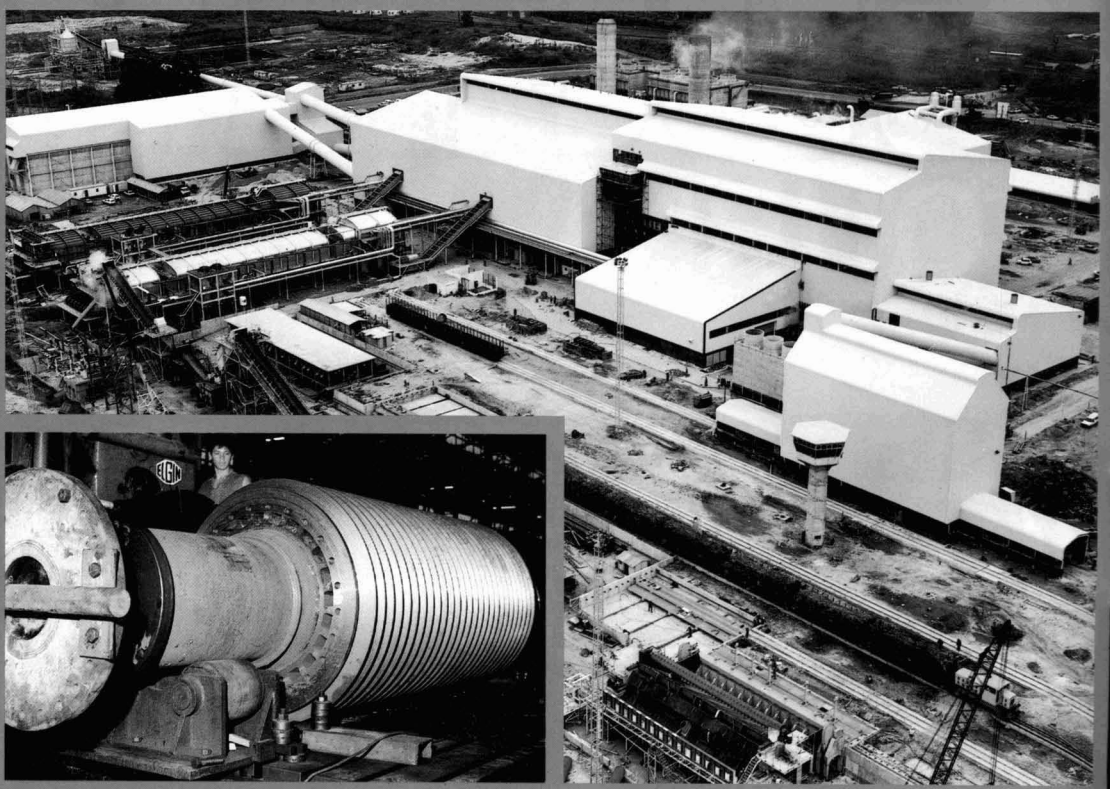

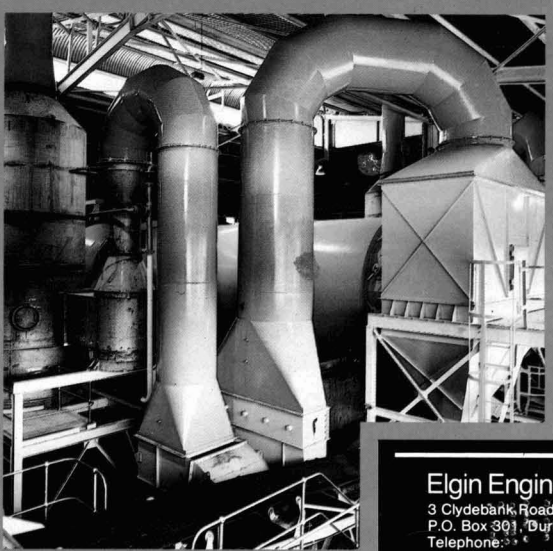

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Notes and comments

World sugar prices

From $90.00 per tonne on May 31, the London Daily Price for raw sugar rose to $95.50 on reports of a Venezuelan buying tender but thereafter slid, to reach a low of $82.50 per tonne on June 10, aided by depressing forecasts of production levels and reports that Mexico, after several years of importing sugar was, entering the market as an exporter again. The price then started to edge higher to reach $93 on June 14 but then declined to $85 a week later at around which level it stayed during the remainder of the month.

The London Daily Price for white sugar started the month at $140.50 but fell in parallel to the LDP until June 10 but did not share the subsequent rise and continued to drift lower, reaching $123.50 per tonne on June 20. It then started to recover, perhaps aided by the decision of the EEC Commission to withdraw from the market during the last week of June, and it ended the month at $132.50 per tonne.

South African sugar production pool system[1]

On May 1 a production pool system was introduced in South Africa. There are two pools: the A-pool is set at approximately 1.8 million tonnes of sugar and includes about 1.3 million tonnes for domestic consumption and some 500,000 tonnes of sugar for export. Domestic consumption is growing at a rate of about 30,000 tonnes/year so that, if the total A-pool remains constant, the proportion of export sugar, initially 29%, will fall to less than 20% after five years. The remaining sugar and cane produced each year in excess of the 1.8 million tonnes will become B-pool sugar and cane and will be paid for at prices related solely to the export market. In the interests of providing stability in the A-pool it may be possible to operate a fund which would syphon off surplus A-pool proceeds when export prices are high and inject them into proceeds when export prices are low.

Each grower will be recorded by the Central Board with an A-pool quota, determined on a basis of the record of sucrose yields during the ten seasons 1975/76-1984/85 (averaging the yields for the best three consecutive seasons and the two best yields of the remaining seasons). The grower will be paid at a price expected to be in the vicinity of R230 per tonne for his A-pool quota and at an export market-related price for any additional B-pool sugar; this price is expected to be in the range R85-R120 per tonne in 1985/86. There is provision for reduction of A-pool quotas for growers who fail to deliver these in two out of five years, while quotas may be transferred from one grower to another. If a future International Sugar Agreement should require restriction of total production, this will first be applied to the B-pool, while provision is made for a review of the A-pool provisions at 5-year intervals.

Australian long-term study[2]

At a meeting in Canberra on April 1, Australian sugar industry leaders, led by the Queensland Premier, presented a submission for assistance to the Australian Prime Minister. In particular the industry leaders requested financial assistance to growers and millers for future seasons to ensure that average costs of production are covered.

The Federal Government reiterated that it was not in a position to give "across the board" assistance to the sugar industry but that it was willing to lend its support to an integrated package that included measures that have a realistic prospect of securing the long-term competitiveness of the industry. With this in mind it proposed that a working party representing the Federal and Queensland governments and sugar industry be established to prepare a long-term plan, looking at assistance in the context of rationalization of the industry. This was accepted by the Queensland government and the sugar industry. It is expected that the working party, which held its first meeting in Brisbane on May 3, will report within 100 days. This report will include recommendations on a package of measures which will facilitate the industry's own internal review of its practices and procedures which has been underway for the last twelve months.

EEC enlargement

In June Spain and Portugal signed treaties of accession to the European Economic Community and will become members with effect from January 1, 1986, after ratification of the treaties by all the Parliaments of the members, now to number twelve. Tariffs between the two countries and the rest of the Community will be dismantled over transition periods of up to ten years in each case. While Portugal produces only a small quantity of sugar in the Azores and Madeira and has a refining industry in Oporto, Lisbon and Santa Iria, the Spanish industry produces more than a million tonnes a year and has been providing a surplus.

EEC withdrawal from the sugar market

Near the end of June the EEC Commission decided not to grant any export licences and issued a statement to the press stating that, as white sugar prices had fallen to only one quarter of production costs, they could not continue to subsidize exports of EEC at such high levels. The Community's sugar surplus provides constant pressure to seek export markets, however, and it was no great surprise, therefore, that the withdrawal lasted only a week, whereupon the tender awards were virtually doubled to 113,000 tonnes, presumably as a

1 *S. African Sugar J.*, 1985, **69**, 113-117.
2 C. Czarnikow Ltd., *Sugar Review*, 1985, (1737), 60.

consequence of the readiness with which refiners in China, South Korea and the US were meeting the demand for white sugar from India.

Turkey sugar situation[3]

It had been intended that 370,000 hectares would be devoted to the Turkish sugar beet crop during 1984 but continuous rain during the sowing season not only reduced the area available but also made it impossible for the work to be completed. Meanwhile, some producers switched to cereals and sunflowers in view of the higher return they could receive from these crops. Having initially suffered from too much rain, the crop then had the problem of too little during the ripening period, with the result that the yield per hectare amounted to only 31.7 tonnes compared with 35.6 tonnes in 1983, and total output of beet reached 11.1 million tonnes while white sugar output amounted to 1,522,000 tonnes.

Output of sugar has been targeted in recent years at 1.5 million tonnes but this figure has tended to be exceeded, the 1983/84 outturn reaching 1,629,000 tonnes. Sales for domestic consumption reached 995,000 tonnes in 1983, equivalent to 26.0 kg per caput, and rose to 1,070,000 tonnes in 1984, equivalent to 27.2 kg per caput. Production of more sugar than required for domestic consumption has resulted in the need to export. High production costs make it difficult to engage in world market activity, but deals have been struck with neighbouring territories. In 1984 the Turkish Sugar Company contracted to sell 360,000 tonnes to Iran and 120,000 tonnes to Iraq. The latter sale also included an option to increase the quantity by 20,000 tonnes, while on both quantities there was a 5% tolerance. Actual shipments amounted in the case of Iran to 322,318 tonnes and to Iraq 134,198 tonnes. In addition, 77,498 tonnes was exported to Iraq outside the special arrangements.

EEC sugar balances[4]

Current planting intentions suggest that there will be a drop in European Economic Community sugar beet sowings of some 1½% for the 1985/86 campaign. From this and a continuation in the long-term trend of rising yields, a statistical forecast of production indicates a 1985/86 figure of 12,188,000 tonnes, white value, a little more than 300,000 tonnes down on 1984/85. Because of the large carry-over of "blocked" C-sugar from 1984/85 (at 750,000 tonnes three times that carried over from 1984/84), the Community will have more than adequate supplies to keep exports at around four million tonnes, the same as in 1983/84 and 1984/85.

In 1984/85 production reached 12,502,000 tonnes, according to the latest revised estimate, while there are signs that consumption in the season 1985/86 is likely to show some recovery, although the forecast total of 9.4 million tonnes is the same as for 1984/85. The forecast balance for 1985/86, together with estimated figures for 1984/85 and provisional figures for 1983/84 are tabulated below.

	1985/86	1984/85	1983/84
		tonnes, white value	
Opening stock[a]	2,050,000	1,744,000	3,027,000
Production[b]	12,188,000	12,502,000	11,003,000
Imports[c]	1,500,000	1,500,000	1,543,000
	15,738,000	15,746,000	15,573,000
Domestic consumption	9,400,000	9,400,000	9,321,000
Exports of sugar as such[d]	3,933,000	3,941,000	4,057,000
Exports in processed products	355,000	355,000	355,000
Statistical balancing item	—	—	96,000
Closing stocks[e]	2,050,000	2,050,000	1,744,000

[a] Includes "blocked" sugar—1,089,000 tonnes in 1983/84, 214,000 tonnes in 1984/85 and 750,000 tonnes in 1985/86
[b] Includes A- and B-quota sugar (10,936,000 tonnes in 1983/84, 11,174,000 tonnes in 1984/85 and 11,236,000 tonnes in 1985/86), the balance being C-sugar
[c] Includes ACP sugar in imported processed products, sugar from East Germany and others
[d] Includes sugar with export refund (3,107,000, 3,149,000 and 2,981,000 tonnes in 1983/84, 1984/85 and 1985/86) and C-sugar not "blocked" (950,000, 792,000 and 952,000 tonnes in the same periods)
[e] Includes "blocked" sugar (214,000 tonnes in 1983/84 and 750,000 tonnes in 1984/85 and 1985/86)

Peru sugar problems[6]

There is concern in Peru that domestic production this year will not be sufficient to meet consumption requirements. Sugar factories in the country are owned by cooperatives and at the end of the last campaign they reported that output in 1985 would amount to 800,000 tonnes. Subsequently this figure was revised downwards to 740,000 tonnes while government sources now suggest that, as a consequence of falling productivity and adverse climatic conditions, the figure will not exceed 660,000 tonnes, or roughly the country's consumption needs.

Though the government has so far refused to authorize imports through the private sector, there have been negotiations for the purchase of about 40,000 tonnes of refined sugar from Cuba and Mexico in government-to-government deals. The cooperatives have continuously complained that any problem is the fault of government as they are suffering from a lack of working capital and the finance to replenish their machinery. They have threatened to take industrial action should sugar eventually be imported.

Sudan sugar production, 1984/85[5]

Sudan produced 306,000 tonnes of semi-refined sugar in the 1984/85 season, making the country self-sufficient. The sugar was produced from 3 million tonnes of cane, with an average crushing rate of 17,000 tonnes per day.

3 C. Czarnikow Ltd., *Sugar Review*, 1985, (1737),
4 *World Sugar J.*, 1985, **7**, (12), 16-21.
5 *Public Ledger*, April 23, 1985.
6 C. Czarnikow Ltd., *Sugar Review*, 1985, (1737), 61.

Vacuum filtration of sulphitation muds—a new concept

By J. J. Bhagat

(The Triveni Engineering Works Ltd., New Delhi, India)

A majority of sugar factories in India producing plantation white sugar follow the double sulphitation process while raw cane sugar factories around the world use the defecation process for clarification of cane juices.

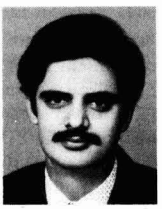
In India, the number of sugar factories multiplied rapidly after grant of protection in 1932 and rose from 31 in 1931/32 to 135 in 1935/36. All these factories initially had batch operations all along the line of manufacture. It was in the mid-1950's that a few of the stages of white sugar production—sulphitation, settling and filtration—were made continuous. This was done by replacing settling tanks and filter presses with continuous clarifiers and rotary vacuum filters. In defecation factories as well, the clarification is now conducted using continuous clarifiers and vacuum filters.

However, even today, many factories in India still use filter presses for filtration of underflow from the clarifiers. Filter presses have a number of inherent disadvantages in respect of manpower requirement, sugar losses, space requirement, etc., yet the quality of filtered juice is superior to that obtained from vacuum filters and the juice can be sent to the evaporators directly. By contrast, in spite of various advantages offered by the continuous filters, the filtrate obtained is of such poor quality that it must be returned to the raw juice.

The quantity of filtrate varies from 15 to 25% on cane and its return to raw juice results in serious constraints on the capacity of the juice heating and clarification equipment. Also, according to some authorities, the broken flocs in the filtrate are

Table I

Crushing rate	100 tonnes
Quantity of filtrate	17 m^3/hr
Insoluble solids	2%
Purity:	
Raw juice	80.0
Vacuum filtrate	75.0
pH	6.5
Temperature	74°C



J. J. Bhagat

detrimental to proper floc formation in the main juice stream and hence result in inferior clarified juice.

A typical analysis of vacuum filtrate is given in Table I.

It may be seen that the filtrate has to be recirculated to raw juice as it contains an appreciable quantity of insoluble solids, making it unsuitable for direct feed to the evaporators. During various trials at Anoopshahar factory in India during the 1980/81 season the author conducted pilot-scale experiments to settle the filtrate and subsequently re-filter it to obtain clear filtrate but these were not successful. Failure to achieve the desired results was due to the very difficult nature of the vacuum filtrate and the slimy characteristics of the precipitated mass.

The filtrate from the continuous vacuum filter when mixed with raw juice also leads to increase in mud volume and entrainment of fine bagacillo particles with the clarifier overflow.

It was therefore decided to conduct trials with a belt discharge vacuum filter for filtration of clarifier underflow.

The conventional cane mud filter is provided with stainless steel perforated screens which allow a substantial amount of insoluble solids to escape along with the filtrate through the perforations, so rendering the filtrate unsuitable for mixing with clarified juice.

The purpose of the trials therefore, was to see whether the belt discharge filter (BDF) can successfully handle sulphitation mud and produce a clear filtrate which can be mixed directly with the clear juice.

BDF's are working successfully in carbonatation factories on carbonatation muds, but with sulphitation mud it was feared that the fine nature of the slurry might create problems and result in poor cake formation, low filtration rates, high pol loss, and poor cake discharge.

Trials

After very careful consideration, it was decided to conduct the trials at Simbhaoli factory. The advantages of selecting Simbhaoli were that it has a steady rate of crush, its performance is one of the best in North India, and there are already three continuous filters working in the factory which offered a ready comparison with the working of the belt discharge filter.

Scale

It has generally been observed that pilot-scale trials do not project a true picture of full-scale performance, and it was therefore decided to conduct the trials on a factory scale. Accordingly a belt discharge filter of 600 sq.ft. filtering area, available at our Mathura factory, was selected for the trials. The conventional cane mud vacuum filters installed in various sugar factories, including Simbhaoli, are normally of 400 sq.ft. filtering area (8 ft dia. $\times$16 ft long) and the belt discharge filter used for the trials was therefore 1.5 times this area.

Installation

The erection of the belt discharge filter at Simbhaoli was completed and the filter commissioned on April 10, 1984. The filter was provided with an independent vacuum system.

The following facilities were available to us for accurate estimation of its performance:

(i) The feed slurry to the BDF was tapped from a common bagacillo-slurry mixer feeding the existing vacuum filters.

(ii) The filtrate obtained from the BDF was independently pumped to a receiver with facility for recording the flow rate.

(iii) The cake discharged from the filter

was collected separately for weighment.

(iv) Provision was made for estimating the filter cake wash water.

(v) Provision was made for estimating the belt wash water.

(vi) The unit had an independent power supply.

(vii) Various laboratory equipment was available for analysis.

A comprehensive chart was drawn for recording the various analytical data. This was done with a view to keep a record of all variables and also to have a ready comparison with the performance of the existing cane mud filters.

Initially it was intended to have a round-the-clock analysis of performance but this did not prove to be feasible on account of interruptions due to:

(a) Undertaking various modifications to the filter.

(b) Shortages of sufficient slurry to feed the BDF (this was overcome, however, by stopping the existing filters).

(c) Change of filter media.

(d) Shortage of diesel fuel (a diesel engine was used for running the generator for power supply to the filters).

(e) Bad weather & miscellaneous.

Despite these intermittent stoppages, the total time available for running was quite sufficient to give us an accurate idea of the performance of the BDF. The trials commenced on April 10, 1984 and were concluded on May 10, 1984 which coincided with the close of the campaign at Simbhaoli.

At the beginning of the trials the performance of the filter was dismal. The pol % filter cake and flow rate and capacity of the filter were far from satisfactory. The results recorded during the initial run are given in Table II.

The major problems faced with the belt discharge filter were poor flow rate and capacity, high sugar loss, and unsatisfactory cake discharge.

However the clarity of juice did not pose any problem, and it was therefore decided to tackle the above problems, one at a time. The following changes and modifications were made to achieve the desired results.

Flow rate

It was observed that the primary reason for a very poor flow rate was that the nature of feed to the filter was not consistent and it was also felt that the flocs were breaking during the passage of slurry to the filter and in the feed trough.

The initial arrangement for feeding the slurry to the filter was through an overflow pump. This was immediately discontinued and a direct line was taken from the mixer. Further, we felt that the speed of the stirrer was very high and therefore it was suitably reduced to give a very gentle stirring action.

Simultaneously, a series of leaf tests were conducted with various samples of cloth to check the flow rate and clarity of filtrate, and a suitable cloth was selected for the purpose. Settling tests were also done with addition of flocculant and milk-of-lime to determine their effect on the mud slurry, as shown in Table III.

We noted that the consistency of the underflow from the clarifier had a very pronounced effect on cake formation and underflow of different consistencies

Table II. Initial run (April 10-12, 1984)—average of each shift

	Pol % filter cake		*Flow rate, litres/hr/sq.ft.*		*Capacity, tch*		*Cake discharge*	
Shift No.	*BDF*	*S.S. Screen Filter*	*BDF*	*S.S. Screen Filter*	*BDF (600 sq.ft.)*	*S.S. Screen Filter (400 sq.ft.)*	*BDF*	*S.S. Screen Filter*
1	5.7	2.6	4.2	17.5	14	37	Unsatisfactory	Good
2	7.9	3.2	4.7	18.75	15.0	40	,,	,,
3	7.8	3.2	5.4	21.25	17.0	45	,,	,,
4	5.5	2.3	4.3	19.5	13.5	41	,,	,,
5	6.6	2.4	6.7	22.5	22.0	47	,,	,,
6	6.2	4.6	7.5	23.75	24.0	50	,,	,,
7	6.8	2.6	6.4	19.5	20.0	41	,,	,,
8	5.1	2.8	5.8	20.0	18.0	42	,,	,,

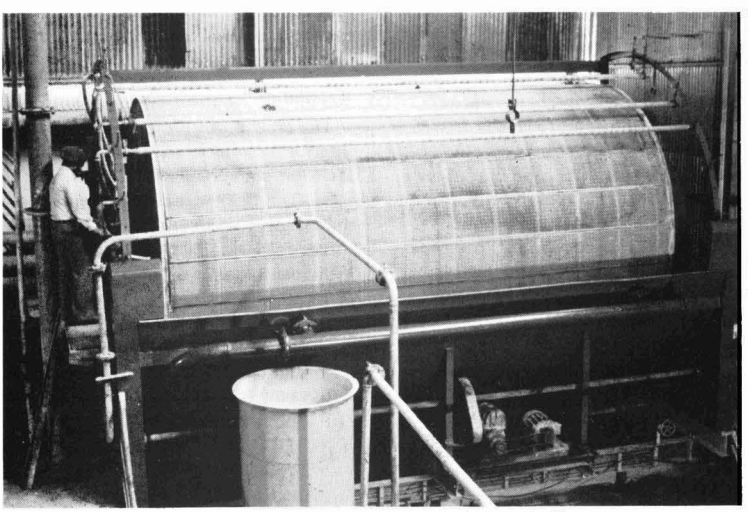


Fig. 1. Rotary belt vacuum filter (without belt) of 750 sq. ft. filter area

was therefore subjected to the filtration test. It was observed that the thin underflow immediately reflected on the performance of the existing cane mud filter also. The various observations at varying underflow consistencies are given in Table IV.

In order to determine the actual flow rate of vacuum filtrate from the cane mud filters, the flow was measured at different intervals. These are recorded in Table V. This directly indicated the percentage of vacuum filtrate returning to raw juice from the three filters.

It was further observed that the speed of rotation of the belt filter had a significant effect on the cake thickness and flow rate. The filter was therefore run at different speeds to achieve optimum cake thickness and flow rate; the results are reported in Table VI. The mud slurry had a density of 1065 g/litre, no flocculant was used and polypropylene cloth was fitted to the filter.

Initially, the belt wash water pressure was 20 psi; this resulted in very rapid fouling of the filter cloth and drop in filtration rate. The pressure was subsequently raised to 50 psi, which gave proper washing of the filter belt and resulted in good cake formation and substantial improvement in flow rates.

As a result of these various changes throughput and cake thickness increased very satisfactorily and trials were conducted with different cloths. The speed of rotation was maintained at 4.5 mpr and belt wash water pressure at 50 psi. Of the various cloths available only one kind each in nylon and polypropylene were finally retained for further trials, and performance of these is also compared in Table VII. The sugar loss and cake dischargeability remained unchanged.

Table III. Mud volume reduction with time*

Dosage: Milk-of-lime, to pH 7.5; Flocculant, 2 ppm-3 ppm

	Mud slurry (at 88°C-92°C)			*Sulphited juice*	
After elapse of	*Without flocculant*	*With flocculant*	*With lime and flocculant*	*Without flocculant*	*With flocculant*
Initial	1000 ml	1000 ml	1000 ml	1000	1000
5 min	—	—	—	830	320
10 min	990	980	970	630	280
15 min	985	975	950	460	270
20 min	—	960	930	400	270
25 min	980	945	920	380	265
30 min	975	935	900	340	265
45 min	970	925	880	320	260
60 min	960	910	860	300	250

*Average of 17 tests

Table IV. Filtration rate with varying mud slurry (underflow) consistencies

Weight per litre of slurry	*Flow rate, litres/hr/sq.ft.*	*Cake thickness*	*Cake discharge*
1032 g	17.0	Very thin	Nil
1040 g	21.5	Very thin	Nil
1055 g	28.0	2-3 mm	Fair
1063 g	32.0	2-3 mm	Good
1070 g	33.5	3-4 mm	Good

Table V. Quantity of cane mud filtrate return

Shift No.	*Crush, tch*	*Filtering area available, sq.ft.*	*Quantity, tonnes*	*Time, min*	*Rate, tonnes/hr*	*Filtrate return % crush*
1	125	1200	5.66	15	22.64	18.1
2	120	1200	6.15	15	24.6	20.5
3	125	1200	6.75	15	27.0	21.6
4	116	1200	5.30	15	21.2	18.3
5	123	1200	4.25	10	25.5	20.7
6	128	1200	4.40	10	26.4	20.6
7	125	1200	4.10	10	26.6	19.7
Average	123	1200			24.6	19.93

Table VI

Speed of rotation, m.p.r.	*Flow rate, litres/hr/sq.ft.*	*Cake thickness, mm*	*Moisture % cake*
3.2	18.5	2-3	67
4.0	24.0	3-4	69
4.5	24.5	3-4	68
5.2	20.0	4-5	67
5.5	17.5	4-5	67

Filtration efficiency

The filtration efficiency was compared and assessed in three ways, viz. (i) % retention of insoluble solids, (ii) drop in purity of the filtrate, and (iii) clarity of the filtrate.

A series of analyses were carried out on insolubles in the underflow and the filtrates. These are given in Table VIII.

It was seen that the percentage of insolubles in the cane mud filtrates were very high against almost nil in case of BDF. The filtration efficiency of the BDF was therefore as high as 97-99% against 78-82% in the case of the cane mud filter.

Drop in purity of the filtrate

The purity of the filtrates from the cane mud filter and the BDF were also analysed a number of times, every day. The purity of filtrate from the BDF was higher by 3-5 units as compared to the screen filter as in Table IX.

During discussions it was debated that this drop in purity of cane mud

filtrate may have been a result of the effect of the insoluble solids. The screen filtrate was therefore analysed after settling and this did indicate increase in purity (Table X).

Nevertheless, the settled solids are returned to raw juice causing their re-dissolution and dispersion. It was, therefore, concluded that the absence of any perceptible rise in purity from mixed to clear juice in sulphitation factories is due to introduction of low purity continuous vacuum filtrate to the raw juice.

Once the recirculation of vacuum filtrate is eliminated, this should cause an appreciable rise in purity in clear juice resulting in improved boiling house efficiency and lower molasses production.

Table VII

Shift No.	*Type of cloth*	*Mud consistency*	*Flow rate, litre/hr/sq.ft.*	*Pol % cake*	*Cake thickness, mm*	*Moisture, %*
1	Nylon	1060	18.0	5.5	2-3	71
2	Nylon	1055	20.0	5.8	2-3	70
3	Nylon	1063	18.5	6.0	3-4	70
4	Nylon	1055	21.0	5.7	2-3	71
5	Nylon	1060	17.5	5.8	2-3	70
6	Polypropylene	1055	27.0	4.5	3-4	68
7	Polypropylene	1055	25.0	4.8	3-4	69
8	Polypropylene	1065	26.5	5.2	4-5	68
9	Polypropylene	1060	28.0	4.5	3-4	67
10	Polypropylene	1055	25.0	5.0	3-4	68

Table VIII. Insoluble solids retention

		Cane mud filter		*Belt discharge filter*	
Shift No.	*% Insoluble solids in mud slurry*	*% Insoluble solids in filtrate*	*Filtration efficiency, %*	*% Insoluble solids in filtrate*	*Filtration efficiency, %*
1	10.23	1.82	82.20	0.25	97.50
2	9.78	2.06	78.93	0.10	98.97
3	9.10	1.66	81.75	0.05	99.00
4	9.96	1.81	81.82	0.05	99.50
5	10.17	1.96	80.72	0.05	99.50
6	10.15	2.01	80.20	0.15	98.52

Table IX. Purity analysis of filtrates

	Cane mud filter			*Belt discharge filter*		
Shift No.	*Brix*	*Pol*	*Purity*	*Brix*	*Pol*	*Purity*
1	14.29	10.09	70.47	15.61	12.43	79.63
2	15.46	11.41	73.80	14.75	11.34	76.57
3	15.35	11.03	71.86	15.34	12.05	78.55
4	14.23	10.52	73.93	15.11	11.63	76.97
5	14.41	10.62	73.70	15.50	12.47	80.45
6	15.01	10.97	73.08	13.29	10.32	77.65
7	15.21	11.19	73.57	15.70	12.69	80.83
8	14.16	10.57	74.65	14.41	11.41	79.18
9	16.11	12.32	76.47	14.21	11.36	79.94
10	14.51	11.23	77.39	14.41	11.55	80.15
11	15.13	11.74	77.59	13.36	10.47	78.37
12	14.29	11.26	78.80	13.11	9.99	76.20
13	15.40	11.54	74.94	14.04	10.99	78.28
14	15.01	11.36	75.68	12.90	10.13	78.53
15	15.40	11.54	74.94	15.01	11.89	79.06
16	15.01	11.36	75.68	13.96	11.24	80.52
17	14.23	10.91	76.67	11.30	8.80	77.88
18	14.23	10.86	76.32	13.91	10.99	79.01
19	13.60	10.24	75.29	13.34	10.61	79.54
20	14.34	10.74	74.89	13.39	10.69	79.84
21	14.10	10.50	74.46	17.31	13.90	80.30
22	14.11	10.27	72.78	12.71	9.81	77.18
23	14.31	10.49	73.30	14.00	10.87	77.64
24				13.94	10.70	76.76
25				13.75	10.75	78.17
26				12.00	9.40	78.33
27				10.41	7.88	75.69
28				11.79	9.10	77.18
Average	14.69	10.99	74.80	13.88	10.91	78.60

Colour

The filtrate obtained from the BDF was very clear, i.e. without any haziness or suspended matter, though dark in colour. The colour obviously cannot be removed through a filter and was subsequently removed by a very mild treatment of the filtrate with milk-of-lime and phosphoric acid. It was observed on a laboratory scale that treatment of filtrate with 0.5% by volume of milk-of-lime at 8°Bé and subsequent neutralization with 5% phosphoric acid to 7.0 pH, followed by settling for 15 minutes resulted in a very light coloured clear juice. Since the filtrate quantity is about 20% on cane, the quantity of milk-of-lime on 100% mixed juice basis will therefore be 0.1% by volume. By contrast, the filtrate from the cane mud filter is very hazy, dark brown in colour and does not respond to the above treatment.

Sugar loss

In spite of achieving good cake formation and flow rate the sugar loss in filter cake continued to be high. It was found through various trials that the drying zone has to be increased as far as possible. This was done by changing the bridge setting of the Hy-flo valve and adjustment of the overflow level. This resulted in spectacular improvement in washability of cake and subsequent reduction in sugar loss to an acceptable level. The pol % filter cake achieved using an equal wash water quantity as in the case of the continuous vacuum filters, was lower for the BDF (Table XI).

In these trials, the cloth used was polypropylene, the belt wash pressure was 50 psi, speed of rotation was

4.0-4.5 mpr, slurry consistency was 1060-1065 g/litre, the vacuum varied between a high of 500-530 mm of Hg and a low of 200-250 mm of Hg. The drying zone was the maximum obtainable, no flocculant was used, but the bagacillo used was the same as in the cane mud filters. Thickness of cake was about 3 mm, and cake wash water used was about 100% on cake. The observations in the table are readings taken at random and do not necessarily correspond.

Table X

	Shift No. 1			*Shift No. 2*		
	Brix	*Pol*	*Purity*	*Brix*	*Pol*	*Purity*
BDF filtrate						
Untreated	11.79	9.10	77.18	11.90	9.05	76.05
Treated*	12.59	9.83	78.07	13.61	10.45	76.78
Continuous vacuum filtrate						
Untreated	14.11	10.27	72.78	14.31	10.49	73.30
After settling	13.56	10.11	74.56	13.51	10.13	74.98
Clear juice	14.70	11.71	79.65	16.04	12.69	79.11

*The BDF filtrate was treated with 0.5% by volume of milk-of-lime at 8°Bé and neutralized with 5% phosphoric acid

Table XI

Belt discharge filter			*Cane mud filter*		
Pol %	*Moisture %*	*Flow rate litres/sq.ft./hr*	*Pol %*	*Moisture %*	*Flow rate litres/sq.ft./hr*
2.2	70	21	2.5	71.0	27
1.8	68	24	2.0	68.0	23
1.5	69	18	2.2	68.0	28
1.6	68	25	1.4	66.0	21
2.5	70	28	1.6	71.0	19
1.8	71	32	2.3	68.0	20
1.7	68	32	3.5	—	27
1.9	—	28	2.1	—	28
1.8	—	23	1.6	—	24
2.0	—	25	2.3	—	30
1.0	—	24	3.5	—	30
2.0	—	29	2.1	—	20
1.0	—	31	2.1	—	20
2.0	—	21	2.2	68.0	24
1.3	—	21	2.5	67.0	25
1.4	68	25	2.0	69.0	25
1.8	69	27	2.5	69.0	27
2.5	70	24	2.1	70.0	28
1.0	70	28	1.7	—	28
1.8	68	28	2.6	—	25
1.7	—	29	2.1	—	23
4.0	—	24	2.6	—	23
2.2	71	32	3.9	—	27
1.5	68	30	1.3	70.0	22
2.8	68	23	1.6	70.0	28
3.2	69	—	2.3	71.0	28
1.5	69	—	1.6	67.0	—
1.7	—	—	1.5	68.0	—
1.3	—	—	2.4	—	—
1.8	—	—	2.5	—	—
1.5	—	—	2.1	—	—
1.8	—	—	2.2	—	—
3.1	—	—	3.1	—	—
1.6	—	—	2.0	69.0	—
1.5	—	—	3.0	68.0	—
2.0	—	—	3.2	68.0	—
1.5	68	—	2.9	69.0	—
2.5	69	—	1.1	—	—
1.8	69	—	2.6	—	—
Average 1.89	69	26.0	2.27	68.75	25.2

Cake discharge

At the beginning of the trials, since the cake built up was negligible, cracking of the cake did not occur. Subsequently, with a change to a suitable cloth and mixing of bagacillo, the cake thickness improved very appreciably but the cake still failed to crack and dislodge.

It was felt that this was probably because the cake was not sufficiently dry, but even after increasing the drying zone and proper washing of the cake it still failed to dislodge. Through careful observation and by manual dislodging it was seen that the cake had no binding characteristics with the cloth. Therefore, it was felt that, if we could crack the cake, it would dislodge with ease. Efforts were accordingly made to vary the angle of travel of the filter belt and it was extremely satisfying to note that by doing so it was possible to dislodge the cake completely. In fact, whereas with the cane mud filter an operator had invariably to scrape a certain portion of the drum, no such thing was required at all with the BDF. After having overcome the problem of cake discharge it was found that the following further improvements took place in the operation of the BDF.

(i) There was a reduction in belt wash water consumption to approximately 150 litres/min.
(ii) The fouling of belt wash was reduced to practically nil and it could be recycled without difficulty.
(iii) Throughput of the filter increased further owing to the clean belt and better cake formation.

The following handicaps were experienced during the trial:

(i) Since the filter was an open-air installation, the strong breeze at times carried away the spray for cake washing resulting in less washing than was recorded.
(ii) The filter being the last installation in the line led to irregular feed.

(iii) As already mentioned, the filter was operated by a diesel generator set/grid; tripping of the grid caused frequent breaks in continuity, and avoidance of this would therefore give still better performance than that recorded.

Operating costs

Power: The BDF consumes extra power on account of higher capacity air pump and belt wash pump. The installed power per BDF is 110 kW and the operating load is 70 kW.

Cost of cloth: Unlike the cane mud filter, the BDF requires at least one change of belt after 45-60 days. The cost of cloth works out to about $0.25 per tonne of sugar. However, this is offset by the replacement cost of stainless screens in the case of the cane mud filter.

Cost of acid: The belt needs an acid wash at least once per shift. This is done using 5% HCl. The cost of acid per filter per season of 150 days will be US $750, approximately.

Equipment cost: The installed cost of a BDF is approximately the same as that of the cane mud filter.

Space: The space requirement is the same as for a cane mud filter.

Manpower: The manpower required per filter is the same as with a cane mud filter.

Conclusion

The trials at Simbhaoli have conclusively established that the BDF is far superior to the conventional vacuum cane mud filter. Its throughput is higher and the sugar loss in filter cake lower. Since the filtration efficiency of the BDF is 97-98% against 75-80% for the cane mud filter, the filtrate is practically clear of all suspended matter and is fit for mixing with the clear juice. The elimination of recirculation of dirty filtrate to raw juice will directly result in increased capacity of the clarification station, lower lime consumption, lower mud volumes and therefore lower filter cake quantity. It reduces retention time in the clarifier to give smaller inversion losses, gives a higher purity rise from mixed juice to clear juice and therefore lower molasses formation and molasses loss, and gives better quality of clear juice, resulting in reduced fouling of evaporator, better sugar quality, etc.

Acknowledgement:

The author is grateful and wishes to sincerely thank Mr. D. C. Sawhney, Advisor, and Mr. D. M. Sawhney, President, Triveni Group, for sanctioning the trials and permission to publish this paper. They have been the chief source of inspiration towards making the trials successful. The author is equally grateful to Mr. G. M. S. Mann, Managing Director, Simbhaoli Sugar Mills, for permitting the trials at the factory and the encouragement received from him from time to time.

My sincere thanks are also due to the officers and all other staff of the two factories for their guidance, cooperation and active participation in the trials.

Summary

An account is given of successful trials on the filtration of sulphitation muds using a belt discharge filter whereby it became possible to obtain a clear filtrate which could be sent direct to the evaporators instead of being returned to the raw juice, while cake losses were reduced, good cake discharge characteristics were achieved, wash water was reduced, etc. Advantages resulting from adoption of the filter are discussed.

La filtration sous vide des boues de sulfitation — Un nouveau concept

On rapporte les essais, couronnés de succès, au sujet de la filtration des boues de sulfitation en utilisant un filtre à bande. On a pu obtenir un filtrat limpide qui pouvait être envoyé directement vers l'évaporation au lieu d'être recyclé vers le jus brut. On a eu de bonnes caractéristiques de décharge du tourteau. On a réduit le volume d'eau de lavage etc. On discute des avantages résultant de l'adoption du filtre.

Vakuum-Filtration von Sulfitationsschlämmen — Ein neues Konzept

Ein Bericht über die erfolgreichen Versuche der Filtration von Sulfitationsschlämmen mit einem Band-Ausräum-Filter, mit dem es möglich war, klares Filtrat zu erhalten, das direkt in die Verdampfstation geleitet werden kann, während die Schlammverluste verringert wurden, der Schlamm gute Charakteristika zeigte, Waschwasser reduziert wurde usw. Die Vorteile durch die Anwendung des Filters werden beschrieben.

Filtración al vacío de lodos de sulfitación — un nuevo concepto

Se presenta un examen de ensayos exitosos de la filtración de lodos de sulfitación con el uso de un filtro a descargamiento por cinta. Fué posible obtener un filtrado limpio que puede enviarse directamente al evaporador en lugar de una vuelta al jugo crudo. Pérdidas en la filtro-torta se reducieron, se obtuvieron buenas características de descarga, y agua de lavado se redució, etc. Beneficious que resultan de la adopción del filtro se discuten.

Brevities

Sweden beet sugar production, 1984/85[1]

In the 1984/85 campaign, the seven beet sugar factories of Sockerbolaget sliced a total of 2,533,603 tonnes of beet to produce 295,411 tonnes of white sugar and 69,396 tonnes of raw sugar, as well as 89,649 tonnes of molasses, 79,732 tonnes of molassed dried pulp and 79,224 tonnes of pulp pellets.

Iran cane area expansion[2]

Iran's sugar cane area in the southern Khuzestan province is to be extended from the current 29,128 hectares to 80,000 hectares over the next ten years, at a cost of 300,000 million rials. Over the same period, annual sugar consumption is expected to rise to 1.7 million tonnes, white value, from the present 1.2 million tonnes.

1 *Zuckerind.*, 1985, **110**, 254-255.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 290.

Talo clarification at Godchaux-Henderson

By J. A. Burt and C. A. Rousse
(Godchaux-Henderson Sugar Co. Inc., Reserve, LA, USA)

Introduction

As a result of erratic melt rates and excess white sugar recirculation, Godchaux-Henderson initiated an engineering study to determine the most feasible and economical solution to the problem. Management concluded that a lack of decolorization capacity was a major contributor. Several clarification and decolorization systems were evaluated, and a Talo clarification system was determined to be the most cost-effective way to replace an out-dated and undersized Williamson phosphatation station. This paper deals with Godchaux-Henderson's experience with the Talo clarification system and draws some comparisons with the Williamson process.

Former phosphatation system

A flow chart of the former clarification process is shown in Figure 1. The Williamson phosphatation station housed nineteen shallow-bed clarifiers, rectangular in shape, with the feed at one end and draw-off at the other end. Seventeen clarifiers had scum rollers that ran on a continuous basis, and two had paddles attached to a chain drive. The use of the steam chest was discontinued many years ago, and heating was accomplished with a heat exchanger prior to the clarifiers. Solids separation before defecation was achieved using

(1) an inclined vibrating screen (20×30 mesh),
(2) Type FR degritting Dorrclones designed to remove abrasive material and heavy solids,
(3) Dorr-Oliver 300° DSM screens, fitted with 100 micron, 316 stainless steel screen surfaces, and
(4) stainless steel Decker screens (80×80 mesh) with a variable speed drive.

Solids separation after defecation was by means of Decker screens (120×120 mesh) and sand filters containing a bed of coal and sand.

Remelt liquor was blended with a washed raw sugar liquor, and this stream was passed through a heat exchanger and aerated with an air eductor prior to the clarifiers. Acid and lime were added and mixed in the line between the heater and the clarifiers. Phosphoric acid was metered through a magnetic flowmeter and proportioned to the liquor stream by a ratio controller. Lime sucrate was added for pH control, and a flocculant added to the liquor before the clarifiers. A Sveen-Pedersen clarifier was used to sweeten-off scum from the Williamson clarifiers. Scums were diluted with sweet-water from the granular Rotoclones. Scum, sweet-water, high-pressure air, and a flocculant were all injected into the suction of a positive displacement pump and directed to the clarifier. Scum from this clarifier was sent to a Dorr-Oliver rotary vacuum filter that was precoated with a coarse filter aid. The filter muds from this system were hauled from the

The refinery has closed since this paper was presented to the 1984 meeting of Sugar Industry Technologists, but we believe that the technology reported remains valid.

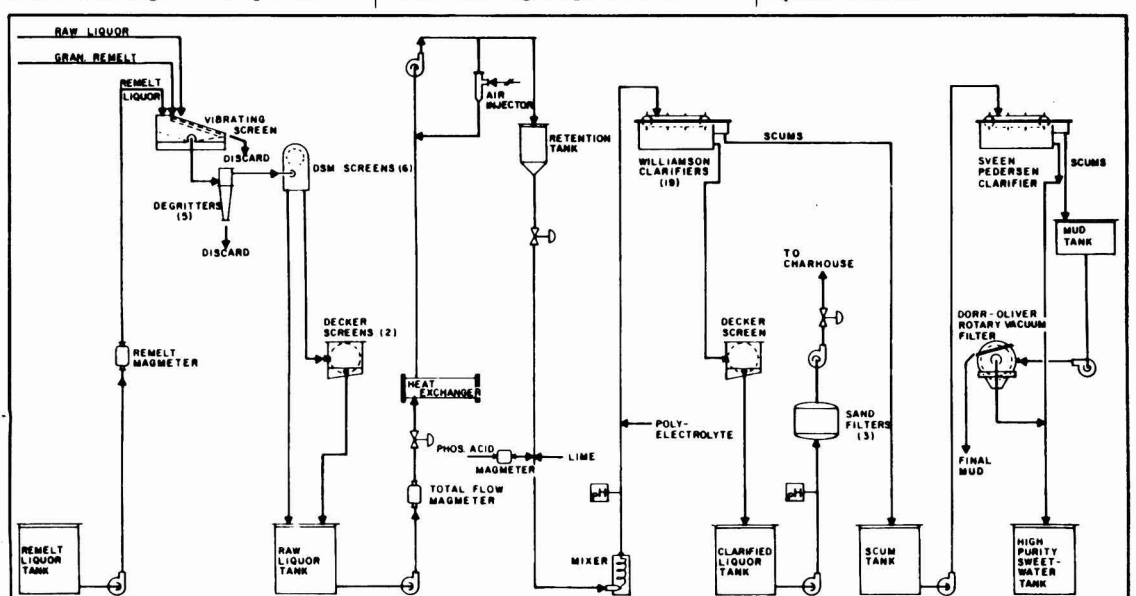


Fig. 1. Former clarification system at Godchaux-Henderson

plant site for disposal. Sweet-water from the clarifiers and rotary vacuum filter was used for melting. Filter aid, energy, maintenance, and labour costs to operate this system were obviously major determining factors in the decision to install the new Talo flotation system for sweetening-off scum.

The Williamson system was limited in its capacity to remove scum during periods of high flow and excess bagacillo in raw sugar. When these conditions occurred, phosphoric acid addition exceeding 150 ppm generated more scum than the sweetening-off system could accommodate. Although the Deckers and sand filters removed a significant amount of solids after defecation, the scum that carried over to the char house caused reduced flow and channelling during the sweetening-off process.

Talo system design and flow

A flow chart of the Talo system is shown in Figure 2. The system was designed and licensed by Tate & Lyle Process Technology and commissioned in March 1983. The new Talo clarification station was installed next to the affination station, and both are operated by the same person. It consists of two 45-tonnes washed raw sugar liquor clarifiers, one 20-tonnes remelt sugar liquor clarifier, and a three-stage scum sweetening-off system designed to treat the combined scums. A bulk lime bin was installed to replace the bag dumping station.

Liquor, scum, sweet-water, aeration, and chemical dosing pumps have spares. All pH controllers have spare electrodes on line so that it is easy to switch from one to another in case of failure or for necessary cleaning.

Liquor from the washed raw sugar melter is screened through a Link-Belt vibrating screen (20×30 mesh) to remove coarse solids that are sweetened-off prior to discard. The liquor is then strained through Baker screens (80×80 mesh) to remove bagacillo that is combined with the scum prior to sweetening-off. Flow continues to a buffer tank, through a heat exchanger, and into a reaction tank where lime sucrate, phosphoric acid, and Talofloc are added. A cut of liquor from the discharge of the clarifier is injected into a centrifugal pump, along with pressurized air, and sent to the aeration tank. Taloflote is added into the line after the aeration tank. The flow continues to the mixing chamber or flocculator in the centre of the circular clarifier. The scum floats to the surface and is removed by a revolving rake. The liquor is drawn from the bottom of the clarifier and flows over an adjustable weir. Remelt is clarified separately in a similar system. Screening after clarification consists of three Decker screens (120×120 mesh) on clarified raw sugar liquor, and one Decker screen (120×120 mesh) on

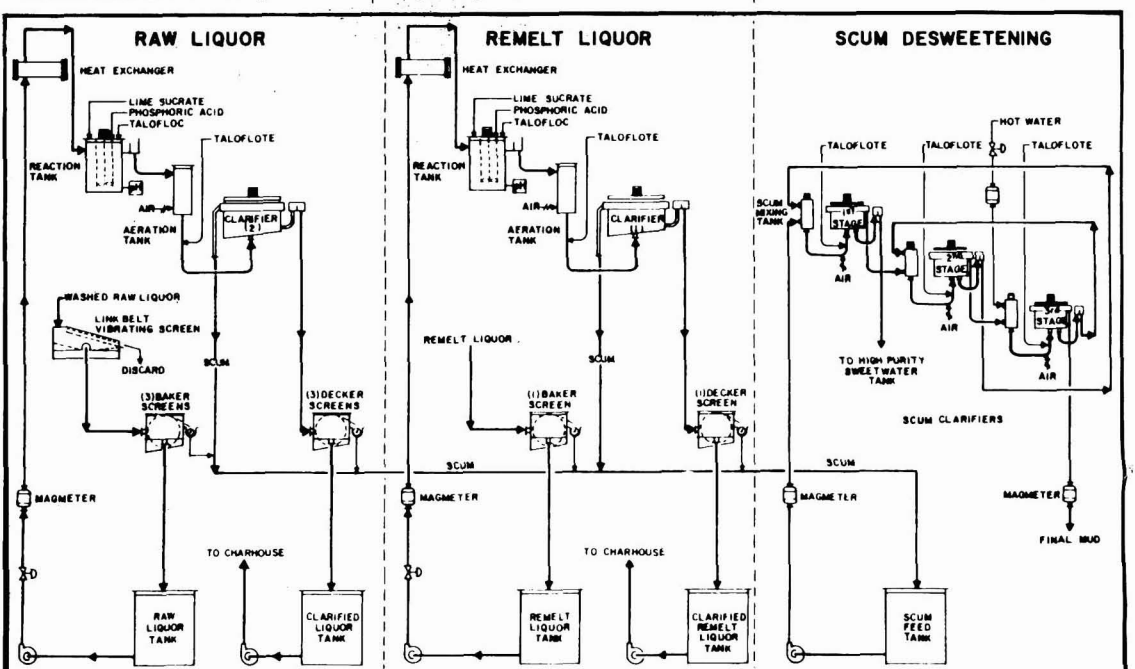


Fig. 2. Talo clarification at Godchaux-Henderson

ISJ Abstracts

Cane sugar manufacture

A trial to compare core sampling with the full width hatch method of cane sampling

M. A. Brokensha. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 9-14.

Whereas the core sampler described by Ashe[1] raises the barrel before discharging the sample, the model as used in recent trials discharges directly to a screw conveyor without first lifting the barrel, which allows the travelling carriage system to be located at four points instead of only two and contributes to greater stability and smoother operation. An account is given of trials which showed that sampling by this means (taking three cores per vehicle load) was of much poorer precision than full-width hatch sampling, and there was evidence of bias (although small) when extraneous matter was present. Moreover, the capital and operating costs of the core sampler are greater than for the other system.

The application of a horizontal vacuum belt filter to smuts dewatering and cane mud filtration

G. P. N. Kruger. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 34-38.

A Delkor pilot-scale horizontal vacuum belt filter (HBF) was used to dewater fly-ash slurry and to filter cane mud in trials at Maidstone factory. The filter comprises two endless belts, one running inside the other; the inner (transporter) belt is a heavy rubber one with raised ribs across its width, and the slurry is contained by raised curbs. The outer belt, of a suitable type of filter cloth, rests on the transporter belt during its horizontal run. The spaces between the filter cloth and the transporter belt created by the ribs form vacuum chambers which are evacuated through small holes in the centre of the transporter belt. The feed comes into contact with the belt just before the start of the vacuum region; filtrate is removed via a vacuum manifold running alongside the belt to a receiver whence it is pumped away, while the cake is discharged at the point where the filter cloth turns on the end roller. Water sprays just after this point help to prevent blinding of the cloth. The average total solids content of filtrate from a coal-bagasse mixture of 7.1% average solids content was 1.3%, and the average suspended solids content 0.3%; average vacuum was −75 kPa and belt speed was set at a maximum of 12 sec/m. When the boiler fuel was solely bagasse, the filtrate total solids content was 0.14% and the suspended solids 0.04% at an average feed solids of 8.3%, a belt speed of 12 sec/m and a vacuum averaging −78 kPa. Varying the belt speed had little effect on performance. Advantages over a multi-roller filter[2] include absence of the need for flocculant, lower belt replacement costs and possibly lower maintenance costs and higher reliability because it is mechanically simpler. When used for cane mud filtration, the HBF gave very low filtrate purities because of the presence of a large dead space below the filtrate pump offtake, although addition of biocide caused a sharp rise in purity. In any future work, the filtrate receiver would be designed with a conical bottom and a bottom offtake. There was no blinding of the cloth, and use of flocculant gave only marginal improvement. A drying cycle of 40 sec provided a cake of 20% solids that was acceptable. Comparison is made between the performances of the HBF and of a Dorr-Oliver rotary filter.

Mud conditioning for good filter operation

G. R. E. Lionnet. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 39-41.

See Anon: *I.S.J.*, 1985, **87**, 3A.

Exhaustion and colour investigations in *A*-massecuite

L. M. S. A. Jullienne. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 42-46.

Investigations showed a strong positive effect of *A*-massecuite Brix at discharge on exhaustion, which is at a maximum level when the massecuite is boiled to a tightness that gives the maximum tolerable boiling time. Generally, a unit increase in Brix at dropping yields the same crystallization results as 8°C of cooling in a crystallizer. Although the colour of the crystals from *A*-massecuite boiled from a *B*-sugar of relatively high colour improved considerably during the intermediate boiling stages, in the final boiling there was, in most cases, a 40-50% increase in colour; preliminary investigations suggested that this colour increase occurred during the Brixing-up period. The level of colour transfer during *A*-massecuite crystallization was found to vary widely within the same factory and between factories.

Preliminary results of a modified boiling system at Illovo factory

J. P. M. de Robillard and A. van Hengel. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 47-50.

The scheme proposed by van Hengel[3] was tested over a 4-week period at a time when, despite extensive use of sodium hydrosulphite, both colour and pol content of the VHP sugar were outside the set limits as a result of poor cane quality. Results showed a marked improvement, as a result of which the scheme was to be adopted for the following season.

An attempt to investigate changes of impurity concentration with the depth of crystal matrix of VHP sugar

Z. J. Kimmerling. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*,

1 *I.S.J.*, 1981, **83**, 54.
2 Goring: *I.S.J.*, 1983, **85**, 210.
3 *I.S.J.*, 1984, **86**, 149.

1984, 51-53.

Graded crystals of VHP sugar were treated under controlled conditions so as to achieve progressive dissolution of successive crystal layers; a portion of the treated crystals was measured and analysed at each stage. Results indicated that, to a large extent, dissolution took place in a regular manner, that the impurities were mostly present in the outermost portion of the crystal and that there was a minor but progressive improvement in pol and colour as the "peeling" action proceeded. Washing with methanol followed by affination prior to crystal layer removal are considered as possibly comparable to steam/water washing in the centrifugal, so that the results could provide a guide to the quality change at this stage in the manufacturing process.

Simple approach to raw sugar drying at Illovo

J. P. M. de Robillard, T. H. de Beer and K. Taylor. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 61-63.

The cooling/drying plant at Illovo consists of two vertical units operating in parallel and fed at the top by a dual screw conveyor system; the sugar cascades downwards and is spread outwards by rotating baffles, fixed cones increasing the sugar-air contact time by preventing the sugar from falling straight down. The upward current of air flows at a rate that is controlled by a damper arrangement in the ducting of the exhaust fan inlet. At an hourly sugar throughput of approx. 22 tonnes and air flow velocity of 0.6 m/sec, the moisture content was reduced from an average of 0.327 to 0.099% and the temperature decreased from 55.7° to 32.9°C. However, while the plant is cost-effective and simple to operate, it is somewhat limited in the quality and type of sugar it can handle, and requirements for its efficient operation are listed.

Investigations of undetermined losses at Pongola

B. S. Purchase, R. L. Blunt and J. C. Chasteau de Balyon. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 78-85.

See Anon: *I.S.J.*, 1985, **87**, 3A.

A comparison of the microbiological activity associated with milling and cane diffusion

L. M. Mackrory, J. S. Cazalet and I. A. Smith. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 86-89.

Investigations of microbial activity showed that this was considerable in mill juices (characterized by low temperatures) but low in diffuser juices (typically of high temperatures). Mesophiles predominated in the mill juices and produced significant quantities of lactic acid, acetic acid and ethanol, a ratio of 8 parts sucrose lost to 1 part lactic acid formed being estimated, in contrast to the ratio of 2:1 established for thermophilic activity in high-temperature systems. The reduction in the lactic acid content of diffuser juices is associated with increase in diffusion temperatures over the last 10 years.

Entrainment from pans and from intermediate evaporator vessels

G. R. E. Lionnet. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 90-92.

See Anon: *I.S.J.*, 1985, **87**, 3A.

Bagasse avalanche screws at Amatikulu

J. R. Jackson. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 93-95.

The advantages and disadvantages of screw conveyors installed to prevent avalanches when too much bagasse is being reclaimed from the top of a relatively high storage pile are discussed and their installation and operation described. The screws are suspended, one on each side of the bagasse crane, and move with the crane as it traverses the shed. They continually sweep the face of the pile and maintain an angle to the face which is marginally less than the angle of repose of the bagasse; the effect is a slippery face down which material from the top of the pile can cascade to the reclamation conveyor. Since installation of the screws there have been no avalanches, bagasse feed is steady and maintenance is minimal. However, the screws cannot cope with excessive feed, they add weight to the crane, need maintaining and cause a small reduction in capacity of the storehouse.

Swinging bagasse ploughs

D. J. Carliell. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 96-97.

Chain slat conveyors conventionally used to feed bagasse to boilers in South Africa are generally noisy and require much maintenance, and it was decided to install a rubber belt conveyor (of lower capital and maintenance costs) at Mount Edgecombe. The system proved to be better than a slat conveyor, but pivoting stern rudder-type ploughs had to be installed to direct the bagasse to the chutes at the side of the conveyor. Details are given of experimental work with bagasse ploughs, and precautions to be observed in their installation are listed, including the need for the motor driving the conveyor belt to be 40% more powerful than normally.

Modifications and innovations to reduce sugar spillage substantially and optimize conveyor loading at the sugar terminal

C. E. Gordon. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984,

98-101.

Work carried out at the Durban sugar terminal since 1982 in order to reduce sugar spillage by a substantial amount is described. There are four types of spillage described: that over the sides of the conveyor belts, that due to carry-over on the return belt, spillage from sugar that accumulates in the hoppers and on skirt boards, etc. and spillage related to dusty sugar. Modifications to plant have resulted in a dramatic reduction in spillage to levels that may be considered negligible; they have also led to considerable savings in labour and to optimization of conveyor loading whereby the ship-loading rate will be increased, it is expected, from 800 to 1000 tonnes/hr at the existing belt speeds.

The selection of a novel crystallizer drive

M. S. Greenfield. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 102-106.

Details are given of the Oilpower HM 275 hydraulic motor, with seven double-acting cylinders and of 22 kW power rating, two of which were installed at Maidstone factory as drives for two vertical crystallizers. The speed range is 0-1.2 rpm and maximum design torque 275,000 Nm. Overall outside diameter is 3.6 m.

Development of a microprocessor-based controller

J. F. Keen. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 107-110.

See Anon: *I.S.J.*, 1985, **87**, 5A.

Control of maximum demand using a microprocessor system

R. A. H. Chilvers. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 111-115.

With the rising cost of electricity, there is every incentive to reduce the maximum demand charges in a sugar factory. Three ways in which this can be done are briefly considered: power factor correction, more even distribution of loads, and load shedding. At Mount Edgecombe, there is no power factor correction equipment; while equipment was available for maximum demand control (load shedding), it was thought that a microprocessor system with terminal and printer would meet the requirements by providing extra information on turbines and the loads drawn by each of the power station breakers. Details are given of the system developed, in which the microprocessor calculates the kVA and kW values approx. every minute from reset pulses and displays these on the VDU for the power station attendant or shift electrician. Every half hour, at the end of each metering period (after a reset has occurred), the kVA, kW and power factor values recorded during that period are printed together with a simple graph comparing the actual kVA with the set-point. The system decides when load must be shed and when it is safe to switch the load back in; the strategy used for this is explained. The system has worked well; the monthly deviation between the maximum demand set-points and the actual maximum is usually less than 2%. There has been a marked improvement in power utilization, and a greater awareness of where and when to use power has been created.

A mechanized vibrator system for discharging FCD bottom-dump rail trucks at the sugar terminal in Durban

B. C. E. Gordon. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 116-119.

The design and development of a hydraulically-operated clamping device, incorporating an electrically-driven rotary vibrator, for raw sugar discharge from FCD bottom-discharge rail trucks are described. The trucks (of 50 tonnes capacity) are designed primarily for bulk raw sugar transportation, for which they have been successful; however, considerable difficulty has often been experienced as a consequence of sugar sticking to the sides of the hoppers. Tests have indicated that the vibratory arrangement described would be more suitable than a manually-operated system of pneumatic hammers hitherto used in the trucks and found to be unsatisfactory.

Dewatering of cane diffuser bagasse using a spike-tooth pressure feeder

C. P. van Breda. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 120-122.

At Amatikulu, the bagasse from the diffuser is dewatered by three sets of mills; one consists of two conventional 4-roller mills in series while the other two are equipped with pressure feeders: a conventional 2-roller feeder with grooved rollers, and a 2-roller spike-tooth feeder. An overhead slat conveyor feeds all three dewatering units; the mill fed by the spike-tooth feeder handles 40% more than either of the other two (calculated on the basis of the escribed volumes of the mills), but only because it is not possible to reduce the feeder throughput. Comparative data for 1983/84 showed that it reduced bagasse moisture to an average of 52.9% compared with 53.4% for the unit with the grooved-roller feeder and 54.3% for the two-mill unit. At the same time, the power requirement for the spike-tooth feeder was lower, and wear on the feeder and mill was reduced because of decreased slippage (which also contributed to the lower power consumption) and less damage caused by tramp iron (because of the greater clearances between the teeth).

Operating experience on single- and three-pass boilers in the cane sugar industry with

particular reference to erosion and drum water level stability

N. Magasiner, D. P. Naudé and P. J. McIntyre. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 123-129.

Two major developments in boiler design that took place in the 1970's that are of interest for the sugar industry are discussed, viz. the single-pass panel wall unit and the three-pass, bottom-supported boiler with an open-pitch furnace tube construction, as installed at Tongaat (where tube bank erosion by sand is expected to be reduced by comparison with previous designs). The modern design is also aimed at improving water level stability. The effect of fuel properties on boiler performance is considered, and determination of dust loads as a function of grate heat release rate and fuel ash content at the furnace and main bank exits is described. The mechanical design features of the two boiler designs are compared.

Experiences with an emergency spray cooling pond

A. H. Winterbach. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 130-132.

Cooling water for the condensers at Malelane sugar factory is normally derived from a cooling tower at an hourly rate of 1320 m^3 and from the local river at 2731 m^3/hr. However, by the start of 1983 the severe drought had caused a serious fall in the level of the river; by March there had still been no rain, and it was feared that crushing would not be possible. The problem was solved by building a spray cooling pond rated to handle a water flow of 2079 m^3/hr and reducing the crushing rate from 325 to 280 tch. The system was completed by the start of the crushing season and allowed operations to continue throughout the year. Some problems were caused by spray nozzle blockages by foreign objects and by reduced pump efficiency as a result of the presence of algae. Savings were made in electric power because no water was pumped from the river.

Improved sugar factory efficiency — suggestions

H. J. Delavier. *Gula Indonesia*, 1984, **10**, 975-981.

Suggested measures for improving processing efficiency are listed and a number discussed, including cane payment on the basis of recoverable sugar, cane cleaning, the use of diffusion and microbiological control.

The presence of yeasts in Sudanese cane sugar factories

G. Bärwald and S. H. Hanad. *Zuckerind.*, 1984, **109**, 1014-1017.

Samples of cane, juice (from various process stations), bagasse, filter cake, molasses and waste water from Assalaya and Kenana sugar factories were analysed for their yeasts. Of the 38 isolates studied, 12 were identified as: *Kluyveromyces marxianus, Issatchenkia orientalis* and its asexual state, *Candida krusei, C. tropicalis, Saccharomyces cerevisiae, Clavispora lusitaniae, Hansenula polymorpha, H. anomala, Rhodotorula glutinis, Cryptococcus albidus* and *Torulaspora delbrueckii. K. marxianus*, seven strains of which were isolated, was found in almost all samples. Almost all of the yeasts found assimilate sucrose and most (particularly *K. marxianus* and *C. tropicalis*) also ferment it. *K. marxianus* survived exposure to 55°C for 20 minutes; *H. polymorpha* is also heat-tolerant but was not widespread. The significance of the findings for sugar recovery (which is low in Sudan) is discussed.

Standard specifications — need for review

D. P. Kulkarni. *Maharashtra Sugar*, 1984, **9**, (12), 13, 15, 17.

The author calls for revision of the standard specifications for sugar factory plant in India and makes some recommendations on modern equipment, including means of saving energy and producing surplus power for the public grid.

Better steam economy and energy conservation in the sugar industry

K. N. Shukla, R. C. Rathi, M. R. Jamkhandikar, A. R. Bhide and B. R. Math. *Maharashtra Sugar*, 1984, **9**, (12), 29-31.

Measures for reducing steam consumption are briefly discussed, including decreasing bagasse moisture (by better cane preparation and use of efficient imbibition), increasing the evaporator heating surface, and installing continuous vertical crystallizers and continuous *B*- and *C*-centrifugals.

Continuous centrifugal performance

Anon. *Ann. Rpt. Bureau Sugar Expt. Stations* (Queensland), 1984, 31-32.

Investigation of the effect of massecuite feed temperature on continuous centrifugal performance showed that the extent of reheating can strongly affect losses in massecuite separation. Whereas raising the temperature from 39° to 75°C resulted in a total purity rise of 7.2 units across both heater and centrifugal, heating to 65°C reduced this purity rise to 3.2 units; moreover, machine capacity obtainable at a given purging efficiency also fell with rise in temperature. Whatever the reasons for such unexpected results, the findings indicate the need for a more cautious approach to the question of massecuite reheating; where improved feedability is required so as to obtain effective separation, there may be some advantage in using molasses dilution to supplement reheating.

Low-grade centrifugal screens

Anon. *Ann. Rpt Bureau Sugar Expt. Stations* (Queensland), 1984, 32.

See Greig *et al.: I.S.J.*, 1985, **87**, 35A.

Beet sugar manufacture

Factors governing thin juice alkalinity and the degree of fall in alkalinity. Methods of stabilizing alkalinity

V. Gryllus. *Cukoripar,* 1984, **37,** 22-25, 62-65, 98-107 (*Hungrian*).

A detailed examination is made of the role played by pH in sugar manufacture (including the need to maintain it at optimum levels so as to minimize sucrose hydrolysis and corrosion) and of the relationship between pH and alkalinity. Methods of maintaining a level of alkalinity corresponding to optimum pH are discussed, including addition of soda and/or milk-of-lime and anion exchange with or without milk-of-lime addition and with or without NH_4^+ removal. Comparison is made in terms of thin and thick juice pH, molasses sugar % beet and white sugar unit production costs. Tabulated data demonstrate the benefits of anion exchange in reducing molasses sugar and production costs.

The effect of juice aeration during the main liming process on the quality of the purified juice

B. Wnuk and H. Zaorska. *Gaz. Cukr.,* 1984, **92,** 73-77 (*Polish*).

Laboratory-scale tests were conducted on liming of prelimed juice at 85°C for 10 minutes during which air was injected at a volumetric rate in the range 0.5-1.5 dm^3 per dm^3 juice. By comparison with the control, aeration reduced thin juice colour and invert sugar contents, the best results being given by 1 dm^3 air/dm^3 juice (30.3-35.2% reduction in invert and 19.2-31.8% reduction in colour, depending on raw juice purity and invert content). Aeration also reduced thin juice total N and amino-N contents, but caused increase in volatile acids and lime salts.

Evaluation of the effects of mass flow coordination using a computer

P. Slugocki. *Gaz. Cukr.,* 1984, **92,** 80-82 (*Polish*).

Automatic coordination of juice flow at the beet end of Chelmza sugar factory (up to and including the evaporator), using a minicomputer as control means, coupled with closed-circuit television and telephone communication between process stations, has proved of benefit in reducing sugar losses. Input, in the form of analogue signals, included the amount of cossettes fed to the two diffusers, quantity of juice entering each station, milk-of-lime density, carbonatation gas pressure and the pressure and temperature of steam fed to the evaporator.

Beet protection in heaps by plastic sheets

R. Vanstallen and J. P. Vandergeten. *Proc. 47th Winter Congr. Inst. Intern. Recherches Betterav.,* 1984, 69-78; through *S.I.A.,* 1984, **46,** Abs. 84-1148.

The evolution of temperature and the sugar loss in beet piles covered with plastic sheeting or not covered were studied during three campaigns. The greatest sugar losses were caused by frost. Losses in the covered and non-covered piles did not in general differ significantly. Under conditions in Belgium, a polyethylene sheet gave sufficient protection against frost. On account of frost risks, systematic covering of beet piles was essential from December 1 onwards. The various kinds of polyethylene sheeting hardly differed at all in efficiency.

Pulp pressing aids: $CaSO_4$

W. Scheda, P. Avanzi, G. Vaccari and I. Velentza. *Ind. Sacc. Ital.,* 1984, **77,** 105-111 (*Italian*).

Details are given of a plant set up at Comacchio sugar factory for production from 20°Bé milk-of-lime and 96% sulphuric acid of $CaSO_4$ to be added to the diffusion water as a means of increasing the pulp pressing properties and thus conserving energy. Experiments in 1982 showed that addition of 500 g $CaSO_4$ per tonne of beet, with a water pH of 7.0-7.2, increased the pulp solids by 1.8 units, while additional acidification to give a pH of 5.7-6.0 increased it by 3.6 units. In 1983, acidification to pH 5.7-6.0 alone caused a 2.6 units increase in pulp solids (21.04% compared with 18.41% without treatment), while acidification combined with $CaSO_4$ addition at the rate of 430 g/tonne of beet gave a total increase of 4.4 units (to 22.81%). The treatment caused a slight increase in Na^+ and K^+ in the raw juice, as well as an increase in SO_4^{--} in both raw juice and molasses (some of these anions being precipitated during juice purification, the effect being greater with higher concentration of the ions). Possible precipitation of $CaSO_4$ during evaporation is also mentioned.

Classification of frost damage and protection of frozen beet before processing at the factory

J. Malec. *Proc. 47th Winter Congr. Inst. Intern. Recherches Betterav.,* 1984, 79-84; through *S.I.A.,* 1984, **46,** Abs. 84-1149.

The frosts which occur in Poland from mid-October onwards cause serious damage to beet. Tests are described in which beet was frozen at -10°C and then stored for 10 days in small piles at ambient temperature (+8°C) or kept for six days in chambers at +1°C. The effects on beet composition and conductivity are tabulated. Seven fungio- and bacteriostatic preparations were tested for their protective effects; the most effective was Sanspor, which decreased sugar losses to 28% of those in untreated beet.

The effect of frost on the root and sugar yield of sugar beets defoliated or topped before harvest

A. Siray. *Proc. 47th Winter Congr. Inst. Intern. Recherches Betterav.,* 1984, 85-98; through *S.I.A.,* 1984, **46,** Abs. 84-1150.

In Turkey, some growers allow their beet to be defoliated by grazing animals, while the beet is still growing in the field, starting at the beginning of the campaign. Tests were carried out to find the effects of this practice and of subsequent frost on the yield (tonnes/ha) and sugar content of the beet. Tabulated data show that, depending on when defoliation was started and how long it continued, the yield by weight decreased by 0.1-14.7% and the sugar yield by 3.6-37.4% for beet not affected by frost; the corresponding figures for frost-affected beet were 0.3-19.2% and 5.2-43.2%, respectively.

What is quality? Quality factors affected by mechanization

P. Devillers. *Sucr. Franç.*, 1984, **125**, 407-426 *(French)*.

The question of beet quality and agronomic factors affecting it (including those having adverse effect on beet storage properties) are discussed, covering topping, injuries and extraneous matter. Tabulated data and graphs demonstrate the various points made.

Sucrose degradation in beet diffusers

N. A. Tveritina, A. I. Fel'dman, A. A. Lipets and A. Ya. Romanyuk. *Izv. Vuzov, Pishch. Tekh.*, 1984, (4), 114-116 *(Russian)*.

The influences of the catalytic effects of H^+ and OH^- ions and of temperature on sucrose degradation as well as of longitudinal mixing of juice and cossettes were investigated and results tabulated showing unknown losses, losses from degradation to acids and those from inversion under various experimental conditions. The amount of sucrose degraded in each of the five zones of a diffuser as well as in the complete diffusion process was also determined for each set of experiments. Since the amount of sucrose lost as a result of acid catalysis was immeasurably smaller than unknown losses, it is considered that this factor may be ignored in assessment of diffusion performance. Equally, the effect of mixing was found to be negligible, and fermentation is therefore regarded as playing the major role in sucrose degradation.

Sugar cooling in fluidized bed units equipped with plate heat exchangers

R. Glaser, M. Styczynska and Z. Styczynski. *Zuckerind.*, 1984, **109**, 913-915 *(German)*.

Investigations were conducted on sugar cooling in the experimental unit described earlier[1] in which the sugar passed through a system of heat exchange plates and intercepted a vertical air stream (of 10-25°C) flowing at right angles to it. The results, which are given in the form of equations for calculation of the heat transfer coefficient of the fluidized bed relative to the surface area of the heat exchange plates, showed that reducing the space between the plates by increasing their number adversely affected performance.

Heat transfer in an evaporator tube

A. Baloh. *Zuckerind.*, 1984, **109**, 916-921 *(German)*.

The value of knowledge of heat transfer coefficients and of the loads on the heating surface in an evaporator tube for an understanding of the processes taking place in evaporation is discussed, and heat transfer in climbing- and falling-film evaporators is analysed. Calculation of the various parameters is shown to allow assessment of changes in operating conditions as well as in tube materials.

Improvement in the operational conditions of the boiling house at Chishmy sugar factory

A. A. Slavyanskii, A. R. Sapronov, A. P. Lobanova, V. A. Pugachev, V. I. Strel'nikov and Z. K. Kholkina. *Sakhar. Prom.*, 1984, (10), 22-25 *(Russian)*.

The unsatisfactory performance of the boiling house at Chishmy after some changes had been introduced (including elimination of low-grade sugar affination and the need to increase massecuite mobility) led to the introduction of a number of remedial measures whereby, under optimum conditions (including a syrup purity no lower than 88), sugar yield was raised and molasses yield and steam consumption reduced. Details are given of the modified boiling house scheme, and a nomogram is presented for calculation of run-off quantities.

Supplementary treatment of thick juice with magnesium oxide

L. G. Kalinenko and M. I. Barabanov. *Sakhar. Prom.*, 1984, (10), 25-27 *(Russian)*.

Tests are reported on supplementary treatment of thick juice-remelt liquor mixture with 1.2% MgO, which reduced colour by 40-50% and degraded 15-50% of the reducing matter; pH_{20} rose by 2.1-2.7 units, but was brought back to optimum for thermal stability (7.5-8.0) by subsequent sulphitation, which also resulted in further reductions in colour and reducing matter. A change in the non-sugars composition and hence in melassigenesis as a result of the MgO treatment was confirmed by treatment of diluted molasses with MgO, which reduced the standard purity at 82% solids by 1.6-1.9 units.

More precise definition of preliming conditions

V. A. Golybin, E. P. Filina, Yu. N. Kazakov and A. R. Sapronov. *Sakhar. Prom.*, 1984, (10), 29-31 *(Russian)*.

In progressive preliming of juice from low-quality beet, increasing the

1 Glaser & Styczynska: *I.S.J.*, 1983, **85**, 376.

retention time by up to 100% in the earlier compartments (where alkalinity was low) and reducing that in the later compartments (of high juice alkalinity) raised the degree of coagulation and settling of high-M.W. matter and colloids, and decreased peptization; the recommended conditions are a retention of 10-12 minutes at 60°C and of 5-6 minutes at 80°C. Recycling of 30% 1st carbonatation juice or 1st or 2nd carbonatation mud increased the settling rate and reduced the volume of mud; increasing the recycle to 50% on juice gave a further reduction in mud volume but also decreased the initial settling rate, while further increases in recycle volume caused reduction in both settling rate and mud volume.

The Anamet biological treatment of waste water

K. Duffek and M. Svejka. *Listy Cukr.*, 1984, **100**, 230-235 *(Czech).*

An illustrated account is given of the Anamet effluent treatment system as used at Örtofta and Jordberga sugar factories in Sweden.

Economic aspects of thick juice storage

R. Schick. *Listy Cukr.*, 1984, **100**, 235-238 *(Czech).*

In a discussion of the economics of thick juice storage under East German conditions, it is pointed out that, in a country such as East Germany where the average daily beet slicing capacity of the sugar factories has not risen above some 1000 tonnes in contrast to the situation in a number of other European countries, the system is financially more attractive than expansion of factories. However, it is pointed out that, while the fixed costs of thick juice storage are low, labour costs rise as does energy consumption.

Modernization of the raw juice purification scheme at Piepaja sugar factory

L. I. Pankin *et al. Sakhar. Prom.*, 1984, (11), 19-22 *(Russian).*

Although the scheme used at Piepaja until 1980 was difficult to operate and filtration was slow, batch 1st carbonatation gave a high-quality juice with only moderate lime consumption; 2nd carbonatation was continuous. For similar results to be achieved using continuous 1st carbonatation, it was necessary to ensure that the $CaCO_3$ had the same high adsorptive capacity; a compartmented carbonatation vessel was therefore recommended, and no carbonatation juice or mud was to be recycled to preliming. Details are given of the modified scheme which has given 1st and 2nd carbonatation juices of lower colour than with the previous scheme, while the lime salts content in 2nd carbonatation juice was reduced; lime consumption was lower and CO_2 utilization efficiency very much higher.

Over-saturation treatment of predefecation juice

M. I. Daishev, R. S. Reshetova and Yu. I. Molotilin. *Sakhar. Prom.*, 1984, (11), 22-23 *(Russian).*

While pre-carbonatation of raw juice has some merits and is considered preferable to recycling of 1st carbonatation juice to liming, it cannot be carried out in a normal screen-type carbonatation vessel because of the low alkalinity of the juice to be treated and because of the low CO_2 utilization efficiency, while gassing to 2nd carbonatation alkalinity causes a marked fall in juice quality. Experimental over-saturation was carried out, in which raw juice was prelimed with 0.3% CaO and then split into two fractions; one was gassed to pH 9.5 at which it was held with continued gassing and gradual addition of lime to a total of 0.5%, heated, limed with 1.7% CaO, gassed to pH 10.8, filtered, the filtrate treated by 2nd carbonatation and filtered. The other fraction was gassed (over-saturated) to 0.03% CaO (pH 7.3), heated, limed with 2.2% CaO, and then treated similarly to the first fraction. Results showed that over-saturation gave faster 1st carbonatation juice settling, lower mud volume, better filtration and superior 2nd carbonatation juice (higher purity and Brix). Use of a rapid counter-current, cascade-type carbonatation vessel gave a CO_2 utilization efficiency of at least 90% provided the juice to be treated had a temperature no lower than 70°C and its pH after treatment was 7.8-8.4 (at a prelimed juice pH of 10.6-11.0).

The accumulation of colouring matter in the sugar manufacturing process

K. Hangyál and L. Parádi. *Zuckerind.*, 1984, **109**, 1009-1014 *(German).*

See *I.S.J.*, 1985, **87**, 8A.

Dextran removal from factory juices during preliming

S. Wawro and J. Dobrzycki. *Gaz. Cukr.*, 1984, **92**, 124-125 *(Polish).*

Comparison was made between various methods of reducing the dextran content in a 10% aqueous sugar solution to which dextran had been added and in raw juice. With both the model solution and the juice, progressive preliming had no effect whatsoever, while a suspension of lime in sugar solution also had nil effect with the model solution and reduced the dextran content by only 5% and 12% in the case of the juice (at a sugar concentration of 1-3% and 4-5% in the lime solution, respectively). A lime-sucrocarbonate complex removed 22-39% and 22-55% of the dextran from the model solution and juice, respectively. Best results were given by simultaneous liming and gassing (67-90% and up to 55% dextran removal from the model solution and juice, respectively). Conventional purification (liming plus carbonatation) removed 30% of the dextran from raw juice, while pre-carbonatation removed 20% (neither method was tested on the model solution).

Sugar refining

Effect of agitation on the filtration of affined sugar liquors

J. L. Díaz R. and A. Cerceño M. *Centro Azúcar,* 1983, **10,** (2), 49-56 *(Spanish).*

Affined sugar was dissolved to 58°Bx, sufficient 0.795M phosphoric acid added to give a P_2O_5 equivalent content of 0.05% and milk-of-lime added to bring the pH to 7.0-7.2 using agitation with a stirrer at either 350 or 830 rpm. The treated solution was heated to 85°C for 30-40 minutes with stirring at one or other of the same speeds, a small amount of filter aid added and the liquor filtered through a precoated Buchner funnel with a jacket to maintain the temperature at 85°C. The volume of filtrate was measured at intervals to determine the filtration rate. Stirring was found not to be a determinant factor in either the chemical treatment or clarification stages; however, there was a tendency for the higher stirrer speed during clarification to improve filtration.

Effect of syrup clarification by flotation on sugar refinability and sugar recovery

T. Moritsugu and B. J. Somera. *Ann. Rpt. Expt. Sta. Hawaiian Sugar Planters' Assoc.,* 1983, 64-65.

Evaluation of results obtained by syrup clarification by flotation during two weeks of investigations at Haina sugar factory showed no statistically significant differences at the 95% confidence level between test and control samples in terms of raw and refined sugar quality and final molasses analyses.

Sugar refinery in Sweden installs turbine-driven heat pump

G. Akesson and R. Gunnarsson. *Sugar y Azúcar,* 1984, **79,** (8), 23-24.

Details are given of a system for utilizing waste heat at Arlöv refinery for district heating of the suburb of Malmö where it is located and for internal heating of the refinery itself. A high-speed axial steam turbine drives a two-stage radial turbo-compressor which raises the pressure of low-pressure evaporator bleed vapour to a level at which it can be condensed to provide hot water at up to 120°C. An alternator between the turbine and compressor produces electricity which can be used to meet the additional requirements of the refinery and help raise the temperature of the condensate. Teething problems (now overcome) in the refrigerating section of the heat pump are mentioned.

The theory and practice of *adsorption of non-sugars in* refinery syrups and run-offs on the surface of carbonatation mud

A. A. Lipets and L. K. Telichuk. *Sakhar. Prom.,* 1984, (10), 27-29 *(Russian).*

Treatment of refined sugar syrups and green syrup with carbonatation mud reduced the colour by 38-44% and caused a slight rise in purity. These results point to the possibility of using spent calcium carbonate instead of active carbon as adsorbent and thus improving on the economics as well as reducing the need for disposal of the mud at sugar factories. A hypothetical explanation for the action of the mud is given.

A graphical method for calculation of a boiling house scheme. IV. A factory with complete reboiling of thick juice

V. Valter, F. Gerza and J. Gebler. *Listy Cukr.,* 1984, **100,** 217–225 *(Czech).*

Use of a vector diagram method for calculation of the required mass balances in a boiling house scheme is demonstrated in the case of a beet sugar factory of 4200 tonnes/day beet slice manufacturing two grades of refined sugar as well as liquid sugar and where no raw sugar from other sugar factories is processed. Two variants of a boiling scheme are calculated.

Practical observations on the use of phosphoric acid and activated carbon as an aid to colour removal in refining

G. Jones. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.,* 1984, 54-55.

Raw sugar is manufactured at Malelane by the conventional hot liming method followed by a 3-boiling scheme using *B*-magma as footing for *A*-massecuite. *A*-sugar manufacture is entirely colour-orientated since all of the sugar is refined, for which a 4-boiling system is used, with sugars from all the strikes blended at the centrifugal station to give a final product. The process ensures that a reasonably consistent colour removal can be achieved despite considerable variation in colour input. However, when the colour of the *A*-melt exceeds a certain value, the sugar from the 4th strike probably has to be rejected because of excessive colour, resulting in a loss in recovery and reduced thermal efficiency. With abnormal operating conditions in 1983/84, an attempt was made to increase colour removal in both the raw house and the refinery so as to maintain an acceptable colour of the final refined sugar. The addition of phosphoric acid to the mixed juice to maintain a P_2O_5 level of 300-320 ppm failed to improve the colour, but did give a mud that settled better in the clarifier and was easier to handle at the filter station, resulting in a significant fall in filter cake pol. Powdered active carbon proved successful in increasing colour removal by carbonatation and could be used where there was a short-term increase in *A*-melt colour, but the amount added (up to 0.5% on Brix) was too high to be economically viable over a long period, so that the degree of remelting becomes an important factor.

Laboratory studies

Factors affecting white sugar colour

M. Shore, N. W. Broughton, J. V. Dutton and A. Sissons. *Sugar Tech. Rev.*, 1984, **12**, 1-99.

The literature (89 references) on colour in juices, syrups, intermediate sugars and white sugar and on changes in white sugar colour during storage is reviewed, the majority of the work being concerned with the separation and characterization of colorants on the basis of their molecular size and optical absorbance. One of the chief methods used was gel permeation chromatography (GPC) on Sephadex G-25, which permits separation of molecules having a M.W. up to 5000. Differences in M.W. are shown between melanoidin and caramel-type colorants; colorants from juices and beet sugars are separable into materials of low M.W. (<100), medium M.W. (100-1000) and high M.W. (1000-5000). Colorants on the surface of white sugar crystals were of much lower M.W. than those inside the crystals; comparison of GPC profiles of the various colorant fractions showed that the colorants on the crystal surface resembled standard liquor while those inside the crystal resembled molasses. In beet sugar manufacture, high-M.W. colorants were tentatively related to melanoidins, while those of medium-to-low M.W. were classed as sugar degradation products (collectively termed "caramels"). Colour was found to be evenly distributed throughout most of the white sugar crystal; 25% of it could be removed by dissolving 20% of the crystal, after which there was no further reduction in colour. Since this applied to both high- and low-colour white sugar, the "extra" colour in a high-colour sugar is not all on the outside of the crystal. Colour distribution in raw and low-grade sugars was markedly different to that in white sugar; 85% of the colour could be removed by dissolving 30% of the crystal. Sugar boiled from syrups containing synthetic melanoidins or factory juice colorants in the laboratory gave results consistent with those achieved under factory conditions, while results with added sugar degradation products differed from those in the factory. A method has been developed for determining a factory colour balance; it permits calculation of the respective contributions to juice colour of colour-forming reactions and of mixing process liquors with sugars. Much colour is returned to process with remelt sugars and wash syrups. HPLC revealed polyphenols only in raw juice, indicating the unlikelihood of these precursors later in the manufacturing process. The polyphenol contents of juices in the UK differed from those in Denmark and Ireland. Treatment of raw juice with SO_2, hydrogen peroxide and oxygen reduced the colour content, whereas use of formalin as diffuser disinfectant gave purified juices of higher colour, so that new techniques using less formalin more effectively are being evaluated. The colour of stored white sugar increased significantly at temperatures above 30°C; exposure of sugar to 50°C over a period of 200 days doubled the colour content, this increase being uniformly distributed throughout the crystal. The presence of SO_2 at 30 ppm effectively inhibited the colour increase. Recommendations are made on preventive methods for improving beet white sugar colour.

Reducing the moisture in crystal sugar

P. Betak, O. Mikus and L. Kristufkova. *Listy Cukr.*, 1984, **100**, 225-230 (*Czech*).

Comparison was made between Karl Fischer titration, GC, drying at a constant 105°C and protracted drying in a desiccator. The effect of relative humidity to which the sugar was exposed before moisture determination was also investigated. The results showed that at R.H. values of <70%, the chemical methods gave values of an order higher than those given by the gravimetric methods. While it had previously been concluded that the difference was due to the fact that chemical methods determined the moisture within the crystal as well as on the surface (in contrast to the other methods), the authors of the present article attribute the differences to the behaviour of the crystal surface during drying, which is incomplete with the chemical methods. Of the methods examined, Karl Fischer titration was considered the most suitable; the gravimetric method based on multi-stage drying is not suitable for direct analysis, but could be of value in the design of drying equipment and silos. A suggested mechanism of sugar drying based on the phase law is described. From this it is concluded that intensive drying is not a suitable means of reducing the moisture content; more advisable is a 3-stage relatively slow method with warm air as the drying medium, whereby the layer of moisture on the surface gradually falls until there is no risk of agglomeration, or a one-stage system designed to reach a stage where the crystal surface moisture is at a constant ratio to the total moisture content.

Computerization of the laboratory at the Illovo mill

K. Taylor. *Proc. 58th Ann. Congr. S. African Sugar Tech. Assoc.*, 1984, 68-73.

Details are given of the hardware and software used in the computerized system in the factory laboratory at Illovo, typical print-outs are reproduced and potential benefits of the scheme, which permits determination of any one of 24 parameters for a given factory product, are indicated.

The application of high-pressure liquid chromatography for process control in a sugar factory and ethanol plant

J. Tannock. *Proc. 58th Congr. S. African Sugar Tech. Assoc.*, 1984,

74-77.

Comparison is made between GLC and HPLC, and reasons are given for purchase of a chromatograph for the latter method to provide accurate analyses in the sugar factory and alcohol distillery at Triangle Ltd. in Zimbabwe. Exceptionally good reproducibility of sucrose, glucose, fructose and ethanol determination by HPLC is indicated by tabulated data, and excellent recoveries were obtained of all four when added to final molasses; the values were in close agreement with published data. Analysis of factory products (mixed juice, syrup and molasses) before and after invertase addition and after fermentation with baker's yeast showed no peaks under the sucrose peak (completely removed by the enzyme) nor under the glucose and fructose peaks after fermentation. The production of small amounts of trehalose during fermentation is of importance, however, since this sugar would be only partially resolved from sucrose if both were present in the same mixture. Interference by inorganic ions added in water to sugar and ethanol standards was not found. Comparison between values given by conventional methods and HPLC for sucrose, glucose, fructose and reducing sugars (as glucose + fructose) showed close agreement for high-purity products but not for ones of low purity. HPLC has been used for analysis of mixed juice, clarified juice, filtrate and evaporator juice to obtain information on sucrose losses — the ease and rapidity of analysis have proved valuable. HPLC has also proved applicable to condensate monitoring for sugar. It is stressed that, because of its greater resolving power, GLC will continue to be used for research purposes, particularly when detailed information is required on complex sugar mixtures.

Effect of dextran on the viscosity of sugar solutions

L. A. Sapronova. *Sakhar. Prom.*, 1984, (11), 23-26 *(Russian)*.

Investigations of the effect of dextran on the viscosity of refined sugar solutions and refinery syrup are reported; tabulated results confirmed the increase in viscosity with increase in concentration of added dextran at constant sugar solution concentration and with fall in temperature from 80 to 30°C. An equation generalizing the results is presented. Further mathematical treatment showed that the linearity between log specific viscosity and log dextran concentration was independent of temperature in the range studied. Further studies showed that the molecular weight of dextran exerted considerable influence on viscosity: increase in M.W. caused increase in viscosity. In the presence of >0.5% dextran by weight of 20×10^6 M.W., refinery syrup exhibited a weak structure, easily broken bonds being formed between the dextran and non-sugar particles; inclusion of a dispersed medium in "super-colloidal" structures causes increase in the viscosity, it is suggested. Refined sugar solutions containing >0.5% dextran of the same M.W. displayed the properties of a Newtonian solution.

A study of the effect of electrolytes on sucrose solubility using high-resolution NMR

V. S. Shterman, A. R. Sapronov, V. I. Smagina, K. I. Popov and I. E. Surovikova. *Sakhar. Prom.*, 1984, (11), 27-29 *(Russian)*.

Earlier studies[1] had shown that rapid exchange of protons between molecules of water and OH groups in sucrose gave rise to one mean line in the NMR spectrum corresponding to a common resonance signal for the protons. In an examination of the effects of certain electrolytes on sucrose solubility using high-resolution nuclear magnetic resonance with hexamethyldisiloxane as external standard, potassium chloride and acetate caused a shift in the signal toward a strong field, indicating a considerable increase in sucrose solubility. On the other hand, magnesium sulphate and chloride and calcium acetate caused a shift in the opposite direction, reflecting a marked fall in solubility. The action of the electrolytes is explained in terms of "positive" and "negative" hydration of their ions; ions subjected to positive hydration strengthen the quasi-crystalline structure of the water, while negative hydration gives ions (e.g. K^+, Cl^-, Br^- and NO_3^- and, to a much lesser extent, Na^+ and organic acid anions) that loosen it.

Investigations on the mechanical properties of sugar beet. II. Factors affecting the breaking strength of beet

L. Drath, R. Strauss and H. Schiweck. *Zuckerind.*, 1984, **109**, 993-1007 *(German)*.

Investigations of the mechanical properties of beet are reported. Details are given of the equipment and techniques used to determine the elasticity modulus, breaking elongation, fracture deflection and resistance to slicing. The results were analysed in relation to nitrogen fertilization and showed a reduction in the mechanical strength of beet at higher N rates (250 and 350 kg/ha), while a rate of 150 kg/ha as normally applied in West Germany had an adverse effect only under certain site conditions such as soil water balance and microbial activity. The mechanical properties were also affected by time of harvest and beet population, whereas no varietal effect could be found. The breaking strength was of great importance for diffusion — cossettes having a fracture resistance (measured as break load) lower than 600 N are more difficult to process.

1 Allen *et al.*: *Sugar Tech. Rev.*, 1974, **2**, 165-180.

By-products

Continuous fermentation systems for alcohol production

G. E. Guidoboni. *Enzyme and Microbial Technol.*, 1984, **6**, (5), 194-200; through *S.I.A.*, 1984, **46**, Abs. 84-1305.

Very few truly continuous processes for the production of ethanol from sugar-based feedstocks, such as molasses and cane juice, are in operation. Batch and continuous modes of operation are compared, and some advantages of the latter are examined. Possible markets for continuous processes are identified, and some possible reasons for the, as yet, lack of wide acceptance of such processes are offered. Seven commercially available processes are discussed: five based on single-tank fermenters (Alcon, Tate & Lyle, Inter-Loop, ATPAL and Biostil) and two based on cascade fermenters (Vogelbusch and Technipetrol).

Biosynthesis of yeast protein and some B-vitamins from cane molasses

S. A. Z. Mahmoud *et al. Res. Bull. Faculty of Agr.* (Ain Shams Univ., Egypt), 1981, (1649), 20 pp.; through *S.I.A.*, 1984, **46**, Abs. 84-1306.

Saccharomyces cerevisiae G104, *Candida tropicalis* P35 and a mixture of them were grown in batch cultures in a medium based on cane molasses. *S. cerevisiae* gave the highest biomass yield (42% after about 45 hours); it also gave the highest amounts of crude protein (15.8 g/litre), inositol (59.4 mg/litre) and nicotinic acid (7.33 μg/litre).

Production of yeast biomass by continuous process using cane molasses

E. M. Ramadan *et al. Res. Bull. Faculty of Agr.* (Ain Shams Univ., Egypt), 1981, (1650), 15 pp.; through *S.I.A.*, 1984, **46**, Abs. 84-1307.

Saccharomyces cerevisiae G104 and *Candida tropicalis* P35 were grown in continuous cultures in a medium based on cane molasses, at dilution rates of 0.014, 0.030 and 0.064/hr. With both strains, increasing the dilution rate led to changes in sugar consumption and biomass content in the steady state. *S. cerevisiae* had a lower sugar consumption than *C. tropicalis*, but gave a higher biomass yield; with both strains, yields were higher than in batch culture (see preceding abstract), but the inositol content was lower.

Production and farm evaluation of feed supplement from filter cake

C. S. Abrigo and A. L. Gerpacio. *Crystallizer*, 1984, **7**, (3), 15-17.

Tests on filter cake as poultry feed showed that incorporation of 7.5% in the total feed caused only 2.5% drop in average total weight gain, while weight losses increased to 7.5%, 14.8% and 15.7% with incorporation of 5%, 10% and 15% filter cake, respectively. Use of filter cake would have the advantage of reducing the cost of poultry feed and helping to dispose of over 500,000 tonnes of filter cake per season from Philippine sugar factories.

Fermentation of high-test molasses

N. F. de Murphy. *Sugar y Azúcar*, 1984, **79**, (9), 37, 39-40, 42-43.

With a gradual decline in sugar manufacture in Puerto Rico, a result of drastic reductions in cane crops because of low world sugar prices, the rum manufacturers have been faced with shortages of blackstrap molasses (BM) and have had to import much of this raw material. A possible alternative to BM is high-test molasses (HTM) (partially inverted cane syrup), which contains 75-79% fermentable sugar and 2.0-2.2% ash; this would provide the rum industry with its needed raw material and could be produced together with or instead of granulated sugar so as to make cane growing a more attractive proposition. However, the rate of fermentation of HTM by yeast is lower than that of BM, probably because of the absence of certain nutrients in the former. Experiments were conducted on fermentation with *Saccharomyces cerevisiae* strain PPR-80 in which various nutrients were added with the aim of increasing the fermentation rate. Highest rate and alcohol yield were obtained when BM was used for yeast seed preparation, while addition of rum distillery vinasse was also successful in this respect. Dehydrated yeast extract was uneconomical as a nutrient source.

Pilot scheme for ethanol+biogas at Ochsenfurt

F. X. Kammerer. *Zuckerind.*, 1984, **109**, 905-912 *(German)*.

Details are given of a pilot plant for ethanol manufacture from various sugar sources, including beet juices by continuous fermentation (the vinasse from which, together with sugar factory effluent, is anaerobically processed by the CSM method) followed by distillation of the fermentate which is based on reduced energy consumption. The purified alcohol is stored in a 500-m^3 tank before being transported by rail to distribution points. The economics of the production scheme are discussed, as is the market situation within West Germany and the EEC.

clarified remelt liquor. The effluent from these screens is not polished before filtration over char.

Operating variables

Pertinent data depicting colour and turbidity removal are shown in Figure 3.

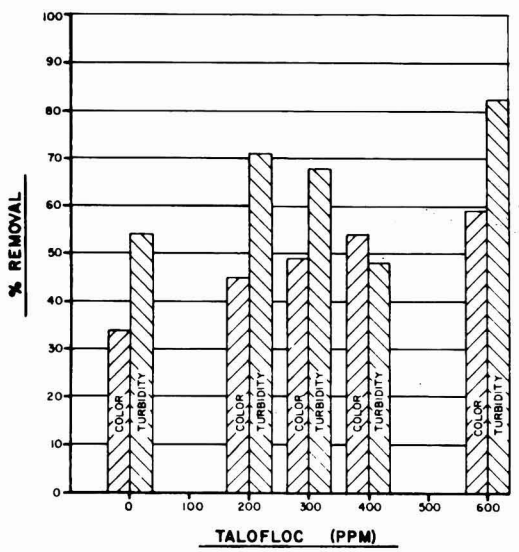


Fig. 3. Colour and turbidity removal from a Dominican Republic sugar. Fixed settings: 400 US g.p.m. flow rate, 67° Brix, 195° F, pH 7.2, 250 ppm P_2O_5, 12 ppm Taloflote

A number of operating variables can significantly affect the performance of the Talo clarification station. Godchaux-Henderson's experiences are as follows:

Brix control is critical. Erratic Brix will affect colour and turbidity removal; in general, lower Brix means better decolorization. The target is set at 65° Bx, considering screening, flow requirements, decolorization, and energy costs.

pH optimum range was found to be 7.0-7.4. Poor control adversely affects colour and turbidity removal, especially in the 7.4-8.0 pH range.

Temperature was originally set at 185°F for clarification. The clarifiers are currently operated at 195°F and an evaluation will be made to determine whether better clarification is occurring at the expense of inversion losses and increased energy cost.

Phosphoric acid addition has generally been set at 250-350 ppm depending on the quality of raw sugar and the influence of excess scum produced at the higher levels.

Talofloc addition depends on the quality of raw sugar feeding the melt, but normally lies between 200 and 400 ppm. Remelt levels are generally set at 600 ppm. Talofloc solidifying in heat traced lines and pitted stainless steel lines has been a major problem. Lines are currently being replaced, water-jacketed, and routes straightened and shortened in an effort to solve the problems of erratic chemical addition, poor decolorization performance, and excess chemical usage.

Taloflote A-100 levels are approximately 12 ppm for the total system. Flocculant preparation is extremely important. High-pressure air is used to disperse Taloflote in the water, and low-pressure air to maintain a homogenous mixture. Tests run on various types of water used in flocculant mixing did not show any significant difference in flocculant activity based on water hardness. Cold filtered tap water is used in the preparation.

Aeration pumps presented some problems when they became "air bound" with, as a result, caramelized sugar forming in pumps. A cavitation aerator is currently under evaluation and appears to be an improvement from an operating and energy savings point of view.

Steady flow conditions are very important to the process. Maximum performance from the station has been obtained when there was a minimum of recirculation and a constant uninterrupted flow through the system.

Chemical dosing pumps should be frequently calibrated. Dosing rates at Godchaux-Henderson are checked once a week by timing the volume delivered into a graduated cylinder. If the dosing rates deviate from standard more than 10%, a previously-calibrated spare pump is run while pump repairs or adjustments are made.

Scum sweetening-off

A flow chart of the new scum sweetening-off system is shown in Figure 2. Three extraction units were installed to sweeten-off the scum from the washed raw sugar and remelt liquor clarifiers. The scum is collected in a feed tank and pumped to the mixing tank feeding the first clarifier. The scum, along with the bagacillo from the Baker screens, is subsequently transferred from stage to stage with the final discard mud coming off the third clarifier and sent to aeration and settling ponds. Potable water is added to mixing tank 3. The sweet-water from clarifers 2 and 3 is pumped in counter-current to the scum into mixing tanks 1 and 2, respectively. The high-purity sweet-water from the first stage is used for melting. In general, 10 US gallons of scum are produced for each short ton of melt solids; however, this volume depends on the quality of raws and level of phosphoric acid addition. Taloflote A-100 is dosed at a rate equivalent to approximately 1.0 ppm

on refinery melt solids for each sweetening-off stage. In order to obtain sugar values as low as 0.03% on melt solids, the following variables are considered critical:

(1) The scum bed depth on the liquor clarifiers should range from 12 to 15 inches. The depth of the bed is normally controlled by the speed of the scum rake.
(2) Hot water (160°F) replaced cold water for scum dilution and significantly reduced sugar loss in scum and improved flotation.
(3) Depending on raw sugar quality, phosphoric acid addition above the 350 ppm level produces more scum than the system can efficiently sweeten-off without generating excess sweet-water.
(4) Scum dilution ratio on a volume basis (input potable water to input scum) can range from 4:1 to 6:1 depending on refinery sweet-water balance. The high purity sweet-water or melting water tank level is the governing factor. A higher dilution ratio results in lower sugar loss in scum and higher sweet-water volume.
(5) Proper aeration and flocculant dosing levels are important for scum flotation, particularly in the third stage.

Economics

The Talo process, along with other improvements at Godchaux-Henderson, has lowered overall refining costs. The following cost factors are considered significant:

(1) The process manning was reduced by 9 persons.
(2) Total gas (ft^3/100 lb melt) has been reduced by approximately 10%.
(3) Filter aid usage in clarification was eliminated.
(4) Char (lb/100 lb melt) usage has decreased approximately 25%.
(5) Sugar in the discharged scum is averaging below 0.03% on melt solids.
(6) Three fewer kilns are operated in the char house, thus saving maintenance and gas as a result of decreasing the char house draw rate.
(7) Buying lime in bulk has reduced cost approximately 25%.
(8) The melt rate has increased 9% since Talo clarification was introduced.
(9) Phosphoric acid and flocculant costs have increased 42% owing to use of higher doses to improve decolorization and clarity.
(10) The use of Talofloc is an additional expense.

It is estimated that approximately 60% of the fuel saving and melt rate improvement is due to Talo clarification.

Conclusions

The Talo clarification system at Godchaux-Henderson has:

(1) provided flexible decolorization capacity to allow refining of raws having a wide quality range while maintaining the melt rate,
(2) reduced the recirculation of colour impurities by separating the treatment of remelt,
(3) produced a scum sweetening-off system that allows for operational flexibility in chemical addition, and
(4) practically eliminated char filter blockage and channelling by significantly reducing scum carry-over to the char house.

System variables are still being evaluated; however, results from one year's operating experience have been encouraging.

Acknowledgements

We would like to gratefully acknowledge the cooperation and hospitality extended by Supreme Sugar Company Inc. and Atlantic Sugar Ltd. during refinery visits, and we also appreciate the assistance and support of the Tate & Lyle process technologists who made a significant contribution to our successful start-up and subsequent operation.

Summary

An account is given of the successful introduction of the Talo melt clarification system at the Reserve, Louisiana, refinery of Godchaux-Henderson Sugar Co. Inc.

Clarification par le TALO à Godchaux-Henderson

On présente le rapport de l'introduction réussie du système de clarification de la refonte en présence de TALO effectuée à la raffinerie de Godchaux-Henderson Sugar Co. Inc. en Reserve, Louisiana.

Die Talo-Klärereinigung bei Godchaux-Henderson

Ein Bericht über die erfolgreiche Einführung des Talo-Kläre-Reinigungssystems in der Raffinerie Reserve bei Godchaux-Henderson Sugar Co. Inc., Louisiana, wird beschrieben.

Clarificación por el sistema Talo a la Godchaux-Henderson

Se presenta un informe sobre la introducción con éxito del sistema Talo para clarificación de licor de azúcar disuelte en la refinería de Godchaux-Henderson Sugar Co. Inc. en Reserve, Louisiana.

Brevities

Süddeutsche Zucker-AG 1984 campaign

Good precipitations and long periods of good weather in the Spring led to good beet growth and sugar content. From a beet area of 115,000 ha (108,000 in 1983), 6.2 million tonnes of beet were grown (5.2 million in 1983). The initially low sugar content improved but the average for 1984 was 16.48% against 17.50% in 1983. Sugar outturn reached 886,000 tonnes, 9.1% more than the 812,000 tonnes produced in 1983; this provided 98,000 tonnes of C-quota sugar against 25,000 tonnes in the previous campaign.

Malawi sugar production and exports, 1984[8]

Sugar production in Malawi in the 1984 season totalled 160,427 tonnes, raw value, as against 187,463 tonnes in the previous season. Consumption rose from 48,482 to 53,441 tonnes, while exports fell from 94,516 tonnes in 1983 to 89,442 tonnes.

8 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 26-27.

Investigations on combustion and combustion control in a sulphur furnace

By Christian Møller and Henrik Jansdorf

(A/S De Danske Sukkerfabrikker, Gørlev, Denmark)

Introduction

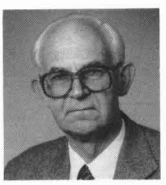
Sulphur dioxide is indispensable in white sugar production, and protects the thin juice against colour formation during the evaporation process. Dependent on local circumstances, sulphur dioxide may be procured by the sugar factory as liquid sulphur dioxide or it may be produced at the sugar factory itself by combustion of sulphur in a furnace.

In Denmark we have no production of liquid sulphur dioxide, which is why it is far more profitable for A/S De Danske Sukkerfabrikker to produce our sulphur dioxide at the DDS sugar factories by combustion of sulphur. Only a limited amount of liquid sulphur dioxide is used for supplementary and reserve purposes.

The standard sulphur furnace

For many years at DDS we used the standard Sangerhausen-type sulphur furnace — an elongated cast iron box with water on the lid to confine the combustion. In the early fifties we improved the feeding of the furnace by substituting the original, small lock-chamber for a few litres of solid sulphur by a melting tank designed for batchwise melting of several hundred kilos of sulphur which in turn could be fed to the combustion chamber of the furnace via a special sulphur trap of melted sulphur.

Compressed air was injected at one end of the combustion chamber. The normal air main for the sulphitation station was replaced in the early sixties by adjustable air blowers for each furnace. The quantity of air is adjusted to the temperature of the sulphur dioxide gas leaving the furnace; the higher the temperature, the stronger the combustion and the greater the sulphur dioxide production. However, parallel to the increased sulphur dioxide production, we get an increased sublimation of sulphur which in turn is condensed on the colder part of the gas line to the thin juice tower — finally plugging this line with a consequent disturbance of the sulphitation process.



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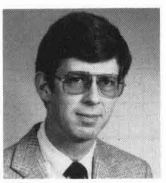

H. Jansdorf

This extremely inconvenient situation is counteracted by running the sulphur furnace at a very low load, but even under these circumstances problems may occur with sublimed sulphur. We therefore decided to study the process of sulphur combustion in the laboratory by means of a small-scale sulphur furnace.

The small-scale sulphur furnace

This study of the sulphur combustion process was started in 1980. The first small-scale furnace was a one-tenth scale model of the furnace used in our Gørlev factory. This model verified that the model behaviour was similar to the factory furnace. Figure 1 shows the laboratory set-up.

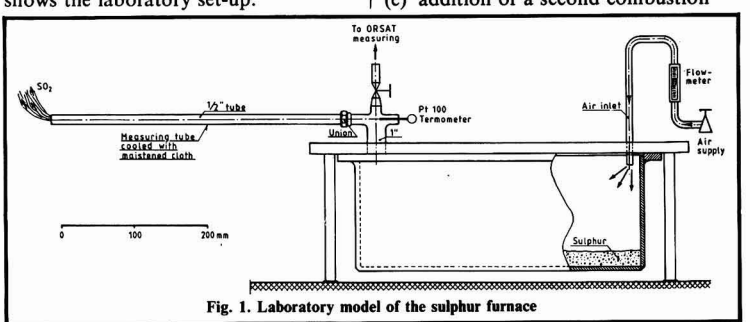

Fig. 1. Laboratory model of the sulphur furnace

The first part of the exhaust pipe from the furnace consists of a 400 mm long ½-inch tube connected to the furnace with a union for easy exchange. This tube was cooled with moistened cloths to achieve a controlled condensation of the sublimed sulphur. The weight of condensed sulphur in terms of the increased weight of this tube after each combustion experiment was an approximately quantitative measure of the sublimation occurring.

The experiments were carried out in the following way:

(1) the furnace was filled with a quantity of granulated sulphur,
(2) the air supply was adjusted to the desired quantity on the flowmeter,
(3) the sulphur was set on fire and a steady state awaited,
(4) at the start of each measuring period a clean exhaust tube was connected to the furnace and then cooled with water-moistened cloth,
(5) for half an hour the air supply was kept constant, the temperature was recorded and the SO_2% measured with an Orsat instrument, and
(6) after each experiment the test tube was weighed again.

Many experiments were carried out using:

(a) different types of air inlet nozzles,
(b) air supply with various oxygen concentrations,
(c) different combustion chamber dimensions,
(d) addition of secondary air in different ways,
(e) addition of a second combustion chamber with and without secondary air supply.

After a series of experiments we chose to carry out all the following experiments with only one air inlet placed just below the top of the combustion chamber.

Because of the exothermic nature of the combustion process we realised the necessity of a kind of systematic heat dispersion. For that reason we tested the influence of adding an inactive gas

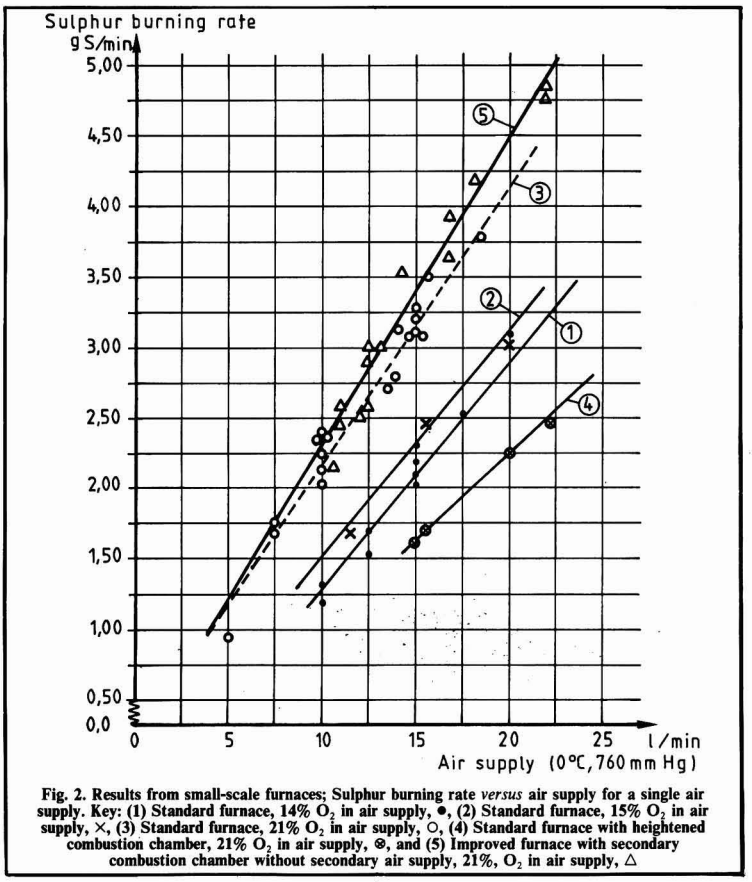

Fig. 2. Results from small-scale furnaces; Sulphur burning rate *versus* air supply for a single air supply. Key: (1) Standard furnace, 14% O_2 in air supply, •, (2) Standard furnace, 15% O_2 in air supply, ×, (3) Standard furnace, 21% O_2 in air supply, ○, (4) Standard furnace with heightened combustion chamber, 21% O_2 in air supply, ⊗, and (5) Improved furnace with secondary combustion chamber without secondary air supply, 21%, O_2 in air supply, △

to the air supply. In the laboratory we used nitrogen and we expected that the heat dispersion to the inactive air ballast would be able to reduce the sublimation. This was confirmed, but the sublimation was still too great, supposedly on account of the higher air velocity in the furnace (see Figures 2 and 3). These experiments gave the valuable information that the sulphur combustion will not continue if the oxygen concentration in the supply air is below about 12%. This is also the explanation why it is very difficult to achieve combustion all over the sulphur surface as the air is gradually mixed with the SO_2 gas produced.

Experiments with doubling of the height of the combustion chamber indicated reduction of the sublimation, but SO_2 production was also reduced because of the reduced air velocity and the consequent reduction in the mean oxygen concentration throughout the furnace (Figures 2 and 3). Up to this point, all our sulphur combustion tests indicated that the combustion gas invariably contains a certain amount of sulphur in the gaseous state.

Different kinds of secondary air supply showed that it is ineffective for oxidizing sublimed sulphur if the temperature of this air is lower than the temperature of the combustion gas.

The most promising experiments were carried out with a furnace combined with a second combustion chamber. This chamber was placed just above the primary combustion chamber. The influence of the heat from the primary combustion zone favours the oxidation of sublimed sulphur (See Figure 2, graphs No. 3 and 5). This, combined with a supply of preheated air to the secondary combustion chamber, strengthened the

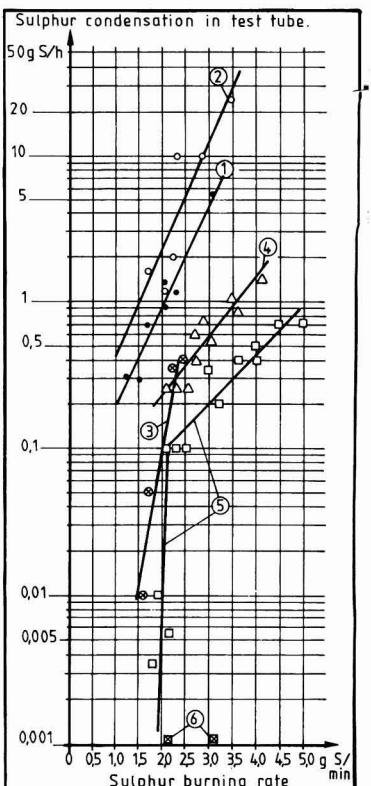

Fig. 3. Results from small-scale furnaces, Sulphur condensation *versus* sulphur burning rate. Key:
(1) Standard furnace, 14% O_2 in air supply, •,
(2) Standard furnace, 21% O_2 in air supply, ○,
(3) Standard furnace with heightened combustion chamber, 21% O_2 in air supply, ⊗,
(4) Improved furnace with secondary combustion chamber without secondary air supply, 21% O_2 in air supply, △,
(5) Improved furnace with secondary combustion chamber and a fixed amount of preheated secondary air supply, □,
(6) Improved furnace with secondary combustion chamber and a controlled ratio of primary to preheated secondary air supply, 21% O_2 in air supply, ■

oxidation in the second combustion zone (See Figure 3, graph No. 5).

Our final investigations and tests showed that the addition of preheated secondary air is a necessary but not a sufficient condition in obtaining a sublimation-free combustion gas. As shown in Figure 3 a fixed quantity of preheated secondary air reduces the sublimation rate significantly and eliminates it when the burning rate is below about 2 grams of sulphur per minute. Moreover a controlled supply of the preheated secondary air as described below seems to increase this limit for a sublimation-free burning rate.

*The improved sulphur furnace**

As a result of our investigations we have developed the sulphur furnace shown in Figure 4. In this furnace the air for the secondary supply is taken as a part of the total air flow from the blower. The air for the primary combustion is reduced when the air to the secondary combustion is increased. An electronic controller controls this ratio as a function of the temperature of the combustion gas measured when it leaves the primary combustion chamber. The secondary air is preheated in the combustion zone before it is added to the secondary chamber as shown in Figure 4. Before the SO_2 gas leaves the furnace it is cooled in the last chamber shown in Figure 4. Normally the temperature of the gas leaving the furnace is about 160-180°C.

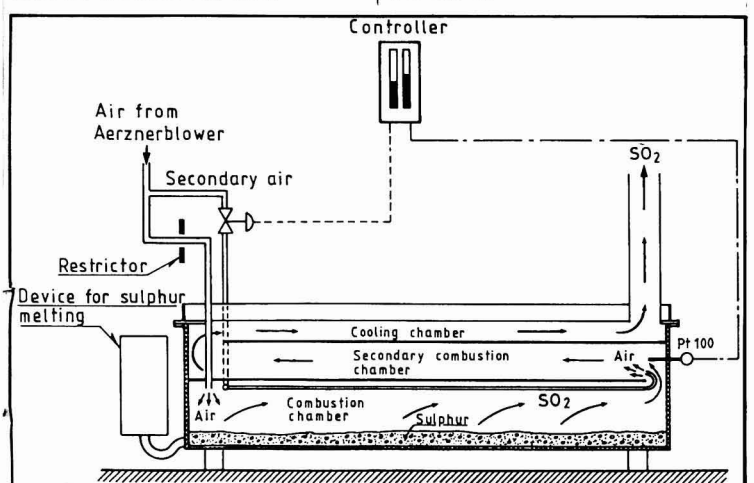

Fig. 4. The improved sulphur furnace with temperature-controlled addition of preheated air into a secondary combustion chamber

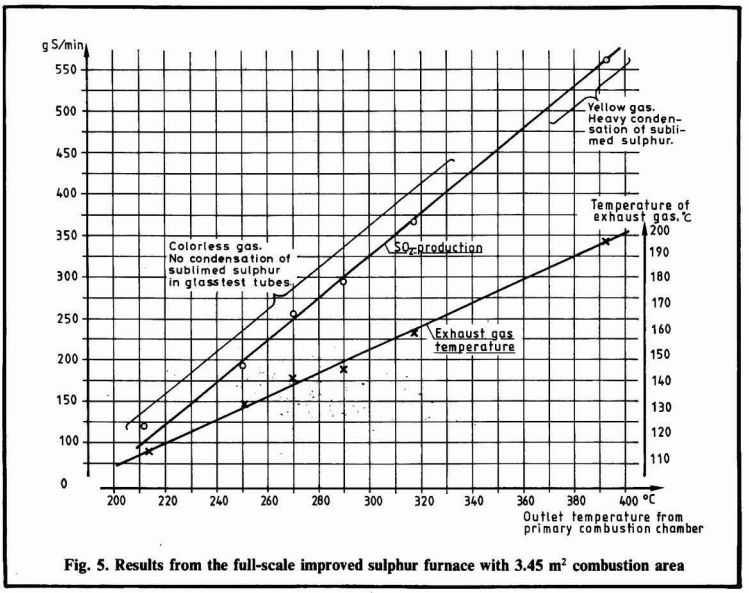

Fig. 5. Results from the full-scale improved sulphur furnace with 3.45 m² combustion area

Figure 5 shows results obtained with one of our furnaces in the 1981 campaign. This furnace, with a 3.45 m² combustion area (100 times as big as the laboratory furnace), is able to produce a SO_2 gas free from sublimed sulphur while burning at a rate of up to about 450 g sulphur per minute or about 650 kg sulphur per day. Visual sublimation testing on the full-scale furnace was done by means of 4 mm glass tubes connected to a vent on the outlet gas line. The normal production in the factory in this furnace corresponds to about 400 to 600 kg sulphur per day. The production is fully controlled and the rate is to be set on the controller as the set-point for the primary gas temperature. An increase in the gas temperature throughout the second combustion chamber has been measured as the evidence of the oxidation of sulphur in the vapour state.

Conclusion

In our Gørlev factory we have now three furnaces in operation according to the new principle, two of 3.45 m²

*Patent pending.

combustion area each for the sulphitation of thin juice and one furnace of 1.75 m^2 for diffusion water treatment. All furnaces have worked without any operational problems, and post-campaign inspection of the downstream gas lines has shown no deposits of sublimed sulphur.

Summary

Using a model furnace, the combustion of sulphur to produce gaseous sulphur dioxide for beet juice treatment was studied and factors identified which governed the completeness of conversion and the sublimation of sulphur. Furnace design modifications were introduced which have been adopted in Gørlev sugar factory and which have operated without sublimation and without any other problems.

Etude de combustion dans un four à soufre

En utilisant un four-modèle, on a étudié la combustion du soufre pour produire de l'anhydride sulfureux gazeux en vue du traitement du jus de betteraves. On a identifié les facteurs importants pour que la conversion soit complète et pour la sublimation du soufre. On a introduit des modifications dans le dessin du four. Celles-ci furent adoptées à la sucrerie de Gørlev où on a travaillé sans sublimation et sans autres problèmes.

Untersuchungen über die Verbrennung in einem Schwefelofen

Unter Verwendung eines Modellofens wurde die Verbrennung von Schwefel zu gasförmigem Schwefeldioxid für die Rübensaftbehandlung untersucht und die Faktoren identifiziert, die die Vollständigkeit der Umwandlung und Sublimierung des Schwefels bestimmen. Die Konstruktion des Ofens wurde geändert und dieser in der Zuckerfabrik Gørlev eingebaut; seitdem arbeitet er ohne Sublimierung und ohne andere Probleme.

Investigaciones de la combustión en un horno para azufre

Por uso de un horno modelo, se ha examinado la combustión de azufre para producir dióxido de azufre en forma gaseosa para tratar el jugo de remolacha. Se ha identificado factores que gobernan el grado de conversión y la sublimación del azufre. Se han introducido modificaciones al diseño del horno y éstas se han adoptado en la azucarera de Gørlev; los hornos modificados se han operado sin sublimación y sin otras problemas.

Brevities and statistics

Japan sugar imports, 1984[1]

	tonnes, raw value
Australia	529,929
Brazil	16,460
Cuba	226,372
Fiji	14,605
Philippines	302,808
South Africa	243,667
Taiwan	25,669
Thailand	476,508
	1,836,018

Central African Republic project[2]

The Central African Republic is to set up its first sugar complex in a FFr 200 million (£17 million) project aimed at producing 6000 tonnes a year of white sugar by the end of 1987. Contracts covering the construction of the complex and its management for five years have just been signed with the French company Agrotechnip. The agreement covers the setting up of a sugar cane plantation, now being planted, and the factory itself, designed to produce the equivalent of the country's annual needs. It will be located in Ouaka province. The small-scale project has been designed using innovative features to save energy and reduce the installation and maintenance costs. The plant, to be owned by Société de Gestion de Sucreries Centrafricaine, will be financed by the French government's overseas development agency as well as several foreign banks and the Saudi Arabian Development Fund.

Peru cane alcohol project[3]

The Energy and Mines Minister has announced that Peru is to produce alcohol from sugar cane as a substitute for gasoline. A start will be made by producing alcohol from 7000 hectares of cane, to be mixed with gasoline. Production will first be located in Pucallpa.

Nicaragua sugar exports, 1984[4]

Exports by Nicaragua fell from 112,327 tonnes, raw value, in 1983 to 106,986 tonnes in 1984. Previously the largest destination, taking 48,036 tonnes in 1983, the USA received only 10,986 tonnes last year, while the USSR also reduced its purchases from 11,593 tonnes to nil. Iran reduced its purchases from 13,375 tonnes to nil, but Mexico's reduction was only from 28,088 to 26,749 tonnes. Algeria increased its purchases markedly, however, from 11,235 tonnes in 1983 to 68,544 tonnes in 1984.

Thailand interest in bagasse pulp[5]

In response to the government's restrictions on imports of pulp in order to become more reliant on locally available materials, many of Thailand's 43 paper factories are showing an increased interest in the use of bagasse for pulp manufacture. To increase its availability, various studies are being made on how to replace bagasse as a fuel in the sugar factories. Lignite, which is available in large quantities and in fairly good qualities, seems to be the prime contender and feasibility studies on its use are being carried out by at least two of the country's sugar producing groups.

Taiwan sugar exports, 1984[6]

	1984	1983	1982
	tonnes, raw value		
Bangladesh	13,588	0	0
Djibouti	11,414	0	0
Hong Kong	218	869	11
Japan	30,014	60,471	130,349
Korea, South	26,135	82,653	127,736
Saudi Arabia	0	11,740	65,764
Sri Lanka	11,631	0	0
U.S.A.	363,826	30,347	56,013
Other countries	0	89	463
	129,826	186,169	380,336

Turkey sugar expansion[7]

The increasing demand from both domestic and foreign markets has enabled the government of Turkey to push for higher production. Processing capacities of some of the old factories have been enlarged and new plants established to process greater beet production. The total number of sugar factories has reached 22 and two new plants are under construction in Carsamba and Elbistan.

1 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, S 134.
2 *Financial Times*, May 9, 1985.
3 F. O. Licht, *International Molasses Rpt.*, 1985, (1).
4 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 31.
5 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 292.
6 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 8-9.
7 *Amerop-Westway Newsletter*, 1984, (138), 14.

Brevities and statistics

Cubar sugar exports, 1984[1]

	1984	1983	1982
	tonnes, raw value		
Albania	14,673	15,698	15,946
Algeria	40,935	99,005	207,896
Angola	45,658	40,633	52,028
Bulgaria	360,107	331,485	277,678
Canada	241,070	190,490	160,299
China	705,054	771,717	915,311
Czechoslovakia	226,489	144,648	134,892
Dutch Antilles	974	3,413	2,346
EEC	27,050	0	0
Egypt	137,911	230,779	190,269
Ethiopia	4,809	0	0
Finland	39,340	64,870	38,816
Germany, East	278,773	280,922	213,461
Guinea Bissau	0	0	2,096
Hungary	0	0	72,903
India	40,999	0	0
Indonesia	0	0	14,236
Iran	0	61,595	0
Iraq	112,719	158,217	133,783
Jamaica	0	0	1,626
Japan	231,087	354,532	294,986
Kampuchea	1,626	529	0
Korea, North	21,262	22,511	17,079
Libya	44,345	90,191	45,055
Malaysia	39,269	60,463	26,269
Mexico	52,702	62,732	139,702
Mongolia	0	4,699	4,701
New Zealand	44,044	0	15,662
Peru	54,411	25,037	0
Portugal	84,974	15,086	70,814
Rumania	272,088	221,454	89,663
Senegal	20,554	0	0
Spain	0	0	21,588
Surinam	0	3,307	4,558
Sweden	0	5,196	0
Switzerland	2,934	2,232	3,089
Syria	132,703	109,323	109,274
Tunisia	26,910	12,114	0
USSR	3,649,996	3,314,985	4,425,519
Vietnam	37,456	77,134	24,155
Yemen, South	0	2,096	0
Yugoslavia	20,878	9,397	0
Other countries	2,710	5,603	8,583
	7,016,510	6,792,093	7,734,283

Chile sugar output reduction[2]

White sugar manufacture is expected by the state-owned sugar company Industria Azucarera Nacional S.A. to fall from 332,671 tonnes in 1984 to some 290,000 tonnes this year, owing to a reduction in area from 47,875 to 42,326 hectares. Domestic consumption requirements are expected to amount to 360,000 tonnes and shortfalls are usually made up by imports from Argentina and Bolivia; however, IANSA states that Chile has sufficient stocks for imports to be unnecessary during 1985.

Bagasse paper project in Egypt[3]

A 60,000 tonnes/year project for paper manufacture from bagasse is in its final stages of study. Four companies have been retained for the project.

Bangladesh sugar expansion plans[4]

There are 16 cane sugar factories in Bangladesh but the total installed capacity amounts only to 192,000 tonnes of white sugar. Under the second five-year plan, due to be completed this year but no doubt put into arrears by the disastrous floods which devastated the cane growing region of the country towards the end of last year, it is proposed to raise capacity to 252,450 tonnes. The crushing season will be reduced from 120 to 100 days while it is hoped to raise the extraction rate from 8.5 to 9.0%. Under the plan the capacity of six existing factories is to be expanded while three old factories are scheduled to be replaced. The work at Setabganj factory in Dinajpur district has already been completed while it is currently in progress at Deshbandu, where the original mill had a capacity of only 200 tonnes of cane per day. Finally, four new factories are to be installed; one of these, at Natore, with a production target of 15,000 tonnes, has already been constructed[5].

West Germany 1984/85 campaign results[6]

Final statistics from West Germany show that, from a gross weight of 20.19 million tonnes of beet, 2,876,000 tonnes of white sugar was produced in 1984/85. This compares with 2,487,000 tonnes from 16.43 million tonnes of beets in 1983/84 and 3,294,000 tonnes from 23.05 million tonnes of beet in the previous campaign. In addition it is customary for about 19,000 tonnes of white sugar to be extracted from molasses. The area fell from 428,602 hectares in 1982/83 to 403,104 ha in 1983/84 but rose again last campaign to 423,294 ha.

Canadian sugar factory not to operate

The Canadian government and the provincial governments of Alberta and Manitoba were persuaded by B.C. Sugars Ltd. to provide subsidies to permit the operation of the company's beet sugar factories at Taber and Fort Garry for the 1985/86 campaign[7]. The subsidies were for one year only, however, and, although the Manitoba growers were prepared to sign contracts for the supply of beets in 1985, those in Alberta were not unless their beet price was raised. No beets have been sown and the Taber factory will not operate in the coming campaign. Further, if all Canadian requirements can be met by the facilities remaining in operation, it is feared that no future subsidies will be provided by the governments and that the Taber plant — the most modern beet sugar factory in Canada and one in which much capital has been invested — could be permanently closed.

Cane alcohol project in the Philippines[8]

President Marcos has announced that the Philippines is to set up a project costing 800 million pesos to produce alcohol from sugar cane in a bid to help the distressed sugar industry. A study by the Ministry of Energy shows that the industry could produce 148 million litres of alcohol per year for mixing with gasoline and save $4.5 million spent on imported tetraethyl lead.

India sugar exports, 1984[9]

	1984	1983	1982
	tonnes, raw value		
Bangladesh	39,760	0	0
China	0	11,885	92,809
Ecuador	0	11,061	0
EEC	10,804	0	0
Egypt	51,320	302,570	29,118
Indonesia	0	29,172	301,161
Lebanon	0	0	327
Maldives	1,621	2,053	1,080
Morocco	0	68,931	0
Nepal	16,912	0	0
Saudi Arabia	11,344	0	0
Somalia	18,799	0	0
Sri Lanka	137,078	186,266	44,090
Sudan	0	38,463	14,262
Tunisia	0	37,924	0
USA	0	21,716	21,203
Yemen, North	19,448	72,605	0
	307,086	782,646	504,050

EEC sugar prices, 1985/86

On May 16, the Council of Ministers of the EEC adopted a common price structure for various crops and produce including sugar and sugar beets, to apply from July 1. Further negotations were to follow on cereals and oilseed. The basic price for sugar beet was unchanged at 40.89 E.C.U. per tonne (£25.30 per tonne), while the intervention price for white sugar was raised by 1.33% from 534.70 to 514.80 E.C.U. per tonne (£330.79 to £335.19 per tonne) and that for raw sugar from 443.40 to 448.50 E.C.U. (£274.31 to £277.46), i.e. by 1.15%. In the UK, the price that will be paid to farmers for beets will be unchanged at 41.64 E.C.U. (£25.76) while the intervention price for white sugar will rise from 546.80 to 553.90 E.C.U. (£338.28 to £342.67) per tonne.

Lower Australian sugar crop forecast[10]

The Bureau of Agricultural Economics has forecast a drop in 1985/86 raw sugar production to 3.40 million tonnes, 94 N.T., from the record 3.54 million tonnes of 1984/85. The Bureau predicted a decline in cane production to 24.80 million tonnes from 25.51 million in 1984/85 in its latest Trends quarterly. It expects sugar exports to decline from 2.71 million tonnes in the twelve months to end-June 1985 to 2.62 million tonnes in 1985/86.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 10-11.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 209.
3 *Amerop-Westway Newsletter*, 1985, (137), 7.
4 C. Czarnikow Ltd., *Sugar Review*, 1985, (1737), 61.
5 *I.S.J.*, 1985, **87**, 97.
6 C. Czarnikow Ltd., *Sugar Review*, 1985, (1737), 61.
7 See *I.S.J.*, 1985, **87**, 102.
8 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 308-309.
9 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 23-24.
10 *Public Ledger*, April 17, 1985.

Philippines sugar exports, 1984[1]

	1984	1983
	tonnes, raw value	
Algeria	0	11,383
Bulgaria	0	12,622
China	67,991	0
Comoro Isl.	0	542
Fiji	0	13,655
Finland	12,962	0
Hong Kong	3,833	8,132
India	23,854	0
Indonesia	0	4,337
Japan	369,408	207,622
Korea, South	129,702	140,714
Malaysia	54,949	15,693
Mexico	0	86,561
New Zealand	18,741	0
Saudi Arabia	0	8,123
Sri Lanka	63,994	31,191
USA	396,786	290,260
	1,200,236	998,790

International symposium on automatic control in the food industry

An international symposium, intended to promote discussion between process engineers interested in automation and optimization problems in the food industry, is to be held in Paris during November 13-19, 1986 under the auspices of the GIA International Food Machinery Exhibition and the Food Working Party of the European Federation of Chemical Engineering. Information is available from ACOFOP, c/o GIA, B.P. 551, 75027 Paris Cedex 01, France. Persons wishing to submit papers should write to Mr. J. J. Bimbenet, 1 Avenue des Olympiades, 91305 Massy, France.

New Pakistan sugar factory[2]

Construction has started on a factory for Al Asif Sugar Mills Ltd. at Garho, in Sind province, according to press reports. This will be the country's 40th factory and will cost 350 million rupees ($28 million), including a foreign exchange component of about $5 million. About 80% of the machinery will be made locally by Ittefaq Foundries Ltd., of Lahore. The factory is scheduled for trial and commercial runs in October 1986; its initial capacity will be 2000 t.c.d. to be increased in due course to 3500 t.c.d. In a normal season the factory will crush about 375,000 tonnes of cane grown on just over 10,000 hectares, and will produce about 30,000 tonnes of white sugar.

Jamaica cane area reduction[3]

Jamaica is to withdraw 20,000 acres of government land from sugar cane cultivation over the next three years and instead to grow vegetables for export to the USA; earnings are expected to be double those of sugar. The government plans to limit sugar production to 225,000 long tons/year; originally it was intended to increase sugar output further. For the past four years production has been less than 200,000 tons.

Pakistan cane sugar production, 1984/85[4]

The 1984/85 cane crushing season in Pakistan ended in the last week of May. The season averaged 169 days, compared with 163 days in 1983/84. The total cane crushed was 14,707,000 tonnes, up 9% from the 13,469,000 tonnes crushed in the previous season and white sugar production amounted to 1,306,000 tonnes (1,420,000 tonnes, raw value), 15% higher than the 1,133,000 tonnes (1,232,000 tonnes, raw value) of 1983/84. The 1984/85 outturn substantially exceeded earlier estimates and is a record. Recovery averaged 8.88% against 8.42% in the previous season.

Mauritius sugar industry plan approved[5]

The plan for restructuring the Mauritius sugar industry[6], presented by the Minister of Agriculture, was approved by Parliament on March 16. The law relating to sugar companies is to be revised and in the next few months the government will set up five companies covering the north, east, centre-west, south-west and south-east geographical regions of the country. Funding of 1000 million rupees ($70 million) will be sought abroad for the plan which will involve investment in new technology, diversification into food products and bagasse utilization as well as intercropping.

Indian sugar consumption and production[7]

The government's planning commission has reported that India's domestic sugar demand is expected to reach some 10 million tonnes by 1989/90. Hence, current total installed annual sugar production capacity of about 7.5 million tonnes, white value, would have to be increased to 11 million tonnes by 1989/90 to meet domestic demand and produce some 1,000,000 tonnes for export. To obtain the estimated 3.5 million tonnes of additional production capacity will require 1340 million rupees ($107.9 million) over the next five years.

Guyana sugar industry development loan[8]

The Inter-American Development Bank recently approved a US $28 million loan to Guyana to finance a new development program for the modernization of equipment in sugar and rice plants. Total cost of the program is estimated at $40 million, with the IADB assuring 40% of financing.

Jamaica sugar factory closure[9]

The medium-sized Holland Sugar Estate has closed, reducing the number of sugar estates in Jamaica to nine. The estate will be converted to production of winter vegetables, rice, soya and corn under the government's agricultural diversification program.

Kenya refined sugar manufacture[10]

The Miwani sugar factory installed a modern refining facility from Finland which started operation in 1984, producing high quality refined sugar for sale on the local market. It has replaced 1000-2000 tonnes of imports in previous years.

HFS usage in Taiwan[11]

Domestic production of high fructose syrup only began in early 1984 but has already cut into Taiwan's sugar consumption, according to a USDA report. Currently, five local processors have an annual syrup output of 40,000 tonnes, produced mainly from tapioca starch. In 1984 all production went to the food industry but, this year, fructose products are on the retail market. Two further companies plan to begin production in 1985 when total capacity would be raised to 70,000 tonnes. The Taiwan Sugar Corporation also plans to become a producer; after successful trial production of the sweetener in February 1985, TSC said their current annual capacity of 3000 tonnes could easily be expanded to 100,000 tonnes once approval is granted by the Taiwan authorities. Government permission may not be forthcoming, however, as the authorities seek to prevent further decline of Taiwan's already troubled sugar industry.

1 *I.S.O. Stat. Bull.*, 1985, **44**, (3), 34.
2 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 291.
3 *Reuter Sugar Newsletter*, April 18, 1985.
4 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 390.
5 *World Sugar J.*, 1985, **7**, (12), 33.
6 *I.S.J.*, 1985, **87**, 42.
7 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 263.
8 *Amerop-Westway Newsletter*, 1984, (138), 13.
9 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 306.
10 *Amerop-Westway Newsletter*, 1984, (138) 14.
11 F. O. Licht, *International Sugar Rpt.*, 1985, **117**, 266.

PERSONAL NOTES

We regret to report the death on May 31 of the late **Professor Sigmund Wolf,** at the age of 80. This prominent Yugoslav sugar technologist began his chemical studies at the University of Munich but returned to Yugoslavia before these were completed, to work as a bench chemist in the Veliki Beckerek sugar factory, now renamed Zrenjanin. Between campaigns he continued his studies and graduated as Chemical Engineer from Stuttgart Technical University. He was promoted, becoming General Manager of the factory from 1941 to 1945. He founded and served as the Director of the Yugoslav Institute for Sugar, Starch and Glucose in Zrenjanin and at the same time served as Chief Adviser to the General Management of the Food Industry. He was responsible for planning of new sugar factories and reconstruction of factories damaged or neglected during the war years. In 1959 he was given the Chair of Carbohydrate Chemistry at the Novi Sad University and remained Director of the Institute which was transferred to Novi Sad. Here he directed basic and applied research for the sugar industry and guided development of the Novi Sad process beet for juice purification which has been adopted in Yugoslavia and in sugar factories of neighbouring countries. He retired in 1968 but continued to act as an adviser to the industry. He had lectured and written many papers on sugar technology, particularly on the Novi Sad process, as readers will be aware from abstracts published in this Journal.

New books

Geography of sugar cane. Environmental, structural and economic aspects of cane sugar production

H. Blume. xx+392 pp; 26.6 x 15.8 cm. (Verlag Dr. Albert Bartens, D-1000 Berlin 38, Postfach 38 02 50, Germany.) 1985. Price: DM 180.00.

The author of this book, who is Professor of Georgraphy at the University of Tübingen, has written several books and numerous articles on various subjects in his field. Among these are a number of works devoted to sugar cane agronomy in various countries and to socio-agrarian questions in tropical countries, so that it seems logical that he should write a book devoted to the sugar cane and its role in the socio-economic development of a country.

The contents are divided into six chapters: Sugar cane and its use by man; Sugar cane and the environment; Organizational structures of cane sugar production; Efficiency according to structural systems and environment; Cane sugar in the world's economy; and Conclusions (in English, French, German and Spanish). The text is accompanied by 84 tables of data, 13 diagrams, 33 maps, 40 photographs (depicting aspects of cane agronomy and sugar manufacture and grouped together at the end of the book) and a world map of cane sugar production. A bibilography towards the end of the book is followed by a location index, author index and subject index. The English is very good, with only minor faults appearing in isolated places. The printing is very clear on a matt paper, and the contents are well arranged.

As with most books in the field of economic geography, there is a wealth of information which the reader might find difficult to absorb with only one reading, but the author has managed to make the subject-matter sufficiently interesting for even the non-expert; the result is a work that is more than just a reference book.

Cane sugar handbook. 11th Edition

J. C. P. Chen. 1134 pp; 13.5×12.7 cm. (John Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England.) 1985. Price: £139.35.

The first edition of this handbook was published in 1889, since when it has gained a prominent position as one of the leading reference books concerned with cane sugar manufacture and refining. The first six editions were written by G. L. Spencer and the three subsequent editions by G. P. Meade, who died in 1975. J. C. P. Chen was co-author with Meade of the 10th Edition. Some 14 years elapsed between the 9th and 10th Editions, whereas the interval between the 10th and 11th Editions has been shortened to 8 years; this would appear to be a recognition of the speed at which new developments have taken place in the sugar industry. Aside from 187 extra pages, the new edition retains much of the 10th Edition but with some new sections added to chapters and addition of a new chapter on energy conservation; some 30% of the material is new or has been revised. After an introductory outline of cane agronomy (by J. E. Irvine) and an explanation of the chemistry of sugars and non-sugars (by M. A. Clarke), the contents are divided into three sections: (i) the processes and equipment used in cane raw sugar manufacture and refining, including chapters contributed by T. W. Baker concerning juice heating and evaporation, by F. G. Carpenter on decolorization in refining, and by H. G. Gerstner on crystallization, drying, packaging, etc. of refined sugar (including information on the various types of sugar produced). Special sections have also been written by P. H. Petri on continuous boiling, by H. M. Lynch on refined sugar microbiological standards, by R. S. Patterson on tablet sugar, by C. C. Chou on the fundamentals of sugar colorants, by M. C. Bennett on carbonatation and the Talofloc decolorization/clarification process in refining, and by C. J. Novotny on ion exchange in refining; (ii) analytical procedures, including a chapter on colour and turbidity by C. C. Chou and one on analytical techniques for sugars and non-sugars by M. A. Clarke; and (iii) chemical and process controls, expanded from chemical control in the 10th Edition to include a review of laboratory automation and computer application, recent studies on molasses target purities, etc.

Apart from rewriting and revising much of the text, J. C. P. Chen has provided supplementary material for those chapters written by the various authors mentioned above. A collection of reference tables and a subject index are to be found at the back of the book, while conversion data have been incorporated on the inside front and back covers. The printing is clear, and the pages fall flat (an important feature in a reference book). There are some typographical errors, but not such as to mar the usefulness of the book. The price may seem somewhat on the high side, but the book contains a huge amount of information and for factory libraries would be a valuable acquisition. Dr. Chen and the contributors have had considerable experience at all levels in the sugar industry, and the material they have provided makes this a publication without parallel in the sugar world.

Bharatiya sugar

Anon. 1100 pp; 21×27 cm. (Jeevan Darshan, 2nd Floor, Block V, Laxmi Road, Pune, India 411030.) 1984. Price: US$ 100.

This is a directory of the Indian sugar industry for 1983/84. It is divided into four parts: (i) general information and a collection of articles, plus details of associations, research and development organizations, etc.; (ii) a "Who's Who"; (iii) information on sugar and paper machinery manufacturers; and (iv) names and addresses of sugar factories, etc.

Trade notices

Batch centrifugals

Braunschweigische Maschinenbauanstalt AG, Postfach 3225, D-3300 Braunschweig, Germany.

BMA G1500 and G1750 batch centrifugals, which first appeared on the market in 1982, are now available with frequency-controlled drives which have a number of advantages over pole-change 3-phase motors and thyristor-controlled D.C. motors of the enclosed type. The machines are extremely smooth running and easy to install, and have the benefits of maximum reliability and low operating and maintenance costs. Already, 43 of these centrifugals have been sold.

Methane production from waste

Biomass International, P.O. Box 54, Chester CH1 3XY, England.

Biomass International's range of immobilized cell reactors for methane production from liquid effluents has been extended to include plant for treatment of waste containing high concentrations of suspended solids (up to 11,000 ppm); these second-generation plants have much lower operating costs than hitherto, giving a pay-back of about 1 year, while sludge production is about 5% of that from an activated sludge system. Effluents at present being successfully treated include distillery waste.

PUBLICATIONS RECEIVED

Digital flame photometer

Jenway Ltd., Gransmore Green, Felsted, Dunmow, Essex CM6 3LB, England.

The PFP-7 low-cost digital flame photometer, designed for a wide variety of analytical applications, combines extreme simplicity of operation with high specification. It incorporates an automatic flame failure cut-out device, operates on A.C. mains power at 250 V, 50 Hz, and requires a supply of propane, butane or natural gas; an incorporated compressor is capable of supplying a moisture-free output at approx. 6 litres/min at a pressure of 1 kg/cm^2. Readings are registered by LED display between 0 and 199.9 in relation to full-scale readings of 3-100 ppm Li, 3-100 ppm Na and 5-100 ppm K. Reproducibility is 1% CV for 20 consecutive samples of 2-6 ml.

Weighers

Chronos Richardson Ltd., Arnside Road, Bestwood, Nottingham NG5 5HD, England.

The February 1985 issue of *Chronos Richardson Review 7*, the company's quarterly review, carries a number of interesting items, including information on the Bulktronic 4 automatic bulk weighing system which provides full screen presentation of operations, each of which is recorded, and logs and totalizes each weighment, this information then being printed on a ticket or communicated to a remote computer/terminal. Also described is a bagging weigher control, the Speedac 5, which has been designed for use in harsh industrial environments.

Automatic palletizing

Dan Conveyor International A/S, Borgergade 17, DK-4241 Vemmelev, Denmark.

A new brochure from Dan Conveyor International illustrates applications of their automatic pallet loading systems, including a scheme for packeted sugar handling.

Larox filters

Larox Oy., P.O. Box 29, SF-53101 Lappeenranta 10, Finland.

Among literature available from Larox are brochures describing the Larox PF fully-automatic pressure filter of up to 31.5 m^2 filtration surface area (one of maximum size is shown handling carbonatation juice) and the Larox CF automatic chamber filter which is suitable for effluent treatment (sludge dewatering). Larox also manufacture classifiers, thickeners/clarifiers, screw pumps/conveyors, rotary valves, pinch valves and jet mills.

Digital thermometers

Coley Thermometers Ltd., Bryco Works 2-4 London Road, Brentford, Middx. TW8 8JP, England.

Coley Thermometers have introduced a new series of industrial digital thermometer. The CT 121 and CT 122 (the latter having high-low alarm contacts) have an accuracy of ±0.5°C in the range 50-200°C. Provided with a stainless steel case, they are operated by rechargeable battery or from the mains. They are designed to meet the stringent requirements of the food industry. A leaflet describing the thermometers is available.

Temperature control unit

Hale Instruments Ltd., Manor House, Manor Road, Altrincham, Cheshire WA15 9QX, England

Information is available on the Model H 1200 TC temperature control unit which will regulate temperatures to within ±1% of a set low point in the range 5-1200°C; the set high point is ignored — should the thermocouple temperature exceed the instrument setting, an in-built alarm is actuated. The temperature is displayed as large numerals by LED.

Checkweigher

Colbern Systems Ltd., Stanwick, Northants., England.

The CS 250 checkweigher can provide more than 300 weighings per minute, using a strain gauge load cell of 3 or 5 kg capacity according to requirement. It has microprocessor electronics and variable speed control, all data being protected by battery back-up, while the set-up information is accessible only by password so as to prevent unauthorized amendments. A warning is given if the average weight falls below the nominal quantity.

Measurement of equilibrium relative humidity

Lee-Integer Ltd., 31 Commercial Road, Kettering, Northants. NN16 8DQ, England.

Lee-Integer are now supplying screw-necked flasks (normally of 250 ml capacity) for use with their humidity probes for measurement of equilibrium relative humidity. A compression gland forms an air-tight seal to the body of a CH12 humidity/temperature probe, which provides simultaneous digital readings of temperature and % relative humidity or equilibrium relative humidity for a range of materials, including granular products and molasses.

Digital colorimeter

Jenway Ltd., Gransmore Green, Felsted, Dunmow, Essex CM6 3LB, England.

The PCO-2 is a digital colorimeter designed for routine measurements in the visual spectrum. It incorporates an LED display and provides three modes of measurement: transmittance from 0 to 100% with a resolution of 1.0%, absorbance from 0 to 1.5 with a resolution of 0.01, and two electronically linearized concentration ranges offering coarse and fine measurement of absorbance readings, with direct reading of solution concentration. Eight filters, covering wavelengths of 430, 470, 490, 520, 540, 580, 600 and 710 nm, are selected by switch. A tungsten light source with associated silicon photocell are provided.

Dust separation

E. E. Services Ltd., Colliery Industrial Estate, Main Road, Morton, Derbyshire, England.

E. E. Services have added a new compact model to their range of Filtajet reverse-pulse dust collectors. Space saving is achieved by use of a special central cartridge enclosed by a Nylotron geometrically pleated fabric, which provides maximum surface area within relatively small dimensions. Micro-chip control enables the filter to clean itself, with a sensing device preventing blockage of the fabric. There are no moving parts, and routine maintenance can be carried out at about monthly intervals by operators without special skills. Each unit, available in steel as standard but also available in stainless steel or aluminium for special applications, has an air volume capacity of 500 cfm; where required, units can be linked to increase capacity to 100,000 cfm.

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Dorr-Oliver caters to all your starch processing and sugar manufacturing needs with the leading line of liquid/solid separation equipment.

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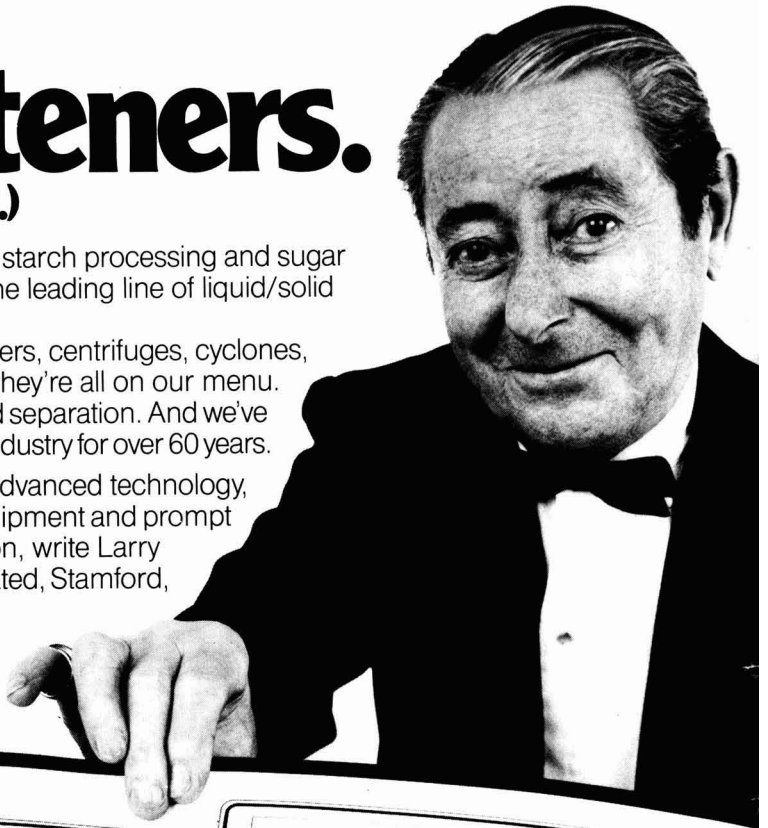

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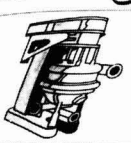
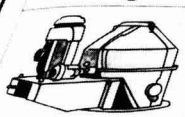
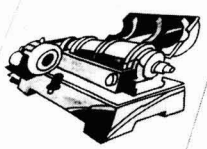


Merco® Disc-Nozzle Centrifuges
- ★Starch concentration, clarification and washing
- ★Syrup purification
- ★Yeast recovery
- ★Three phase separations

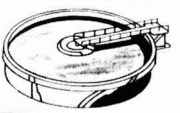


Mercone® Screening Centrifuges
- ★Fiber dewatering
- ★Crystal dewatering

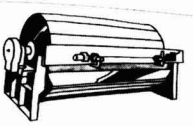


MercoBowl® Solid Bowl Centrifuges
- ★Fruitwater removal
- ★Decanting
- ★Gluten concentration

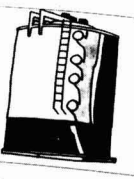
DSM® Screens
- ★Fiber washing
- ★Germ washing
- ★Dewatering
- ★Sugar juice fiber removal
- ★Syrup purification



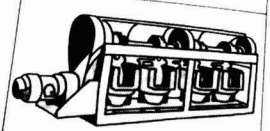
CableTorq® Thickeners
- ★Wash water recovery



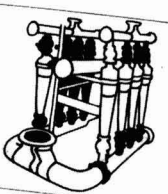
Vacuum Drum Filters
- ★Gluten dewatering
- ★Syrup polishing
- ★Starch dewatering
- ★Cane mud filters
- ★Beet carbonation filters
- ★Wash water recovery—mud dewatering



RapiDorr® 444 Clarifiers
- ★Cane and beet juice purification



Dorrco® Diaphragm Pumps
- ★Thickener underflow ★pumps
- ★Clarifier mud pumps
- ★Slurry pumps



DorrClone® Liquid Cyclones
- ★Germ separation
- ★Starch washing systems
- ★Degritting
- ★Desanding systems

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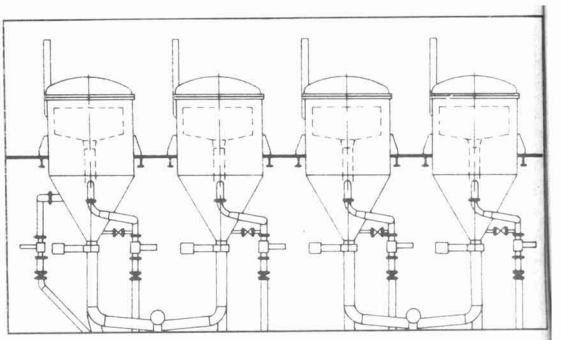

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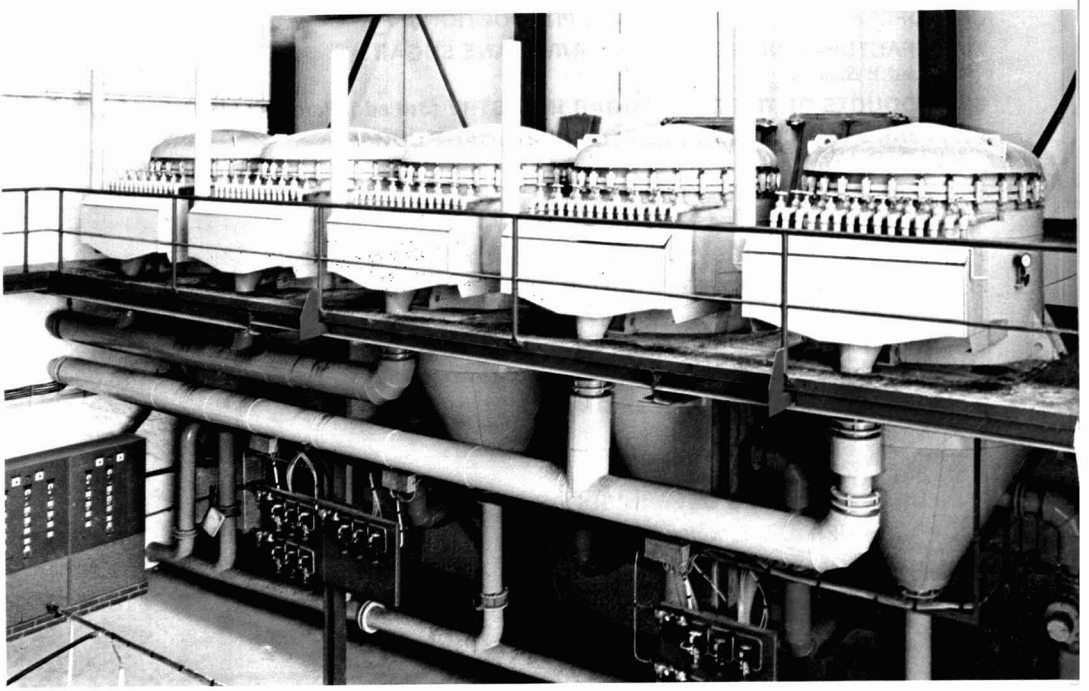

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