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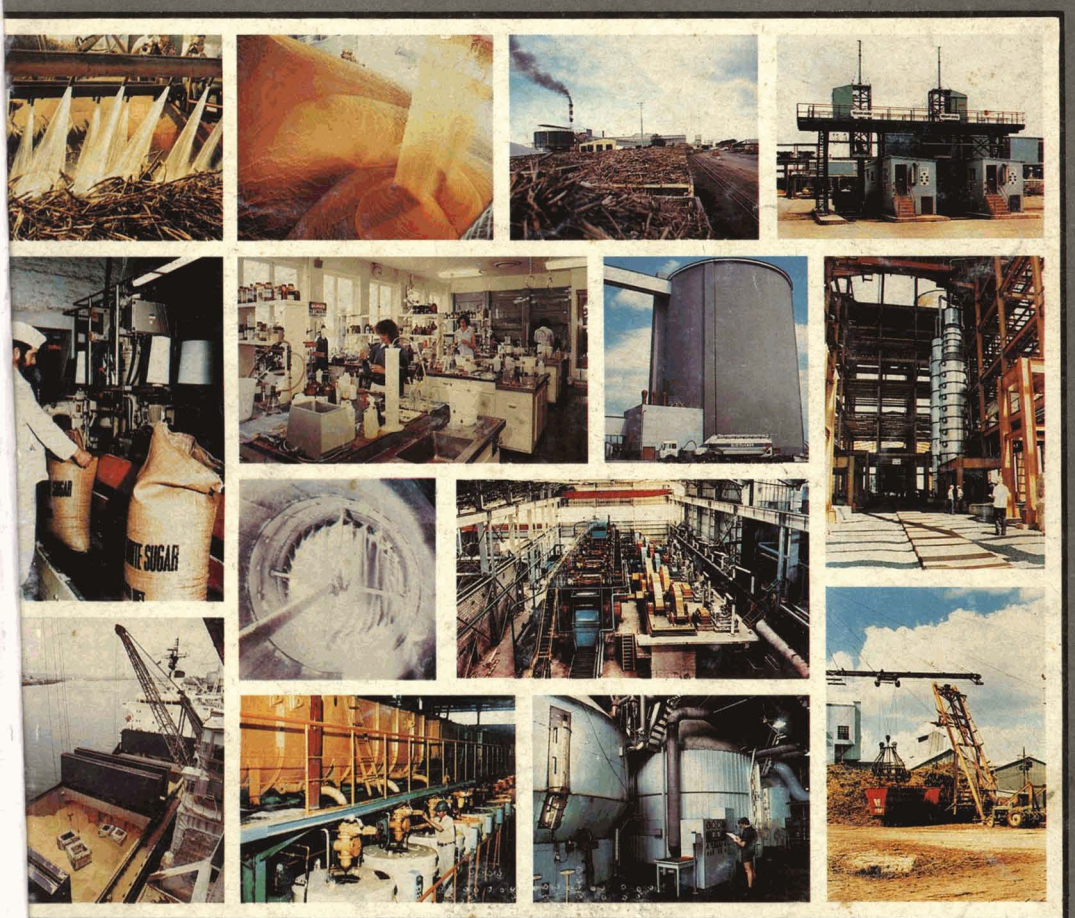

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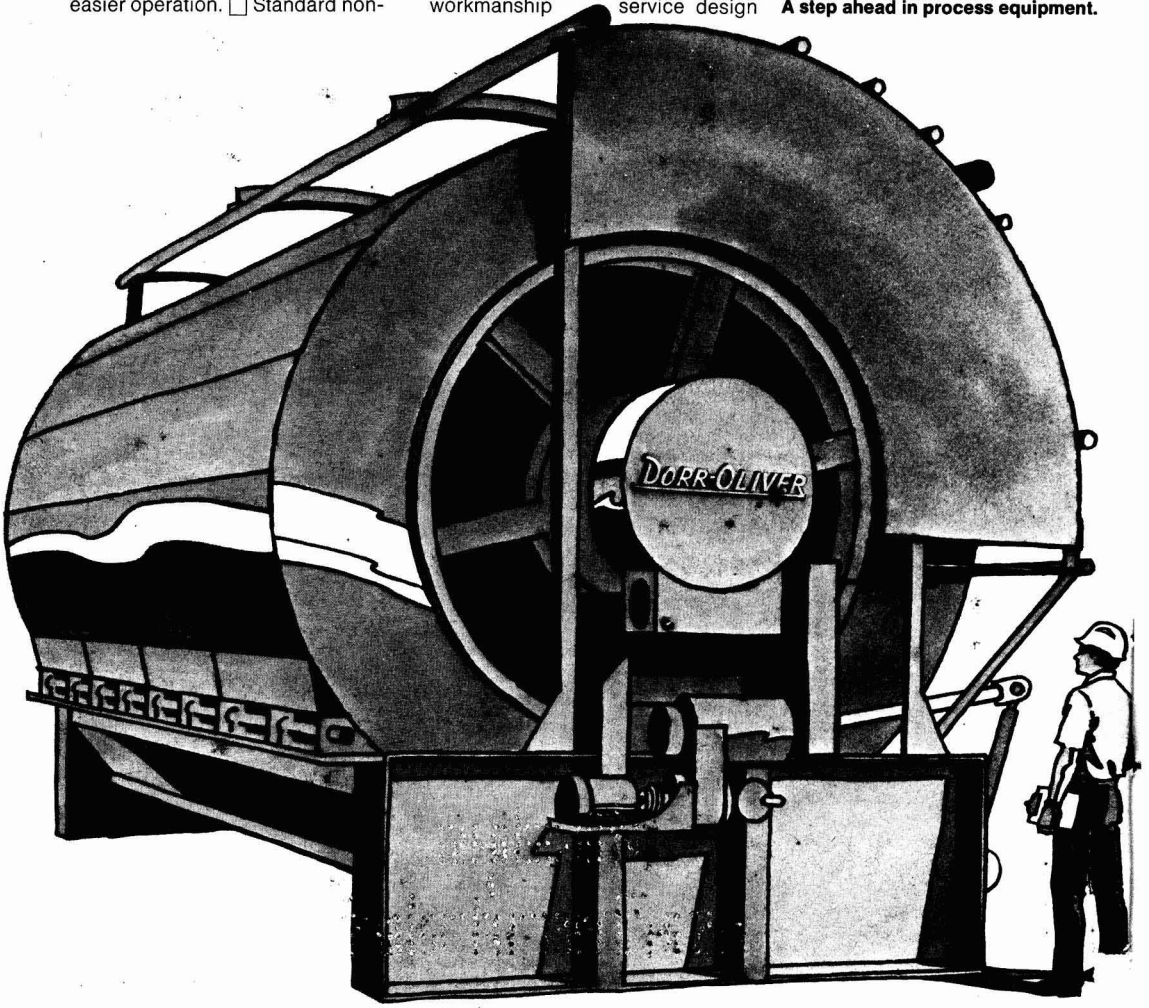

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NOTES AND COMMENTS

World sugar prices

The slide in prices at the end of October continued in November and the LDP which started the month at £135 per tonne dropped to £130 on November 3. News that Brazilian representatives were in Moscow negotiating a sale to the USSR cheered the market, especially when it was announced that the quantity was higher than had been expected. Another factor was news that the Philippines had bought white sugar for internal use because of a delay in its own crop. The price rose to £145 by November 8 but the recovery was short-lived and by November 14 the LDP had dropped to £131.50 per tonne following an assessment of the world sugar balance by F. O. Licht GmbH which indicated that favourable conditions in Europe were making for a crop recovery which would eliminate the previously expected shortfall of world production against consumption. Some brief confidence returned but the price fell again to £129 on November 17. Following reports of Soviet purchases of EEC sugar, including beet raws, and inquiries from the Far East the market was encouraged again and the price rose to £145 on November 22 before easing to £140 two days later. Further news of Philippine purchases of sugar, and a surge in gold prices also affected the sugar market to bring the LDP back to £145 but the improvement could not be sustained and the month ended with a price of £143 per tonne.

The continued availability of white sugar in large amounts, and news of over-quota sales by India as well as Thailand were factors in weakening the premium of whites over raw sugar, so that the LDP(W) which started the month at £152 represented a premium of £17 which was reduced to only £10.50 per tonne by November 8 although it recovered later and remained around £14-£16 through most of the month, ending on November 30 at £18.50, when the LDP(W) was £161.50 per tonne.

World sugar production, 1983/84

F. O. Licht GmbH have recently published their first estimate of world sugar production for the 1983/84 season[1]. Their figures (reproduced elsewhere in this issue) refer to crops which begin in the period May 1983/April 1984 and are consequently not directly comparable with other estimates using a different criterion. The remarkable level of production in 1982/83, set at above 100 million tonnes, raw value, gave rise to the current enormous world sugar surplus and might have been expected to have led to a marked drop in output during the current season. Licht's estimate indicates, however, that output is not expected to decline by more than 6%. Moreover, this is not solely due to deliberate reductions in crop areas but also to adverse weather in key growing areas. This augurs ill for the 1984/85 crop as production in these areas is likely to come back. In 1983/84 world production and consumption are considered likely to be in better balance, with production at 94.5 million tonnes and consumption rising to 95-96 million tonnes, which could create a small overall deficit. However, this will not solve the current surplus problem; "it is imperative that the question of overproduction is addressed as soon as possible. Whether it is addressed directly by individually decided or internationally agreed cuts, or indirectly by cutting exports and letting the heavy build-up of stocks force production cuts, is immaterial. At the same time, it is important to ensure that production is not cut too much, sowing the seed of the next destructive swing of the sugar cycle".

Following the exceptionally high yields of 1982/83, the cut in areas in 1983 and early bad weather conditions can be expected to reduce beet sugar production in Western Europe and a fall of 3.7 million tonnes is forecast. In East Europe crops are expected to be the same or smaller except in the one which counts – the USSR, where earlier sowings and favourable weather are expected to raise sugar production, giving a net increase of 300,000 tonnes for the region.

A similar increase is expected in non-European beet sugar outturn, with appreciable increases in Canada, Chile, China, Egypt, Iran and Morocco only partly offset by a decrease in Japan.

As a consequence of increases in Cuba and elsewhere offset by decreases in Mexico and the US, cane sugar production in the Western Hemisphere is expected to be almost exactly the same as in 1982/83, while in Africa, the increases expected in Kenya and the Sudan are more than offset by reductions in Mauritius, Réunion and South Africa, so that an overall drop in production of 600,000 tonnes is forecast.

A greater fall is expected in Asia, where major crop reductions are expected in China, India and Thailand, leading to 1.6 million tonnes less sugar. In Oceania, adverse weather has hit both Australia and Fiji and production is estimated at 740,000 tonnes less than in 1982/83. As a consequence of all these, beet sugar and cane sugar outturns are each expected to be some 3 million tonnes lower, giving a reduction from 100.6 to 94.5 million tonnes.

EEC sugar situation

C. Czarnikow Ltd. reviewed supply, consumption, stocks and availabilities in the EEC recently[2], as follows:

"Expectations for the current crop in the Community have continued to show improvement in recent weeks as conditions for harvesting in many areas have been almost ideal. Although the start of the campaign was delayed to allow the crop some additional time in order to maximize this late recovery in yields, the total volume of roots has been much lower this season and already harvesting operations in many countries are reaching their closing stages. Factories will continue processing until the early weeks of 1984 but by now a reasonably close assessment of final production can be made. The latest estimates indicate a total for the Community, including cane sugar production in the French Overseas Departments, of about 11.1-11.2 million tonnes, white value.

"The EEC producers in each of the past two seasons have segregated approximately one million tonnes out of their C-sugar production to be carried forward to the following marketing year. The amount of such sugar brought forward to 1983/84 is 1.08 million tonnes which will augment current production and will form the initial charge against respective members' basic quotas. The sharp fall expected in production from the current crop will have a corresponding effect upon the output of C-sugar in 1983/84. We believe that this

[1] *International Sugar Rpt.*, 1983, **115**, 527-535.
[2] *Sugar Review*, 1983, (1676), 221-222.

will only amount to one third of the level reached last season at some 1.15 million tons. Producers have until the end of January 1984 to decide how much, if any, of this sugar is to be carried forward into 1984/85 and a definite decision will not be known until then. However, it is our impression that most, if not all, of this sugar will probably be destined for export this season.

"Supplies from the ACP producers of 1.3 million tonnes brings the total to 13.53 million tonnes. From this can be deducted estimated consumption at around 9.5 million tonnes and 100,000 tonnes representing the net export of sugar in composite goods, to leave a balance of 3.93 million tonnes of surplus sugar available for export and/or placing in stock. Of this we have already referred to some 1.15 million tonnes which is C-sugar, leaving nearly 2.8 million tonnes of quota sugar. Up to this point we have made no reference to the level of quota sugar carry-over stocks and the extent to which these might be altered during the course of 1983/84. These stocks were at historically high levels at the beginning of 1983/84 and are believed to have amounted to some 1.95 million tonnes. It is possible that stock-holding to this degree will continue to form part of the Community's marketing policy but, should it wish to, the Commission clearly has the scope to permit exports of quota sugar to exceed 2.8 million tonnes to the extent that it is prepared to reduce carry-over levels of A- and B-sugar."

World sugar production and consumption

Sugar production throughout the world is now of the order of 100 million tonnes, as is consumption, and the assembly of figures from all the countries concerned, in order to prepare a composite picture of world supply and demand is fraught with potential error. Figures published by different bodies are often quite close but when quite small percentage differences are in opposite directions in respect of supply and demand, the net effect can give a significantly different idea of the balance.

An example of this has been provided recently by F. O. Licht GmbH and *World Sugar Journal.* Licht estimates world sugar production in 1983/84 to reach 94.5 million tonnes, raw value, and consumption 95-96 million tonnes, resulting in a deficit of 0.5-1.5 million tonnes[1]. On the other hand, admittedly on a different crop year basis, *WSJ* calculates[2] that production will fall to 92.9 million tonnes and consumption rise to 97.0 million. While the production and consumption figures are only 1.7% and 1.0-2.1% apart, respectively, the *WSJ* deficit is 4.1 million tonnes and could reduce considerably the real surplus of sugar hanging over the market. It will be interesting to see, in the fullness of time, which forecast is nearer reality.

Indian sugar expansion queried

Final production of sugar in the 1982/83 season is estimated at 8.23 million tonnes, white value, against 8.44 million tonnes in the previous season[3]. The problem of large surpluses will thus continue next year and a serious problem will be to provide adequate storage space for large stocks. Moreover, the financing of these stocks will seriously strain the resources of the sugar industry.

On the other hand, the government continues to license new sugar factories, although at some stage this will need review in the context of the present glut of sugar. Recently, five new sugar factories with a processing capacity of 1250 t.c.d. have been sanctioned while licences for a further 57 factories have been granted in recent years. The total licensed capacity has been placed by the government at about 81 million tonnes; however, the industry thinks that this assessment is very conservative and considers a realistic figure would be about 94 million tonnes which corresponds to the figure visualized for the end of the 6th Five-Year Plan, i.e. 1984/85. The industry has therefore persistently urged the government to stop further licensing of new sugar factories.

The sugar price argument

An interesting viewpoint was recently put forward in *Sucrerie Française*[4] concerning the benefits of a higher sugar price. The editorial points out that the world market is more complex than the idea of rich developed countries buying from poor developing sugar exporters. There are rich exporters such as the EEC selling to poor importers such as Nigeria, rich selling to rich (Australia to Japan), poor to poor (Thailand to Vietnam) and poor to rich (Cuba to Canada). Not all the poor developing countries have an interest in higher sugar prices and there are 91 of them, with a total population of 2000 million, who are importers and thus have an interest in low prices, against 35, with a total population of 1100 million, who are sugar exporters, and would thus like a high price.

A solution might be for the rich importing countries to provide guaranteed outlets at favourable prices to developing exporters who could then sell at a lower price to developing importers. In parallel, the rich exporters could have two scales of charges depending on whether the customer were a rich or a poor importer. In fact, *Sucrerie Française* points out, the rich importing countries refuse to provide purchase guarantees or to participate in the financing of stocks, while the poor exporters put pressure on the EEC in the name of third-world interests in order to lead to an increase in price — which would make it more difficult for many developing countries to buy sugar!

Possible Italian sugar industry crisis[5]

The national sugar beet growers' consortium has said that Italian growers are considering sowing alternative crops instead of sugar beet next year because the sugar industry's financial position does not seem to be improving significantly despite the allocation of 100,000 million lire in government funds to the sector. Despite receiving 42,000 million lire in government allocations in the summer of 1982, the Montesi Group's sugar-producing firms Generale Zuccherifici and Carvarzere are still in debt to farmers for beets delivered during the 1982 season, the consortium said. The sugar producer Romana Zuccheri has also been in government receivership for several years.

Consortium sources said that, since the financial instability of the producer firms does not guarantee farmers will be paid for their delivered produce, farmers in some areas, particularly the central-east region and several southern regions, are currently considering planting maize and hard wheat next year rather than sugar beet. The sugar beet area in 1983 was already substantially reduced compared with the year before, and a further decline in sowings would put the future of the Italian sugar industry in jeopardy.

Austrian beet sugar and alcohol project[6]. — A project is in hand for the establishment of combined alcohol and sugar production at the Bruck sugar factory, the smallest in the country.

[1] *International Sugar Rpt.*, 1983, **115**, 531-532.
[2] *World Sugar J.*, 1983, **6**, (4), 9.
[3] F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 524.
[4] 1983, **124**, 413-414.
[5] F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 537.
[6] *Zuckerind.*, 1983, **108**, 1093-1094.

Bagasse drying: past, present and future

By ABILIO ARRASCAETA and PAUL FRIEDMAN
(Cuban Sugar Research Institute, Havana, Cuba)

Introduction

The first interest shown in bagasse drying with boiler stack gases dates back to 1910, when Professor E. W. Kerr[1] showed that it was impossible in some Louisiana mills at that time to cover the sugar mill's energy demand with bagasse alone, owing to its high moisture content. He built a dryer and reduced the moisture content from 54.47% to 44.45%, raising the steam production from 1.63 to 2.53 kg steam/kg bagasse. His dryer was a square tower with bagasse descending and stack gas rising in a countercurrent manner. The tower was equipped with deflectors to promote better gas-solid contact. According to a report Kerr made of his work, the dryer was not used commercially.

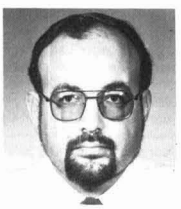
Between 1910 and 1970, only a small number of papers appeared in the literature and even fewer industrial applications were reported. These papers in general did not contain material and energy balances, and some even incorrectly considered that the increase in the calorific value of the dried bagasse was the cause of the increased steam production[2]. This was later corrected by authors who showed that the increase in steam production is a consequence of increased boiler efficiency. Some authors such as Díaz Compain[3] suggested the use of air pre-heated by boiler stack gases as the drying agent.

The reasons for the lack of interest in bagasse drying during this period are clear. Owing to the low cost of fossil fuel, bagasse was not very attractive as an alternative and, in the cases where it was used as a raw material, cheap oil was used as its substitute.

Since 1970, a number of technical reports, both theoretical and practical, have appeared. Grobart[4,5] and ICIDCA[2] developed a mathematical model of the dryer-boiler system and studied different combinations. Boulet[6] stated that drying could reduce both air pollution and excess air to the boiler. Other authors considered using a dryer combined with an economizer or air pre-heater. Shishido[7] noted that the saving due to the use of this energy recovery process is greater when the boiler is more inefficient.

Mullen[8] suggested the use of preheated air for drying in rotary drums with moisture reductions from 50 to 35% while Paul[9] showed that the heat content of the boiler stack gases is more than sufficient to dry the bagasse. Bailliet[10] calculated an increase of 8.9% in boiler efficiency when fired with bagasse reduced from 52 to 32% moisture. Mullen[8] recommended drying only part of the bagasse and then mixing it with the rest, while Ghosh[11] considered that the air preheater is preferable to the dryer for energy recovery since it is easier to install and operate while requiring less energy than the dryer.

A. Arrascaeta



Paul Friedman

Very few industrial applications have been reported. Furines[12] described his experience in a mill in Louisiana with a rotary drum dryer. In 1979, Fraser[13] reported an increase of 24% in the electricity generated by the Waialua sugar mill in Hawaii after installing a bagasse dryer. Shishido[7] gave further details on the same installation, stating that boiler efficiency increased from 64.3% to 68.9% with a saving of 8% of bagasse by drying from 47.8% to 33.5% moisture. In 1980, Correira[14] described the use of a pneumatic transport dryer and the advantages it has over the rotary dryer. He reported an increase in steam production of 16% by drying the bagasse from 52% to 40% moisture.

Present situation

Today, the demands for the use of bagasse as a fuel or a raw material for the production of paper, particle board, furfural, animal feed, etc. are growing rapidly. Thus a sugar mill with a bagasse surplus can:

(a) supply bagasse to nearby paper mills, particle board plants, etc.,
(b) supply steam to neighbouring plants for the production of refined sugar, torula yeast and alcohol, or
(c) produce electricity for sale to adjoining plants, regional power systems, or for irrigation of sugar cane[13].

It is necessary to point out that in most cases where bagasse is presently being used as a raw material, it is not surplus and must be substituted for in the sugar mill by fuel oil. For example, in the case of Latin America where 58 million tonnes of bagasse are produced annually and 9.2 million tonnes of this bagasse are used as raw material for other industries[15], about 1.6 million tonnes of fuel oil are used to substitute this bagasse at a cost of over 250 million dollars. Thus it is very clear that profitability of using bagasse as a raw material depends on whether it is surplus or not.

According to Quesada[16], in 1969, Cuban sugar mills did not have bagasse surpluses. This situation did not change until 1981. On the other hand, Lu[17] at the same time reported surpluses in Taiwan because of a more efficient use of process steam. Baloh[18] carried out a thermodynamic availability study of the sugar mill and showed that by increasing the efficiencies of both steam

1 *Louisiana Bulletin,* 1911, (128); quoted by Boulet: *Sugar J.,* 1975, **37**, (10), 40-47.
2 "Mathematical modelling of dryer-boiler system using bagasse as a fuel. Project IA-112", (Eng. Dept., ICIDCA, Cuba) 1971.
3 *Proc. 34th Conf. ATAC,* 1960, 75-87.
4 *ICIDCA Rpt.,* 1972, (72-164).
5 *ibid.,* 1972, (72-167).
6 *Sugar J.,* 1975, **38**, (6), 8-11.
7 *Hawaiian Sugar Tech. Rpts.,* 1979, 130-132.
8 *ibid.,* 1977, 21-23.
9 *Proc. 5th Joint Conv. Indian Sugar Tech. Assocs.,* 1975, (1), E.33-E.37.
10 *Sugar J.,* 1976, **38**, (10), 52-53.
11 *Proc. 16th Congr. ISSCT,* 1977, 2363-2373.
12 *Sugar J.,* 1976, **39**, (3), 39-40.
13 *Hawaiian Sugar Tech. Rpts.,* 1979, 133-135.
14 *Proc. 17th Congr. ISSCT,* 1980, 2000-2011.
15 *Noa et al.: Paper presented to the 43rd Conf. ATAC,* 1981.
16 *CubaAzúcar,* 1969, (July-Sept.), 2-12.
17 *Taiwan Sugar,* 1971, **18**, 21-31, 63-75, 111-118, 161.
18 *Rpt. seminar on energy in the sugar industry* (OLADE/GEPLACEA/UNDP, La Habana, Cuba), 1980.

production and use, it should be possible to obtain surpluses of 50% of the bagasse produced.

De Armas *et al.*[19] analysed the factors involved in increasing the energy efficiency of a sugar mill, thereby obtaining surplus bagasse, and these results are shown in Table I.

Table I. Sugar mill steam balance[19]

Type of sugar mill	Steam production, tonnes steam/ tonne cane	Steam consumption, tonnes steam/ tonne cane	Bagasse surplus, %
Present technology Latin America	0.50	0.50	0
More efficient use of steam*	0.50	0.35	15
More efficient use* and production** of steam	0.65	0.35	30

* Quintuple-effect evaporator station with bleeding to supply all steam to heaters and vacuum pans
** Boiler with spreader-stoker and air preheater with boiler stack gases at about 200°C

In addition to the above-mentioned surpluses, if the boiler stack gases were used to dry bagasse from 50% to 30%, an extra surplus of approximately 10% could be obtained, as is shown in Fig. 1, reproduced from a paper by Arrascaeta[20]. Other authors (Correira[14], Grobart[5], Rader[21] and Shishido[7]) have calculated and/or obtained similar results.

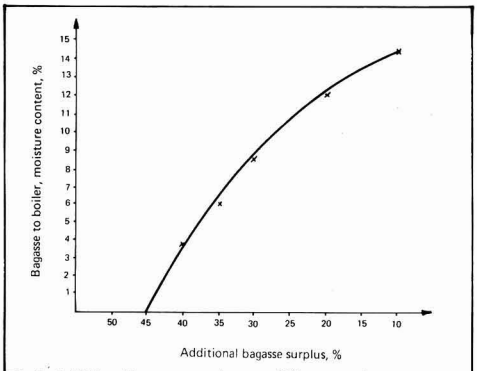


Fig. 1. Additional bagasse surpluses at different moisture contents

This additional surplus is due to the increase in boiler efficiency because of the energy recovered in the boiler stack gases which can exit at temperatures as low as 60°C (Nelson[22], Shishido[7]).

Other advantages of bagasse drying are:
- better combustion of bagasse[10],
- higher temperatures in the boiler[23],
- reduction in the amount of excess air[6],
- reduction in the volume of the stack gases[14] and
- reduction of air pollution[6,7,22,24].

According to Horton[23], gas leaving the boiler contains from 1500 to 12500 mg/Nm^3 of ash which must be reduced to 400 mg/Nm^3. Bagasse dryers could help solve this problem and results of both rotary[7] and pneumatic[14] bagasse dryers show important reductions in ash content of the final stack gases.

Bagasse drying as part of an integrated system

Different types of equipment can be used to recover energy from the boiler stack gases; air pre-heaters, feed water heaters (economizers) and bagasse dryers. The bagasse dryer can be used in combination with the others. There are several advantages in using the bagasse dryer. Perhaps the most important is that a greater amount of energy can be recovered from the boiler stack gases, because a final temperature of 60°C can be reached[7,22], as compared with 150-200°C with air pre-heaters and economizers, owing to localized corrosion. Another important advantage is that, during the drying, size classification of particles can also be achieved which could bring further benefits in bagasse transport, storage and combustion[25].

There are several difficulties which arise in the installation of an industrial dryer, viz. (1) very few dryers have been installed and the process has not yet been optimized, (2) there is a need for an efficient system to transport and store the dried bagasse, and (3) existing boilers cannot use bagasse of less than 40% moisture[22].

The dryers which could be used for bagasse are rotary drum, pneumatic transport and fluidized bed types and combinations of these.

Although the rotary drum dryer has been used in several installations[7,12,21], Correira[14] reports that the cost of a pneumatic transport dryer is 47% less than that of the rotary drum dryer. On the other hand, Friedman[26] has suggested that a combined fluid bed-pneumatic transport dryer would have lower investment and operating costs than a pneumatic transport dryer. The ICINAZ pilot plant combined dryer, currently under study, is shown in Fig. 2.

Bagasse is a very non-uniform material. Boizan[27] has divided the raw bagasse into three size classifications: bagasse, greater than 5 mm; bagacillo, between 0.3 and 5 mm, and pith, less than 0.3 mm. A typical distribution by size fraction reported by Ponce[28] is shown in Table II.

In pneumatic transport, the velocity at which a gas will begin to transport a specific particle is called the terminal velocity. The terminal velocities for different bagasse size fractions were determined by Grobert[2] and are shown in Table III.

Table III shows that, at gas velocities greater than 13.9 m/sec, all of the bagasse will be transported pneumatically. At velocities less than 13.9 m/sec the raw bagasse will be separated into two fractions. This separation could enable the use of more efficient systems of pneumatic transport, and storage in silos, which would

19 *ibid.*
20 *Paper presented to the 43rd Conf. ATAC,* 1981.
21 Rader Companies Inc. Brochure, 1980, (8006).
22 *Paper presented* February 10, 1977 in Baton Rouge, Louisiana, U.S.A.
23 Horton: *I.S.J.,* 1980, **82,** 309-315.
24 Finlayson *et al:* "The use of low quality coal." (Coal Processing Consultants Ltd., England) 1979.
25 Arrascaeta: *Paper presented to the 6th Conf. ICINAZ,* 1981.
26 Internal report, ICINAZ, Cuba, 1981.
27 *Control, Cibernética y Automatización,* 1980, **14,** (1), 9-18.
28 *Paper presented to the 6th Conf. ICINAZ,* 1981.

Table II. Bagasse size distribution at Pablo Noriega sugar mill, 1981[28]

Size, mm	0.18	0.48	0.72	1.02	1.78	3.18	4.80	6.80	9.60	13.60	19.20
Weight, %	4.0	11.8	14.1	11.2	17.8	7.4	13.5	4.5	7.0	4.2	2.0

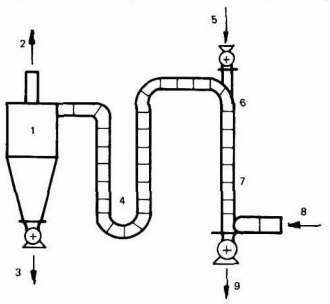


Fig. 2. ICINAZ pilot plant combined dryer. Key: (1) Cyclone; (2) Gases to stack; (3) Dried bagasse fines discharge; (4) Pneumatic transport stage; (5) Wet bagasse feed inlet; (6) Separation chamber; (7) Free-fall stage; (8) Boiler stack gas inlet; (9) Dried coarse bagasse discharge

be placed between the mill train and the boilers. Separation of the bagasse into a coarse and a fine fraction could also permit the use of feeders and burners adapted specifically to the size fraction in question.

Dried bagasse with 30-40% moisture content will allow a more efficient combustion process with higher temperatures. This is a limiting factor in the use of dried bagasse in traditional boilers[23], because the ash softening temperature can be exceeded causing the fouling by slag of the boiler tubes[29].

There are several possible alternatives to solve this problem. One is the use of cells[30], to burn the bagasse where particles are separated by size and the combustion process supposedly is more highly controlled. The use of cyclonic burners where ash is extracted in liquid form[29] is a possibility which would greatly improve the air pollution problem and permit the use of higher temperatures. A third possibility is the use of fluidized bed burners as reported[24] for the combustion of low quality coal.

Thus it is clear that the bagasse dryer is only a part of an integrated system which is composed of the dryer-classifier, pneumatic transport, silos, special burners, more efficient boilers, and air pollution control devices.

In practices, the bagasse "system" will vary, according to the needs and conditions of the specific sugar mill.

Two cases where the installation of an integrated system would be very useful are:

Case A (see Figure 3): Sugar mills which have a surplus of bagasse that can be used as: (i) raw material for a by-product plant, (ii) fuel for producing steam to be supplied to neighbouring plant, or (iii) fuel for the generation of electricity to be supplied to an electrical system or other plants.

Case B (see Figure 4): Sugar mills which have a surplus of bagasse that will be depithed and used as a raw material for other plants. In this case, the fibre (depithed bagasse) is pre-dried before storage to reduce losses which have been reported[31] to be as high as 25%.

Conclusions

1. The use of bagasse as a fuel and a raw material for the production of paper, particle board, furfural and other products is of ever-increasing interest.
2. The use of bagasse substituted by fuel oil is much less advantageous economically than the use of surplus bagasse.
3. Among the different energy recovery processes from boiler stack gases, bagasse drying has the advantage of

Table III. Terminal velocities for bagasse fractions[2]

Size fraction, mm	<1.0	1.0	2.0	4.0	8.0	12.5	16.0	>20.0
Gas velocity, m/s	1.15	3.00	4.65	6.15	7.25	8.30	8.80	13.90

[29] Babcock & Wilcox Co.: "Steam, its generation and use", 37th Edn. (Ediciones Revolucionarias, Cuba) 1966.
[30] Ocampo: *Sugar News,* 1968, **44**, 242-245.
[31] Lois *et al.: CubaAzúcar,* 1981, (Jan-March), 27-35.

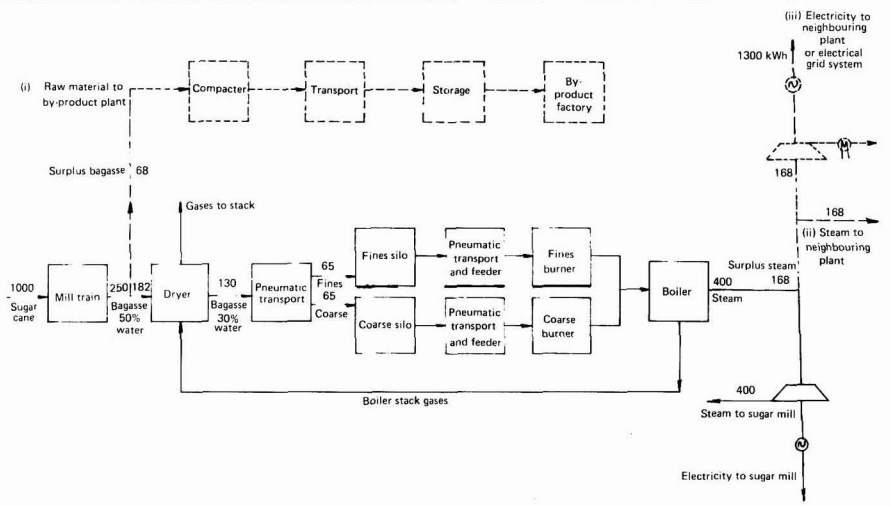


Fig. 3. Case A (Flows in tonnes per day)

producing additional bagasse surpluses of up to 10% and reducing air pollution.
4. Further research is needed to develop an "optimum" bagasse dryer.
5. The full advantage of bagasse drying and classification can only be achieved by the development of an integrated system which would incorporate new methods of transport, storage, and combustion.

Summary

Although bagasse drying for energy recovery was first studied in 1910, little was done until the past few years when interest in bagasse as a fuel and as a raw material increased greatly, owing to the world energy crisis and possible raw material shortages. A critical analysis is made of the literature, and the advantages of bagasse drying are shown. Different types of dryer are considered, and the use of a combined fluidized-pneumatic transport dryer is suggested. A dryer of this type would also separate the bagasse into different fractions, and it is shown that this would be advantageous for handling, storing and burning bagasse in an integrated system. Several possibilities for the use of such an integrated system are suggested.

Séchage de bagasse: passé, présent, futur

Bien que le séchage de bagasse pour récupération d'énergie fut d'abord étudié en 1910, peu fut fait jusque ces dernières années quand l'intérêt pour la bagasse comme fuel augmenta considérablement dû à la crise mondiale d'énergie et déficit possible en matières premières. Une analyse critique est faite de la littérature et les avantages du séchage de la bagasse sont montrés. Différents types de sécheurs sont considérés et l'utilisation d'un sécheur à lit fluidisé combiné à transport pneumatique est suggérée. Un sécheur de ce type séparera aussi la bagasse en différentes fractions et il est montré que cela est avantageux pour la manipulation, le stockage et la combustion de la bagasse dans un système intégré. Différentes possibilités pour l'utilisation d'un tel système intégré sont suggérées.

Bagassetrocknung: Vergangenheit, Gegenwart und Zukunft

Obwohl die Bagassetrocknung für die Energie- und Rohstoffgewinnung erstmals im Jahre 1910 untersucht wurde, geschah relativ wenig bis vor ein paar Jahren, als das Interesse für Bagasse als Brennstoff und Rohstoff infolge der Ölkrise und möglicher Rohstoffknappheit stark zunahm. Kritisch wird die Literatur analysiert und die Vorteile der Bagassetrocknung werden gezeigt. Verschiedene Trocknertypen werden betrachtet, und die Verwendung eines kombinierten, fluidisiert-pneumatischen Transporttrockners wird vorgeschlagen. Ein Trockner dieser Art würde auch die Bagasse in verschiedene Fraktionen trennen, was für Handhabung, Lagerung und Verbrennen in einem integrierten System vorteilhaft wäre. Mehrere Möglichkeiten für die Verwendung eines solchen integrierten Systems werden vorgeschlagen.

Secado de bagazo: pasado, presente y futuro

Aunque el secado de bagazo para recuperación de energía se han estudiado inicialmente en 1910, no ha hecho mucho hasta los últimos años cuando interés en bagazo como combustible y como materia prima ha aumentado marcadamente debido a la crisis mondial de energía y la posibilidad de escasez de materias primas. Se presenta un análisis crítico de la literatura y se demuestran los ventajes del secado de bagazo. Varios tipos de secador se consideran y el uso de un secador de transporte combinado – por fluidización y neumatico – se sugiere. Un secador de este tipo puede separar las diferentes fracciones del bagazo, también, y se demuestra que ésto sería ventajoso para el manejo, almacenaje y combustión del bagazo en un sistema integrado. Varias posibilidades se sugieron para el uso de un tal sistema integrado.

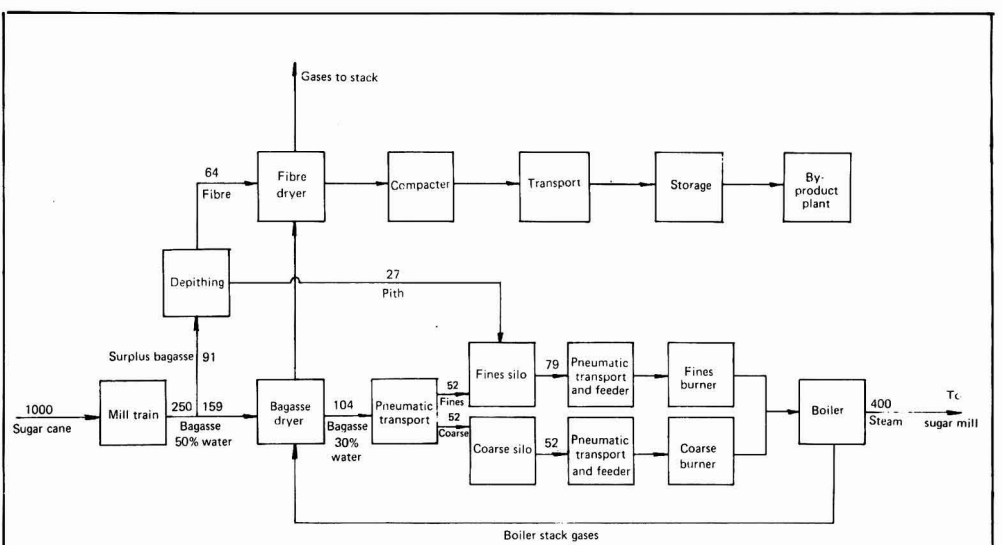


Fig. 4. Case B (Flows in tonnes per day)

Amino-acid removal during cane juice clarification

By S. C. SHARMA and P. C. JOHARY
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Cawnpore Sugar Works Ltd., Marhowrah P.O.,
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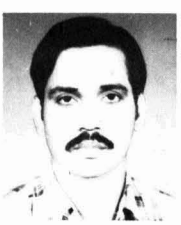
Introduction

Sugar cane juices are characterized by the presence of a series of colouring matter such as chlorophyll, xanthophyll, carotene and anthocyanins including a number of polyphenolic compounds most of which are eliminated completely or partially during clarification. Development of new colorants occurs during the course of concentration and further processing of the juices and syrups; these include caramel, melanoidin, a complex produced by iron-polyphenol interaction and products derived from polyphenolic constituents by enzymic oxidation. Like other organic and inorganic non-sugars, polyphenols[1] and amino-acids[2] are also removed to different extents during various processes of cane juice clarification.

Very recently, authors have made detailed studies on the role of polyphenolic compounds with special reference to their elimination during clarification[3-5]. Amino-acids are known to be of significance in the production of melanoidins. An average cane juice contains 0.02-0.06% nitrogen of which as much as 60% is present as ammonia and amino-compounds. The nitrogen-containing non-sugars present in cane juices may be distinguished as amido-amino acids (e.g. asparagine and glutamine), high molecular weight nitrogen-containing non-sugars (e.g. proteins or proteinic non-sugars) and amino-acids. Some of the amino-acids are removed during the clarification process, while others exist throughout the manufacturing process and have a tendency to react with degraded invert sugar to produce browning. These browning products cause colour during the process as well as in the final product. The work done and knowledge accumulated so far in respect of amino-acids is mostly confined to the quantitative assessment and identification of individual amino-acids in raw juice, raw and refined sugar molasses. Relatively less attention has been paid to the behaviour of amino-acids during the course of clarification. Although the determination of amino-acids has been carried out for many years by means of automated analysis equipment, up to now no action had been taken to suggest a uniform method of analysis either for all or for individual amino-acids. Further, on scanning the literature, it appears that no detailed and systematic studies have been made in respect of variation in amino-acid level. However, Agarwal *et al.*[6], while studying the physicochemical aspects of the formation of melanoidin and their influence on the colour of technical sugar solutions, estimated the amino-acid content in some abnormal and refractory Indian cane juices, employing the method described by Wiggins & Williams[7]. They also studied briefly the removal of amino-acids during the clarification process[2]. Recently, Kadar *et al.*[8] studied, by a chromatographic technique, the presence of 15 free amino-acids in Egyptian and Brazilian raw sugars, observing an additional acid, threonine, in the latter.

S. C. Sharma



P. C. Johary

The present communication discusses the results of the detailed and systematic experiments carried out to observe the variation in amino-acid content during various processes and schemes of cane juice clarification. In addition, the work also deals with the influence of milk-of-lime dose, extra phosphate addition, preliming and presulphitation on the extent of removal of amino-acid content. The relationships of amino-acid content with optical density of clarified juices and with ICUMSA colour of white sugar crystals is also described.

Experimental procedure

Representative samples of mixed juice were obtained from a nearby sugar factory during its normal working, and particularly when disease-free and fresh cane was being crushed, and were subjected to clarification on the laboratory scale employing conventional methods of defecation, sulphitation and carbonatation.

In one series of experiments mixed juices were clarified by the sulphitation process using different dosages of milk of lime; in another, different dosages of P_2O_5 were added to normal and phosphate-deficient mixed juice prior to clarification. The effect of preliming to pH 6.0, 6.5, 7.0, 7.5 and 8.0 before heating and sulphitation was examined, as was presulphitation to pH 5.0, 4.5 and 4.0.

Total amino-acid content (TAA) expressed as α-amino acetic acid or glycine equivalents, was determined in mixed and clarified juices by the method of Wiggins & Williams[7] with minor changes as follows: 10 ml of the filtered juice was pipetted into a 50 ml measuring flask and either 10% solution of sodium bicarbonate or a very dilute acetic acid solution added drop by drop so as to bring the pH to about 8.0. To this was added 20 ml of a copper phosphate suspension made up by mixing distilled water solutions of 35.80 g disodium hydrogen phosphate dihydrate and 6.0 g copper sulphate pentahydrate and making up to one litre. The volume of the juice mixture was made up to 50 ml with distilled water with thorough mixing. After keeping for about 25 min with occasional shaking, the contents of the flask were filtered through dry filter paper into a dry test tube, discarding the first few ml of filtrate. A 2.5 ml aliquot of the filtrate was placed in a

1 Sharma *et al.: Proc. Sugar Tech. Assoc. India,* 1978, **42,** M.123-M.126.
2 Agarwal & Johary: *Sharkara,* 1974, **13,** (3), 89-95.
3 Sharma *et al.: Proc. Sugar Tech. Assoc. India,* 1979, **43,** M.11-M.21.
4 Sharma & Johary: *ibid.,* 1980, **44,** M.73-M.90.
5 Sharma *et al.: Proc. 17th Congr. ISSCT,* 1980, 2137-2143.
6 *Proc. Sugar Tech. Assoc. India,* 1972, **38,** M.29-M.52.
7 *Proc. British W. Ind. Sug. Tech.,* 1951, 40-45.
8 *Proc. 17th Congr.,* ISSCT, 2056-2064.

graduated flask of 50 ml capacity and about 10 ml of the solvent (containing 140 parts of acetone, 60 parts of distilled water and 1 part of glacial acetic acid) was added. After addition of 1 ml of 0.2% solution of sodium diethyl dithiocarbamate, the contents of the flask were made up to 50 ml (solution A) with more solvent and shaken. A blank (solution B) was also prepared by taking 10 ml distilled water in place of juice. The optical density of solution A was measured against solution B at 420 nm on a Beckman Spectrophotometer Model B. A standard curve was also drawn by taking different concentrations of glycine. The total amino-acid content (TAA) was evaluated by interpolation and expressed in mg glycine equivalent per litre on 100°Bx.

The TAA content of 20 samples each of sulphitation and carbonatation white sugar was also evaluated by the same method as indicated above after standardizing it for direct consumption white sugars.

The optical density of clarified juices was measured at 420 nm after 1:4 dilution with buffer of pH 7.0, whilst the colour of sugar in solution was determined by the method recently described by ICUMSA[9].

Results and discussions

The extent of amino-acid removal in various processes of cane juice clarification is shown in Table I. It may be seen from the data that about 24% of the total amino-acids may be eliminated by clarifying the mixed juice by simple defecation. This could be due to the removal of a particular category of amino-acids along with the colloidal matter having an isoelectric point within the pH range 5.5-7.0 and which would be coagulated by bringing the pH of the mixed juice to 7.0.

About 42% reduction in amino-acid content was observed when the mixed juices were clarified by the normal sulphitation process employing 2% milk-of-lime. This probably results from:

(i) interaction of amino-acids and invert sugars to form melanoidin colorants during liming, sulphitation and heating of the treated juice,

(ii) adsorption of certain amino-acids on the surface of calcium sulphite, and

(iii) coagulation of amino-acids along with the colloidal matter during the clarification process.

The effect of variation in milk-of-lime dose in sulphitation is shown by the data in Table II. The TAA content removal increased from about 30% at 0.5% lime and attained its highest value of about 42% at an optimum lime dose of 2.0%, after which removal remained more or less constant up to 4.0% lime. The small variation in removal at higher lime dosage might be attributed to the high solubilities of amino-acids[10] in the presence of increased amounts of milk-of-lime and/or the slower rates of melanoidin formation in the presence of greater quantities of calcium sulphite in precipitated and/or dissolved state.

The influence of extra phosphate addition to normal mixed juices on TAA removal is shown by the data in Table III to be insignificant with only a very slight increase in percent elimination on adding 100 ppm P_2O_5 or more. In the presence of flocculated precipitate of tricalcium phosphate, since this is acidic in nature, the rate of melanoidin formation might have diminished appreciably, thereby consuming less amino-acids. On the other hand, the amino-acids were not adsorbed on the surface of tricalcium phosphate to the same extent as polyphenols. However, the mechanism needs further attention.

The removal of TAA content was also studied in phosphate-deficient juices after the addition of extra P_2O_5 doses prior to clarification and the results are reported in Table IV. The phosphate-deficient juices were characterized in having large amounts of amino-acids as is seen from the table. It was interesting to observe, however, the increase in the amino-acid elimination by the addition of extra P_2O_5. The results in Tables III and IV indicate that maximum elimination in amino-acid content occurred when the mixed juices had a P_2O_5 level of about 400 ppm. Values of phosphate lower than this showed relatively poor elimination while values higher than this did not impart a significant increase in the % removal. The higher concentration of amino-acids in phosphate-deficient cane juices and their significant removal as a result of adding larger doses of P_2O_5 appeared to be very interesting and needs further investigation so as to arrive at a definite conclusion and to explain the phenomenon.

Table I. Variation in TAA during various clarification processes

Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA variation from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice	2656	–	0.57
2.	a. Defecation	2020	−23.94	0.49
	b. Sulphitation	1538	−42.09	0.35
	c. Carbonatation			
	(i) 1st Carbonatation	3625	+36.48	0.20
	(ii) 2nd Carbonatation	2503	− 5.76	0.16

Data are average of three sets.

Table II. TAA affected by variation in dosage of milk of lime (10°Bx) employed for sulphitation

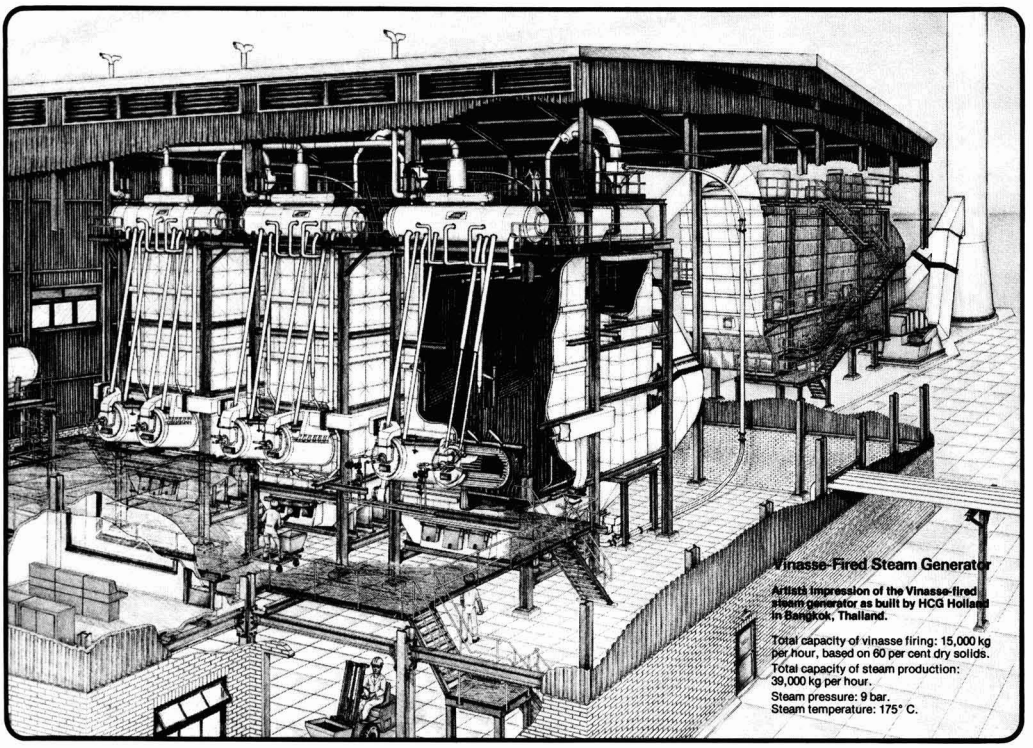
Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA removal from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice	2558	–	0.54
2.	Clarified juice (C.J.) with 0.5% lime	1778	30.49	0.35
3.	C.J. with 1.0% lime	1733	32.25	0.35
4.	„ 1.5% lime	1656	35.26	0.32
5.	„ 2.0% lime	1485	41.94	0.31
6.	„ 2.5% lime	1493	41.63	0.29
7.	„ 3.0% lime	1492	41.67	0.30
8.	„ 4.0% lime	1496	41.52	0.28

Data are average of three sets.

[9] "Sugar Analysis: ICUMSA Methods", 1979.

[10] Honig: "Principles of Sugar Technology". Volume III (Elsevier, Amsterdam) 1963, pp. 142-143, 145, 527.

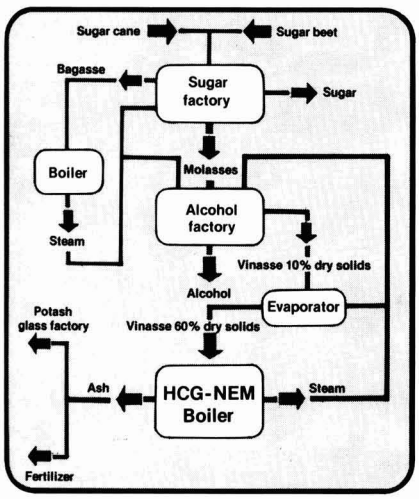
EFFLUENT TREATMENT and ENERGY SAVING through NEM VINASSE BOILER



Vinasse-Fired Steam Generator

Artist's impression of the Vinasse-fired steam generator as built by HCG Holland in Bangkok, Thailand.

Total capacity of vinasse firing: 15,000 kg per hour, based on 60 per cent dry solids.
Total capacity of steam production: 39,000 kg per hour.
Steam pressure: 9 bar.
Steam temperature: 175° C.



- During the production of power alcohol as well as industrial alcohol, vinasse is obtained as by-product. By evaporation to 60% solids concentration this vinasse becomes suitable as fuel for the HCG combustion boiler for generating process steam.
- By using vinasse as fuel, the alcohol factory can achieve savings of approximately 50% in fuel consumption.
- HCG has been involved in the development of vinasse-fired boilers for many years. Nine boilers have been built.

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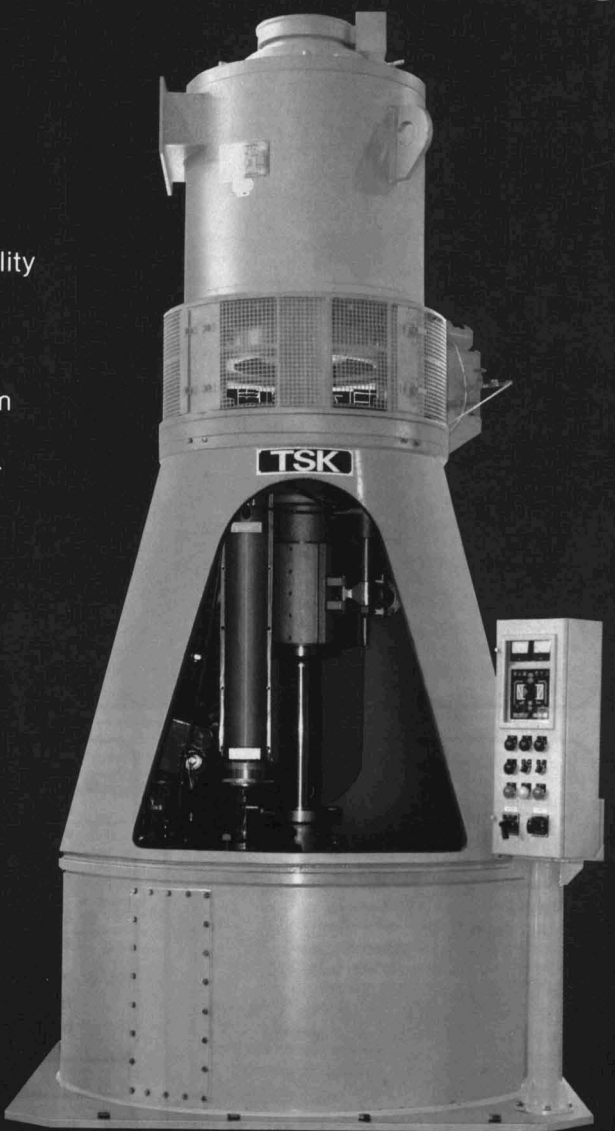

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- Constant high performance and durability due to mechanical simplicity
- Very low power consumption
- Easy, safe, quiet and clean operation
- Highly reliable sequence control system with micro processor
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SPEC. OUTLINES

- Basket size and Volume:
  48″×30″ (450L)
  48″×36″ (530L)
  50″×40″ (650L)
  53″×34″ (650L)
  53″×40″ (760L)
  53″×48″ (970L)
- Drive motor:
  BL Motor (Brushless, commutatorless variable speed AC motor with thyristor cells)
- Electrically regenerative brake system
- Spinning speed: 1,300rpm (normal)
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Table V shows the influence on removal of amino-acids of preliming to different pH values. It may be seen that preliming to 6.5 resulted in highest removal. Further, amino-acid removal from acidic prelimed juice (pH 6.0 to 7.0) was improved, while in the alkaline range (pH 7.0 to 8.0) amino-acid removal was even less than that observed for the control. The greater removal of amino-acids on preliming to pH 6.5 might be associated with coagulation of certain colloids at around this pH. Further, a number of amino-acids have their isoelectric point[11] in the pH range 5.5 to 6.5 and not in the alkaline pH range. In addition to this, the solubility of many amino-acids in alkaline medium, as indicated by Honig[10], might also contribute to their lower removal on preliming in the pH range 7.0 to 8.0.

The effect of presulphitation on TAA removal is presented in Table VI. It may be seen from the results that, by reducing the pH of mixed juice with SO_2 before liming, considerably larger amounts of amino-acids could be eliminated. Further, the maximum removal of nearly 50% could be achieved by presulphitation carried out at pH 4.0. Such a high removal in amino-acid level was not observed by any other process or scheme examined during the course of these studies. It was of interest to note that, in spite of the meagre possibilities for melanoidin formation during presulphitation carried out at pH 4.0, the amino-acids were removed to an appreciably greater extent. This might be due to flocculation of a large number of lyophilic colloids under acidic conditions, particularly around pH 4.0; the amino-acids may have been removed along with these colloids. This supposition is supported by the observation made by Vasatko[13] that most nitrogen-containing substances in beet juice are flocculated in acid medium, with a rapid change in the rate of flocculation with heating.

The variation in TAA content in the carbonatation process was shown in Table I. Instead of any elimination during 1st carbonatation, there was an enormous increase of 36.48% in amino-acid level; during second carbonatation the TAA content was reduced to 5.76% below that of mixed juice. Thus, overall removal in the carbonatation process appears quite low by comparison with the other clarification systems. The enormous increase in the amino-acid level during 1st carbonatation is quite an interesting observation and is not readily explained. However, it may be due to the hydrolysis[14] of certain low molecular weight proteins, peptides and polypeptides to a mixture of amino-acids under the strongly alkaline conditions prevailing during 1st carbonatation.

The significant removal of amino-acids during the 2nd carbonatation stage might be due to the adsorption of amino-acids on the surface of the calcium carbonate precipitate; according to Dedek (quoted in a review[14]) amino-acids may be adsorbed irreversibly on calcium carbonate precipitate produced during second carbonatation but not in first carbonatation owing to their high solubility under alkaline conditions as mentioned by Honig[10]. In addition, the melanoidin colorants are also known to be adsorbed on calcium carbonate precipitate produced during second carbonatation.

Table III. Influence of extra phosphate (P_2O_5) addition to mixed juice on TAA removal

Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA removal from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice (M.J.)	2768	–	0.63
2.	Clarified juice (C.J.)	1628	41.18	0.44
3.	C.J. from M.J. containing:			
	(i) 50 ppm additional P_2O_5	1628	41.18	0.40
	(ii) 75 ppm " "	1619	41.50	0.37
	(iii) 100 ppm " "	1610	41.83	0.32
	(iv) 125 ppm " "	1614	41.69	0.32
	(v) 150 ppm " "	1614	41.69	0.30
	(vi) 200 ppm " "	1512	41.76	0.28

Initial P_2O_5 level in mixed juice – 300 ppm.
Data are average of three sets.

Table IV. Influence of extra phosphate (P_2O_5) addition to phosphate deficient mixed juices on TAA removal

Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA removal from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice (M.J.)	3475	–	0.72
2.	Clarified juice (C.J.)	2277	34.47	0.58
3.	C.J. from M.J. containing:			
	(i) 50 ppm additional P_2O_5	2251	35.22	0.56
	(ii) 100 ppm " "	2125	38.84	0.50
	(iii) 150 ppm " "	2080	40.14	0.42
	(iv) 200 ppm " "	2057	40.80	0.38
	(v) 250 ppm " "	2065	40.57	0.32

Initial P_2O_5 level in mixed juice – 180 ppm.
Data are average of three sets.

Table V. Extent of removal of TAA effected by preliming of mixed juices at different pH

Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA removal from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice (M.J.)	2853	–	0.52
2.	Clarified juice (C.J.) from M.J.	1650	42.16	0.33
3.	C.J. from M.J. with preliming at:			
	(i) 6.0 pH	1633	42.76	0.30
	(ii) 6.5 pH	1521	46.68	0.32
	(iii) 7.0 pH	1623	43.11	0.34
	(iv) 7.5 pH	1661	41.78	0.34
	(v) 8.0 pH	1749	38.69	0.36

Data are average of three sets.

[11] Roberts & Caserio: "Basic principles of organic chemistry". (Benjamin, New York) 1964, pp.703-705.
[12] *Zeitsch v.d. Zuckerind,* 1934/35, **82**, 356-361.
[13] Finar: "Organic chemistry". Volume II. (Longmans, London) 1964, p. 499.
[14] *Sugar Tech. Rev.*, 1974, **2**, 204.

Table VI. Effect of presulphitation of mixed juice at different pH on the removal of TAA

Sample No.	Type of juice	TAA (mg/l on 100°Bx)	% TAA removal from mixed juice	O.D. of clarified juice at 420 nm expressed on 15°Bx
1.	Mixed juice (M.J.)	2194	–	0.50
2.	Clarified juice (C.J.)	1254	42.84	0.37
3.	C.J. from M.J. with presulphitation at:			
	(i) 5.0 pH	1204	45.12	0.40
	(ii) 4.5 pH	1146	47.76	0.40
	(iii) 4.0 pH	1106	49.58	0.42

Data are average of three sets.

Table VII. ICUMSA colour and TAA in plantation white sugar samples produced by few Indian sugar factories situated in Eastern Uttar Pradesh and Bihar in the crushing season 1981-82

Sample No.	Sulphitation sugar		Carbonatation sugar	
	ICUMSA colour	TAA (mg/kg)	ICUMSA colour	TAA (mg/kg)
1	90	175	110	225
2	130	190	80	180
3	110	180	130	195
4	320	195	90	175
5	300	195	60	220
6	170	255	80	280
7	150	195	120	175
8	250	170	40	225
9	100	185	80	140
10	140	230	60	175
11	320	165	100	180
12	120	190	40	155
13	90	215	100	170
14	240	155	30	215
15	140	220	90	175
16	80	175	140	280
17	80	125	60	230
18	320	270	40	285
19	80	255	90	250
20	170	260	80	270
Range	80-320	125-270	30-140	140-285
Average	170	200	81	210

The data in respect of amino-acid content and ICUMSA colour for a number of direct plantation white sugar samples produced under different conditions and in different periods of the crushing season is presented in Table VII. The results did not show any significant correlation between ICUMSA colour and amino-acid content. The TAA values were in the range 125-285 mg/kg irrespective of the process adopted. However, comparatively higher TAA values for carbonatation sugar supported the findings in relation to lower removal observed in carbonatation process as discussed above. Unlike sulphitation sugars, the carbonatation sugars, although possessing low ICUMSA colour values, contained larger amounts of amino-acids. The faster deterioration[15] of carbonatation sugar during storage might also be due to the presence of significant quantities of amino-acids which react with quinones and phenolics present in the sugar crystal to produce coloured high molecular weight condensation products[16].

It is interesting to note that the total amino-acid content was not found to be related with the drop in colour content of the clarified juices, as may be seen from the data given in the various tables. This indicates that the major colorants in clarified juices obtained by any of the above processes are not exactly those derived from amino-acids.

Conclusions

The data suggested that the standard sulphitation process could remove amino-acids to a greater extent (42%) than other clarification methods; the removal could be increased to 45.68% by employing preliming at pH 6.5 and to about 49.58% by presulphitation to pH 4.0. Increasing lime dosage and P_2O_5 dosage did not result in any appreciable removal. However, benefits from additional dosage of P_2O_5 were achieved in respect of amino-acid removal from phosphate-deficient juices. The higher removal in the sulphitation process and lower removal in carbonatation suggests that melanoidin colorants are produced to greater extent in the former. The small overall removal of amino-acids in the carbonatation process is an interesting observation and needs more investigation. Further, the qualitative behaviour of individual amino-acids removed and produced during various processes requires proper attention and needs further study.

Summary

The variation in amino-acids during different processes of cane juice clarification has been studied. The observations suggest a higher removal of amino-acids in the sulphitation process by comparison with carbonatation and defecation. Presulphitation and preliming offer possibilities for better amino-acid removal, up to 46.68% and 49.58%, respectively, against 42.09% for the standard system. Increasing the lime dose to more than 2.0% gave a more or less insignificant response. Although additional P_2O_5 dosage did not influence amino-acid removal from normal cane juice significantly, removal was affected considerably in the case of phosphate-deficient juice. No significant correlation was obtained between drop in colour intensity and amino-acid content of clarified juices. Carbonatation sugars were characterized in having relatively higher amino-acids than sulphitation sugars although possessing lower ICUMSA colour values.

Enlèvement des amino-acides pendant la clarification du jus de canne

La variation en amino-acides a été étudiée durant les differents procédés de clarification du jus de canne. Les observations montrent un enlèvement plus conséquent d'amino-acides durant le procédé de sulfitation par comparaison avec carbonatation et défécation. Présulfitation et préchaulage offrent des possibilités d'un meilleur enlèvement d'amino-acides de 46,48% et 49,58%, respectivement, contre 42,09% pour le système standard. Augmenter la dose de chaux de plus de 0,2% donne une réponse plus ou moins insignifiante. Bien qu'un dosage accru de P_2O_5 n'influence pas l'enlèvement d'amino-acides de jus de canne normal, l'enlèvement est considéràblement affecté en cas de jus déficient en phosphate.

15 Gupta & Srivatsa: *Proc. 17th Congr. ISSCT*, 1980, 2145-2151.
16 Coombs *et al.*: *ibid.*, 2098-2117.

Aucune signification de corrélation n'a été obtenue entre chute en intensité de coloration et teneur en amino-acides des jus clarifiés. Des sucres obtenus par carbonatation étaient caractérisés en ayant relativement plus d'amino-acides que les sucres obtenus par sulfitation, bien que possédant moins de coloration ICUMSA.

Aminosäureabtrennung bei der Rohrsaftreinigung

Die Veränderung des Aminosäuregehalts bei den verschiedenen Verfahren der Rohrsaftreinigung wurden untersucht. Die Beobachtungen legen den Schluß nahe, daß beim Sulfitationsverfahren mehr Aminosäuren entfernt werden als beim Carbonatations und Defäkationsverfahren. Vorsulfitation (46,68%) und Vorkalkung (49,58%) ermöglichen eine bessere Aminosäureentfernung als im Standardverfahren (42,09%). Die Erhöhung der Kalkmenge über 0,2% ergab einen mehr oder weniger nichtsignifikanten Effekt. Obwohl eine zusätzliche P_2O_5-Zugabe die Aminosäureabtrennung aus normalem Rohrsaft nichtsignifikant beeinflußt, wurde die Abtrennung bei phosphat-armem Saft beträchtlich beeinflußt. Keine signifikante Korrelation wurde zwischen der Farbabnahme und dem Aminosäuregehalt des gereinigten Saftes erhalten. Carbonatationszucker haben im Vergleich zu Sulfitationszuckern einen relativ höheren Aminosäuregehalt, obwohl sie eine geringere ICUMSA-Farbe haben.

Separación de ámino-ácidos en la clarificación de jugo de caña

La variación en ámino-ácidos durante varios procesos de clarificación de jugo de caña se ha estudiado. Las observaciones sugieron una separación más completa en el proceso de sulfitación que en carbonatación o defecación. Pre-sulfitación y pre-tratamiento con cal ofrecen posibilidades de mejor separación de ámino-ácidos — hasta 46.68% y 49.58%, respectivament, contra 42.09% por el sistema convencional. Aumento del dosis de cal hasta más de 0.2% produció una respuesta más o menos no-significativa. Aunque tratamiento con un dosis adicional de fosfato no influyó significativamente la separación de ámino-ácidos del jugo normal de caña, separación se afectó notablemente en el caso de jugo deficiente de fosfato. No se obtuvo una corelación significativa entre disminución de intensidad de color y contenido de ámino-ácidos en jugos clarificados. Azucares producido por carbonatación se caracterizaron por contenidos de ámino-ácidos relativamente más altos que azucares producido por sulfitación aunque tuvieron menores valores ICUMSA de color.

Energy saving through more efficient beet diffusers

By G. V. GENIE*

Introduction

A comprehensive review of the recent literature on beet diffusion[1], included 570 references. In spite of such apparent abundance, diffusion remains a neglected field of beet sugar technology. There are several reasons for this, both technical and economic in nature. Unlike other sugar equipment, which tends to be uniform, four types of diffusers with completely divergent designs coexist in a limited market firmly held by a few manufacturers. The present size of 5000 tonnes/day and the financial warranty of performance required by sugar companies make diffusers extremely costly and no newcomer is prepared to invest in such hazardous enterprise, whatever the anticipated improvements. As a result, only slight modifications to existing types are possible. The present size of the diffusers and the fact that most factories own only one, also make practical experimentation very difficult. While production managers may occasionally agree to slow down one centrifugal or one pulp press temporarily for research purposes, they are not prepared to accept such inconvenience for their diffuser. It is characteristic that in the 570 papers cited above, none deals with an objective experimental study or comparison between different types of diffusers.

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The increase in the cost of fuel did not bring any fundamental changes in the situation. Aside from a trend to reduce the juice draft slightly where possible, the only practical effect was to generalize on the production of cold juice in diffusers, whereas this had been previously a characteristic of the DDS diffuser alone. Cold juice production allows the recovery of low-temperature heat, which would otherwise be wasted, and results in a non-negligible saving of fuel. Various juice-cossettes heat exchangers are currently being developed for that purpose and they are sometimes combined with the diffuser into a single unit. Another substantial fuel economy would be to reduce the volume of juice to be evaporated, i.e. to operate the diffuser at a lower draft. Fig. 1 shows the possible reduction in evaporated water corresponding to an increase in the efficiency of the diffuser, for a loss of 0.2% sucrose on beets and 18% dry solids in pressed pulp. As may be seen, even a moderate improvement of the diffuser efficiency would have a sizeable effect on the fuel consumption, but it would also require structural changes in the design, which the manufacturers are not prepared to accept now. But, willingly or not, they will have to change their mind, as the measures taken downstream for steam economy change the equilibrium between the steam consumption and the volume of

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1 Genie: *Sugar Tech. Rev.,* 1982, **9**, 119-270.
2 Giorgi: *Ind. Alim. Agric.,* 1981, **98**, 591-592.

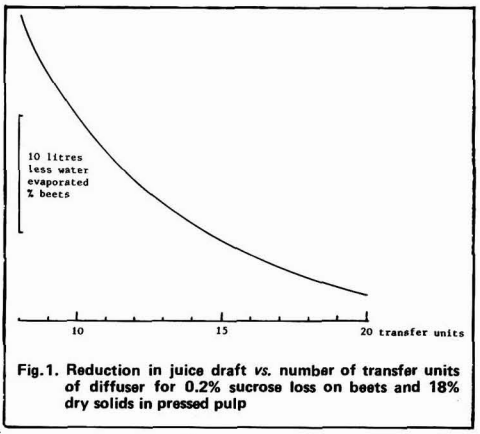

Fig.1. Reduction in juice draft *vs.* number of transfer units of diffuser for 0.2% sucrose loss on beets and 18% dry solids in pressed pulp

evaporated thin juice[2]. In the long run, to cope with a surplus of steam, juice drafts will have to be lowered and the efficiency of diffusers raised. Many process variables influence the efficiency of a diffuser as well as design features, and the object of this communication is to describe the use of a convenient and inexpensive computer model for the study of the behaviour of stepwise diffusers.

Theories of diffusion

Theoretical approaches to the diffusion process have been attempted in the past by many authors, notably Silin[3] whose theory received a universal recognition which it surely did not deserve. The soundness of both his premises and mathematical development has been questioned[4,5] and, in spite of the efforts of some late defenders[6], his theory is now generally recognized as useless. More developed theories, for instance that of Brüniche-Olsen[4], are restricted to a steady state analysis of the diffusion process because they rely on a so-called "quasi-stationary" form of Fick's law, which is obviously not applicable to the extraction of sucrose from cossettes, in which no steady state is reached until they are completely exhausted. This problem was avoided in a recent theory by Genie[7,8,9], but at the cost of complicated mathematical developments, even for cossettes of simple geometrical shape. For industrial cossettes, the difficulties become almost insurmountable. However, the depletion of sucrose in the cossettes is only one aspect of the diffusion process, which ignores the countercurrent movement of cossettes and juice, with possible back-mixing. A dynamic approach to the diffusion process is therefore required. Some authors, for instance Silin, did not differentiate between stationary and dynamic conditions and merely applied their equations to the whole diffuser. Smet[10,11] developed an early dynamic theory for stepwise diffusers, which was later extended by Genie[12] to include juice back-mixing effects. To the knowledge of the author, the only true dynamic theory for stepless diffusers was developed in conjunction with a tower diffuser in Chile by two mathematicians[13], who were however obviously not acquainted with the technology of sugar. It is so complicated that it is extremely difficult to understand and almost inapplicable. Moreover, it does not take into account back-mixing, which is a characteristic inseparable from tower diffusers. The possibilities of a direct practical mathematical approach to the diffusion process are thus very limited and another way must be found.

Mathematical models

The advent of computers has somewhat moved the mathematical theories to the background and mathematical models have been developed by various authors with the object of optimizing the diffusion process. However, most of them, if not all, rely on a previous mathematical theory, for instance Silin's equation[14]. Obviously, they are just an application of that theory, which cannot be better than it, and have no advantage over conventional calculation other than convenience and speed. In the opinion of the author, they do not deserve the name of "mathematical model" which should apply to models which simulate the actual diffusion process and depend only on unquestionable relations, such as weight balance and Fick's law. Such a model was developed more than ten years ago by Genie[8,15] for a Belgian sugar company. The diffusion field was divided into a large number of blocks, to each of which one or more values were assigned (concentration, temperature, beet or juice, etc.). The field was then swept back and forth, up and down, and a small fraction of the difference between adjacent blocks was transferred at each passage. At predetermined intervals, blocks were separated and moved, so as to represent the displacement of juice and beet, while the sweeping action was maintained in the cossettes in order to simulate the slow equalization of the concentration, and in the juice to simulate a complete mixing (juice block values were added and substituted by the mean value). It was also possible to leave a layer of juice on the cossettes in order to simulate incomplete draining. Almost any conceivable problem could be solved with the model, provided the computer had sufficient memory capacity. However, this mathematical model turned out to be very expensive because it was operated on an IBM 360/50 computer on a time-sharing basis at the cost of more than $10 per minute. In the case of complicated problems, the computing time could even exceed the limit of 10 minutes set by IBM, after which time the work was automatically stopped and the results already obtained discarded to make room for other subscribers, resulting in a $100 loss. As a consequence, the sugar company ceased to sponsor it. The decrease in cost of computers and the possibility of owning them have since dramatically changed that situation. On the other hand, the original program of 454 lines Fortran could be adapted and rewritten in segments compatible with inexpensive programmable calculators (Texas Instruments) and operated in sequence. Apart from the much longer processing time, the only inconvenience was the insufficient number of memories. This was overcome by stacking several parameters in a single memory, which can accept a sign and fifteen digits — much more than required for sugar concentrations. Over the years, these programs

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3 *Proc. 5th Congr. Int. Ind. Agric.*, 1937, (1), 534-563.
4 Brüniche Olsen "Solid-liquid extraction" (NYT Nordisk Forlag, Copenhagen) 1962.
5 Genie: *Sucr. Franç.*, 1976, **117**, 159-163.
6 Giorgi: *Sucr. Franç.*, 1975, **116**, 487-490.
7 *Zucker*, 1970, **23**, 409-412.
8 *ibid.*, 1971, **24**, 223-227.
9 *ibid.*, 1972, **25**, 117-122.
10 *Sucr. Belge*, 1948, **68**, 122-134.
11 *ibid.*, 1950, **69**, 241-252.
12 *ibid.*, 1964, **84**, 97-133, 154-162.
13 Plachko & Krasuk: *Ind. Eng. Chem. Process Des. Develop.*, 1970, **9**, 419-433.
14 Blok & van der Poel: *Proc. 15th Gen. Ass. CITS*, 1975, 75-90.
15 Genie: *I.S.J.*, 1973, **75**, 67-70, 99-103.

have been continuously improved to make them shorter and new refinements introduced. Finally, several of them were again integrated into a single unit. It was a kind of game, which resulted in a program that was completely obscure except for the designer. In its present form, it consists of a main program, written for each particular problem, which dialogues with a subroutine of only 122 instructions through several auxiliary input/output segments; these process the data into a coded language understandable by the subroutine and vice versa. Results are shown or printed in sugar technologists' normal units. The procedure is as follows: a batch diffuser is considered, whose 2n steps are represented by n memories. All parameters, such as n, concentration of fresh cossettes, juice draft, cossettes and juice back-mixing, sucrose transfer coefficient, mean thickness of cossettes and standard deviation, time of contact, dry solids in pressed pulp, are fed into the main program and carried to the subroutine in coded form. The subroutine then replaces all or part of the cossettes in the first memory by fresh cossettes, transfers a calculated amount of sucrose, depending on cossette size, time of contact and difference of concentration, from the cossettes to the juice in that memory, goes to the second memory, moves the cossettes between the first, second and third memories according to the back-mixing instructions, transfers another calculated amount of sucrose to the juice in the second memory, goes to the third memory and so on until the last one. The last cossettes removed are pressed to the specified dry solids content, the press water is returned with the adequate volume of fresh water to the last memory and a calculated amount of sucrose is transferred from the cossettes to the juice in the last memory. The subroutine then goes to the penultimate memory, moves the juice according to the back-mixing instructions, transfers a calculated amount of sucrose from the cossettes to the juice in that memory, and proceeds from memory to memory backwards to the first one. The juice removed from the first memory becomes the diffusion juice. There are twice as many transfers of sucrose as memories and this cycle behaves as a stepwise countercurrent diffuser with 2n steps, which is confirmed by the fact that its efficiency for an infinite contact time is exactly 2n transfer units. Memories are shared by even and uneven steps and, if required, all 2n concentrations of both cossettes and juice can be recalled at any time from the subroutine. As a consequence, the number of memories required is only half that of the steps, for instance 18 memories for a RT4 diffuser with 36 compartments. Of course, the model assumes that a homogeneous concentration is restored both in beet and juice between successive steps. No influence of the change in volume between the cossettes and the juice on their ratio is considered, because it is only of minor importance, as the cell juice passing into the extraction juice moves back toward the head of the diffuser and does not change substantially the ratio of cell juice to extraction juice, which remains about the same in all steps. In other words, the volume of the exhausted cossettes is lower at the end of the diffuser by comparison with that of the fresh cossettes, but the volume of feed water is also reduced in the same proportion compared with that of diffusion juice, and both effects cancel each other.

The execution of this loop requires one or more minutes, depending on the number of steps. The control is then returned to the main program, which decides whether new loops are required, possibly with modified parameters, for instance to answer questions such as "What should the juice draft be as a function of the thickness and the size distribution of the cossettes for a constant sucrose loss in the pulp?". The model also allows the study of non-steady conditions; for questions like: "What would be the concentration curve in the diffuser 30 minutes after the fresh water supply is increased by 5%?", the model is stopped after a predetermined number of loops. As a rule, however, what is sought is the ultimate loss in pulp under specified conditions; the loop is then repeated until an equilibrium is asymptotically reached and the subroutine is programmed to stop when nine consecutive loops do not change the concentration of the exhausted cossettes, which may require ten hours or more. A slight difference in results may nevertheless still be observed, depending on whether the equilibrium is approached from the high side or from the low side. It is convenient to operate the model overnight to answer such problems. It should be pointed out that the model is based only on weight or volume balances, statistical laws of cossette size distribution and an exact mathematical integration of Fick's law, and that it is an iterative process in which errors are not additive. On the contrary, false concentrations deliberately introduced in one or more steps are progressively eliminated and the model slowly returns to equilibrium. In other words, it behaves exactly like an actual diffuser. A routine check for errors is included in the program: the juice draft is recalculated from the four end concentrations; if a difference of more than 0.1 unit is found, an error is to be suspected or the model has not yet reached equilibrium. The model is very useful because all kinds of experiments can be undertaken, at no cost and without sugar loss, and its reliability is excellent. In cases for which an exact mathematical solution is known, its accuracy is better than ± 0.5%. It removes the difficulty, mentioned above, of conducting actual experiments in diffusers and the influence of each variable can be examined separately without being disturbed by the unsteady conditions of a factory. It is hard to believe how much about the behaviour of diffusers has been learned from its use, and some thoughts of the author have consequently been revised.

Cossettes-juice heat exchangers

A simulation model based on the same principles has also been developed for the study of the cossettes-juice heat exchange and the evaluation of cossette prescalders. Temperatures of both juice and cossettes are included in the program and a heat transfer efficiency factor is computed together with a temperature-dependent mass transfer coefficient. As a consequence, both heat and mass transfer are simulated. Considering previous experimental work with cossettes between 60° and 75°C (unpublished), the following empirical relationship has been used for $t > 50°C$:

$$D = 0.04(t - 50).10^{-5}\ (cm^2.sec^{-1})$$

in which D is the sucrose transfer coefficient and t the temperature of the cossettes. Below 50°C, the only mass transfer is that of juice from open cells, which has been ignored. Also disregarded is the radiant heat loss of the prescalder, which is assumed to be perfectly insulated, but the difference of specific heat between the juice and the cossettes is taken into account. The model can be used to compute the number of steps required, the heat transfer efficiency factor and the amount of sucrose extracted in a prescalder.

RT countercurrent scheme

The models described above operate on a straight countercurrent principle. RT rotary diffusers, however,

have a particular countercurrent scheme, in which the juice is divided into two streams, which alternately meet two (or more recently three[16]) batches of cossettes. The residence time of the juice is only half that of the cossettes and it has been repeatedly claimed that such a modified countercurrent scheme would be superior to a normal one. A computer model has been constructed with two series of memories, which are alternately processed step by step with two separate juices. This model is indispensable for a study of the stability of RT diffusers under unbalanced conditions, but it requires twice as many memories and the processing is excessively long. A simpler treatment is possible when it is assumed that it is immaterial whether the juice meets the cossettes in one compartment or in its homologue in the opposite series because, under steady conditions, both concentrations are exactly the same on account of the symmetry of the device. The complex RT countercurrent scheme is then reduced to two single juice schemes similar to that shown in Fig. 2. The juice moves immediately from one step to the next, while the cossettes spend an equal time out of the juice above the diametral partition, in the upper part of the drum, so their residence time is 72 half-revolutions compared with 36 half-revolutions for the juice. The mixing scheme is also different in RT diffusers: when the juice is not completely separated, part of it moves backward with the raised cossettes at half speed, which effect has to be compensated by a larger forward flow. Unlike in other devices, no sizeable back-mixing of cossettes is possible in RT diffusers, because the cossettes cannot pass through the screens, but part of them can be retained indefinitely in the same compartment. A very complicated model including all these features has been developed and tested.

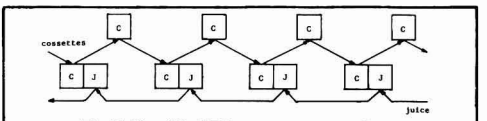

Fig. 2. Simplified RT countercurrent scheme

Results

Owing to the limited space available for this communication, only a brief examination of some of the results is possible. Unless specified, the conditions assumed in the following examples are:

- a stepwise diffuser with 20 steps of one minute each,
- juice draft 115%, with no back-mixing,
- equivalent thickness of cossettes (ratio of volume to surface area) 0.06 cm (standard deviation 0),
- sucrose transfer coefficient 0.8×10^{-5} $cm^2.sec^{-1}$ at 70°C,
- 100 kg cossettes contain 95 kg cell juice with 15.2 kg dissolved sucrose and produce 75 kg of exhausted cossettes containing 6 kg dry solids[17], which are pressed to 18% d.s. and the press water recycled,
- specific heat of juice is 0.92 and that of cossettes 0.86.

Influence of pulp pressing on diffuser efficiency and juice draft

It is generally believed that high-pressure pulp pressing reduces the load on the diffuser because more sucrose can be left in the exhausted cossettes for an equivalent pulp loss. However, the larger volume of recycled pulp-press water reduces the volume of make-up water and increases the sugar concentrations in the last step, which causes a slight decrease of the driving difference

16 Belgian Patent 891,530.
17 Cronewitz: *Zuckerind.*, 1980, **105**, 129-139.

Table I. Influence of pulp pressing at 115% constant juice draft

Pressed pulp dry solids, %	Sucrose loss, % beets	Sucrose in exhausted cossettes	Driving difference of concentration	Diffuser efficiency (transfer units)
8	0.47	0.68	0.68	8.32
10	0.44	0.81	0.68	8.32
12	0.41	0.93	0.67	8.32
14	0.38	1.03	0.67	8.32
16	0.36	1.13	0.66	8.32
18	0.33	1.23	0.66	8.32
20	0.31	1.31	0.65	8.32
22	0.29	1.39	0.65	8.32
24	0.27	1.46	0.65	8.32

Table II. Influence of pulp pressing at constant loss in pressed pulp

Pressed pulp dry solids, %	Juice draft, %	Sucrose in exhausted cossettes, %	Sucrose loss, % beets	Diffuser efficiency (transfer units)
8	125.0	0.49	0.334	7.88
10	122.5	0.62	0.334	7.98
12	120.2	0.76	0.334	8.08
14	118.3	0.91	0.334	8.17
16	116.6	1.06	0.334	8.25
18	115.0	1.23	0.334	8.32
20	113.6	1.39	0.334	8.39
22	112.3	1.57	0.334	8.46
24	111.1	1.76	0.334	8.52

of concentration, as shown in Table I. The more difficult extraction exactly compensates the smaller quantity of sucrose to be extracted, and the efficiency of the diffuser remains constant. In Table II, the model was programmed so as to keep a constant loss of sucrose, the juice draft being the variable. It shows what fuel economy results *on the factory side* from a higher pressure for pulp pressing. The efficiency of the diffuser increases slightly, but the difference is too small to be of practical importance. The conclusion is that high-pressure pulp pressing has a mechanical effect on the losses, but does not reduce the load on the diffuser, nor does it improve its efficiency significantly. (It should be noted that Table II cannot be extrapolated to other conditions than those shown, because the juice draft values are sharply dependent on them.)

Table III. Influence of the duration of extraction on pulp losses

Total extraction time, minutes	Sucrose in exhausted cossettes, %	Sucrose loss, % beets	Diffuser efficiency (transfer units)
20	1.23	0.33	8.32
25	0.97	0.25	9.41
30	0.79	0.21	10.40
35	0.65	0.18	11.31
40	0.55	0.15	12.26
50	0.41	0.11	13.64
60	0.32	0.09	14.89
70	0.26	0.07	15.91

Influence of extraction time on pulp losses

Table III shows the pulp loss as a function of the duration of the extraction. The model assumes, of course, that the optimum contact conditions secured in the laboratory when the sucrose transfer coefficient is measured also apply in the diffuser. Hence the good extraction figures for retention times shorter than usual. For practical results, the actual sucrose transfer coefficient measured in a diffuser of the type considered should be substituted in the data, but the object of Table III is only to show the trend. The efficiency of the diffuser is obviously improved when the duration of the extraction is increased, but this is of course paid for by a drop in throughput.

Influence of mixing

The most useful application of this model is the study of mixing, for which no simple mathematical solution is available. When juice mixing was first introduced in the model, the sucrose loss in the pressed pulp was found to be 0.33%, 0.43%, 0.55%, 0.70% and 0.89%, respectively, for 0, 5, 10, 15 and 20% mixing. However, these results soon appeared inadequate for rotary diffusers on account of two side-effects, which required a modification of the model:

(a) Extended retention time: While in true continuous diffusers, e.g. towers or DDS troughs, both forward- and back-mixing are possible, in rotary diffusers, juice or cossettes can lag behind normal flow but not exceed it. The distribution curve in rotary diffusers is therefore shifted and asymmetrical, which results in an increase of the mean retention time of both cossettes and juice, and the pulp loss does not increase with mixing as rapidly as it should. There are various ways in which mixing can be simulated in models, and that used in

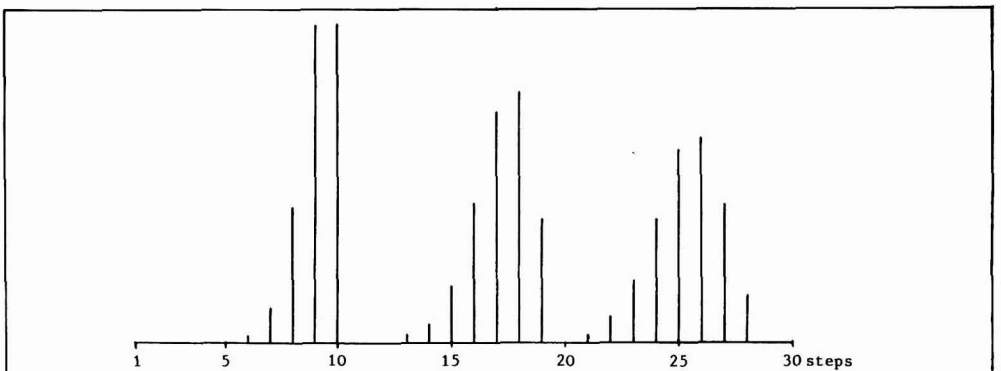

Fig. 3. Mixing pattern of model after 9, 18 and 27 cycles for 10% mixing

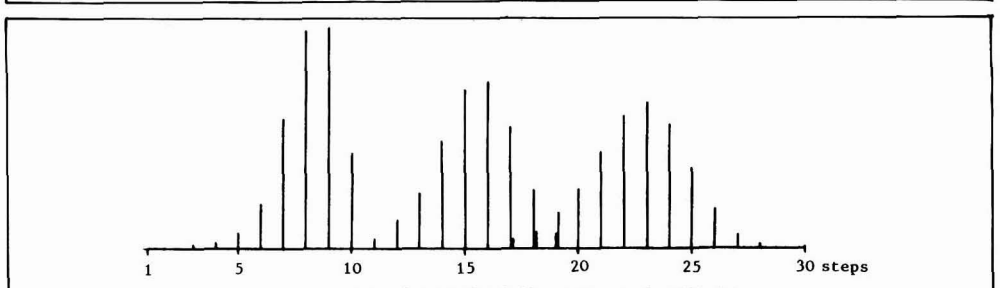

Fig. 4. Mixing pattern of model after 9, 18 and 27 cycles for 20% mixing

this model is specially designed for rotary diffusers. The mixing pattern of a model can be shown in a very simple way, similarly to experiments with carrots or coloured cossettes in an actual diffuser. The sucrose transfer coefficient is set at nil and the model is operated with cossettes of zero concentration. Then a single load of cossettes of supposed 100% sucrose concentration is introduced and the model stopped at regular intervals. Without mixing, this load moves undisturbed from step to step. Figs. 3 and 4 show the mixing patterns after 9, 18 and 27 cycles, respectively, for 10% and 20% back-mixing.

(b) Increased volume of juice: The usual juice draft is defined as the weight (or volume) of juice drawn from the diffuser per 100 kg of cossettes. This figure is however not directly linked to the sucrose transfer process in the diffuser, which depends only on the ratio of the volume of the cell juice to the volume of the extracting juice in the various compartments. When the extracting juice is quantitatively transferred from step to step, this ratio corresponds to the juice draft, but not when mixing occurs. The more the juice is delayed, the larger is the volume of juice held in the drum, which determines the sucrose transfer, and the smaller the actual draft. The situation is similar for the cossettes and, if both juice and cossettes are delayed in the same proportion, the juice:cossettes ratio may be restored to normal in the compartments. This is clearly shown in Table IV; juice mixing increases the pulp loss, but less than it would do without correction, while cossettes mixing decreases it. Both leave it almost unchanged.

Number of steps of cossettes-juice heat exchangers

As already mentioned, the practice is now to use the cossettes to cool the diffusion juice in order to allow the recovery of waste heat. In their endeavour to reduce the final temperature difference, some manufacturers have replaced the formerly-used simple devices of two or three steps by heavy equipment with up to ten steps, which is claimed also to increase the processing capacity of an existing diffuser by 20%[18]. Table V shows the results of a simulation both for 100% (when equilibrium is reached) and 50% heat exchange efficiency, assuming a cossettes temperature of 12°C and a juice temperature of 75°C. A mathematical theory of stepwise heat exchange was subsequently developed, which confirmed within ± 0.1% the temperatures found with the model. It was used to construct the diagram in Fig. 5, which represents the difference in temperature between cold juice and cold cossettes (expressed as a fraction of that between hot juice and cold cossettes) as a function of the number of steps and the heat exchange efficiency. It

[18] Withers & Pollard: *I.S.J.*, 1982, **84**, 195-200.

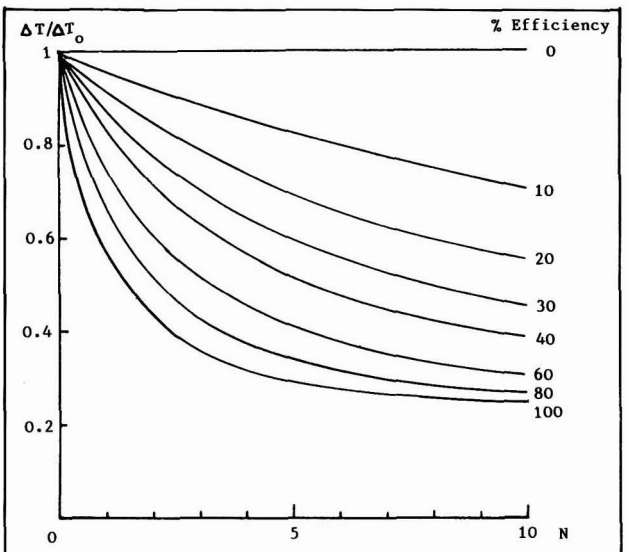

Fig. 5. Decrease in temperature in prescalders *vs.* number of steps

Table IV. Influence of juice and cossettes mixing in rotary diffusers on pulp losses

% mixing		Sucrose in exhausted cossettes, %	Sucrose loss, % beets	Diffuser efficiency (transfer units)
Juice	Cossettes			
0	0	1.23	0.33	8.32
5	0	1.30	0.35	8.08
10	0	1.36	0.37	7.86
15	0	1.42	0.39	7.65
20	0	1.49	0.41	7.45
0	5	1.14	0.31	8.64
0	10	1.06	0.29	8.99
0	15	0.98	0.27	9.37
0	20	0.90	0.24	9.77
5	5	1.20	0.33	8.39
10	10	1.19	0.32	8.46
15	15	1.17	0.32	8.53
20	20	1.15	0.31	8.61

shows that an improvement in the efficiency is much more rewarding than a costly increase in the number of steps

Table V. Influence of the number of steps on the final temperature difference and sucrose extraction in cossette/juice heat exchangers at 100% and 50% efficiency

	Temperature difference, °C		Increase in sucrose concentration	
Number of steps	100%	50%	100%	50%
2	26.60	41.06	0.29	0
4	19.78	31.75	0.79	0.34
6	17.16	26.66	1.06	0.60
8	15.90	23.48	1.22	0.86
10	15.24	21.34	1.33	0.98

It has been known for more than twenty years[10,12,19] that extraction is an inverse *exponential* function of the number of steps, but even nowadays some designers still recommend more steps as if the relationship were linear. The same mistake is currently being made with prescalders. Except for very low efficiencies, for which the curve is almost linear, it is clear that an increase in the number of steps beyond three or four cannot have any sizeable effect and is wasted money. As far as the improvement of an existing diffuser is concerned, let us repeat that extraction begins only after the scalding temperature is reached and that it is not a linear process. A gain of 1-1½° Bx at the head has little significance for the final exhaustion, because it is much easier to extract sucrose there than at the pulp end of the diffuser. A prescalder is therefore of little or no value for the extraction proper, because most of this increase in Brix would be gained in the diffuser without a prescalder. The possible overall reduction in the pulp loss is marginal, say 0.02-0.03 units at the most, and this gain in extraction is moreover likely to be lost as a result of increased bacterial activity, on account of low temperatures and longer retention time.

Evaluation of the efficiency of a rotary prescalder

On December 15, 1981, a RT5 rotary prescalder with 10 compartments was operated 24 hours under the following average conditions: temperature of cossettes 16.3°C; sucrose content 15.99%; cossettes length 11.0 m /100 g; pulp loss 0.28%; draft 120%; temperature of juice: inlet 72°C, outlet 41°C; drum speed 48 rph. These values were fed to the model, the efficiency and the increase in juice Brix being the unknown variables. An efficiency of 32.5% was obtained, and Brix increased by 1.43°. It is noteworthy that, with cossettes of good quality, a De Smet prescalder achieves an equivalent temperature drop in two passes only, with an efficiency of almost 100%.

Summary

A simulation model of stepwise diffusers, adapted to inexpensive programmable calculators (Texas Instruments) has been developed, which is based only on mass or volume balances, statistical laws and Fick's law. It therefore closely follows the actual diffusion process, without referring to any of the known theories. It is useful for the determination of the influence of the process variables on the diffuser efficiency and hence on the minimum juice draft and heat consumption required for juice evaporation. Some results are reported concerning the effect of dry solids in the pressed pulp, the duration of the extraction, the back-mixing in rotary diffusers and the number of steps of cossettes/juice heat exchangers.

[19] Genie: *Zeitsch. Zuckerind.*, 1974, **24**, 473-477.

Economie d'énergie au moyen de diffuseurs de betterave de plus haute efficacité

Un modèle de simulation des diffuseurs compartimentés, adapté aux calculatrices programmables bon marché (Texas Instruments) a été développé, qui n'est basé que sur des bilans de masse et de volume, sur des lois statistiques et sur la loi de Fick. Il suit de la sorte de très près le processus réel de la diffusion, sans se référer à aucune des théories connues. Il est utile pour déterminer l'influence des variables du procédé sur le degré d'efficacité du diffuseur et donc sur le soutirage minimum et sur l'énergie nécessaire pour l'évaporation du jus. Quelques résultats sont mentionnés concernant l'effet des matières sèches dans les pulpes, la durée de l'extraction, les mélanges dans les diffuseurs rotatifs et le nombre d'étages des échangeurs de chaleur jus/cossettes.

Energieeinsparung mittels Rübenextrakteure höheres Wirkungsgrads

Ein Simulationsmodell für Stufenextrakteure mit Zwangsführung ist ausgearbeitet worden, das für billige programmierbare Rechner geeignet ist. Es basiert nur auf Massen- und Volumenbilanzen, statistischen Gesetzen und dem Fickschen Gesetz. Daher simuliert es den wirklichen Extraktionsvorgang sehr gut, ohne dabei die bekannten Theorien zu berücksichtigen. Man kann das Modell benutzen, um den Einfluss der Prozessgrössen auf den Wirkungsgrad des Extrakteurs zu bestimmen, und dadurch den Saftabzug minimieren, um den Energieverbrauch für die Eindampfung des Saftes zu verringern. Einige Ergebnisse werden mitgeteilt über den Einfluss des Trockensubstanzgehaltes der Pressschnitzel auf die Extraktion, die Extraktionszeit, den Mischvorgang im rotierenden Extrakteur und die Anzahl der Stufen in Schnitzel/Saft-Wärmeaustauschern.

Ahorro de energía por uso de más eficientes difusores de remolacha

Un modelo de simulación de difusores compartimentados, adaptado a calculadores de bajo costo y capaces de programación (Marca Texas Instruments) se ha desarrollado, que se basa solamente sobre balanzas de masa y de volumen, sobre las leyes estatísticas y sobre la ley de Fick. Así, segue estrechamente el proceso real de difusión, sin referencia a alguna de las teorías conocidas. Es útil para la determinación de la influencia de los variables del proceso sobre la eficiencia del difusor y por eso sobre el tiro mínimo de jugo y consumo de calor requerido para evaporación del jugo. Algunos resultados se presentan respecto del efecto de sólidos secos en la pulpa prensada, la duración de la extracción, el mezclado-atrás en difusores rotativos, y el número de etapas de los cambiadores de calor entre cosetas y jugo.

CANE SUGAR MANUFACTURE

Technico-economic assessment of the cleaning station of the "Urbano Noris" agro-industrial complex. V. González E. *Paper presented to the 18th Congr. ISSCT,* 1983, 31 pp. – A technical and economic assessment was made at the end of the 1981 harvest of the first cane cleaning station to be installed in Cuba. The station is located at about 2 km from the sugar factory and receives cane from four different cane districts. The cleaning systems consists of six primary and three secondary fans. The cleaning efficiency (amount of extraneous matter removed) averaged 40.42%, and cane losses in the fan system were less than 0.5%. The trash content of the cane received at the sugar factory was 7.6%. Hourly throughput of the cleaning station averaged 431.1 tonnes of cane. The economics of cleaning station operation are discussed, based on a season of 150 days.

An investigation into tramp iron detection and separation. V. Mason and S. R. Reichard. *Paper presented to 18th Congr. ISSCT,* 1983, 39 pp. – Work undertaken to evaluate the use of electromagnetic separators for the collection of tramp iron and the use of eddy current detectors for the presence of metallic objects on a high-speed conveyor belt is described. The tests showed that magnetic separators could operate very efficiently if the material was presented to them in the correct way. The eddy current detectors were found to lack sufficient discrimination of the mass of the tramp iron and it is recommended that their use be limited to the detection of very large pieces of tramp iron that would cause significant damage.

System for the separation of soot from natural-draft boilers. R. Romero L. and C. Ramírez C. *Paper presented to the 18th Congr. ISSCT,* 1983, 17 pp. – A new system has been developed for the treatment of waste gases from natural draft boilers by a combined wet-dry method and was tested at two Cuban sugar factories. A grill in the gas conduit diverts the soot which is entrained by water sprays and then separated from the water by means of filters in which bagasse is employed as the filter material. The water is circulated in a closed circuit and soot separation has been achieved with a pressure loss of only 78.48 – 98.1 Pa.

Suspension-fired boilers and their grates. P. W. Levy. *Paper presented to the 18th Congr. ISSCT,* 1983, 28 pp. Steam for use in raw cane sugar factories is increasingly being generated in boilers in which bagasse is burnt in turbulent suspension rather than in static piles. Suspension firing offers economies in capital, operating and maintenance costs of the boiler plant. When firing takes place in suspension, the furnace grate is deprived of the coverage of fuel and ash which, with other firing methods, insulates the grate from radiant combustion heat. Several forms of grate are employed in suspension-fired boilers but, amongst these, individual grates are often copies of designs which have been developed for other fuels and other firing methods and are not always suited to the application. Design and operational measures to limit grate component temperatures and to ensure uniform air distribution require particular attention. Each of the various forms of grate offers advantages and disadvantages which should be assessed against the requirements of a particular installation. A relatively new form, the water-cooled stationary grate, provides technical and economic features which may make it the optimum selection for many applications.

Cooling policies for batch crystallizers. S. M. R. Maudarbocus and E. T. White. *Paper presented to the 18th Congr. ISSCT,* 1983, 22 pp. – An optimum cooling concept is develped for pure sucrose solution and extended to impure solutions. The applicability of such a concept to individual crystallizer operation is discussed. Results of an optimum cooling program using a crystallization model are presented for a range of pan drop conditions, and are compared with typical industrial cooling practices. Limitations on implementation of the optimum cooling policy are also discussed.

A laboratory evaluation of three methods for the clarification of *B*-molasses. L. M. S. A. Jullienne and D. M. Frankland. *Paper presented to the 18th Congr. ISSCT,* 1983, 35 pp. – The clarification of *B*-molasses by three different methods, namely phospho-flotation, froth-flotation and sulphitation, was investigated under laboratory conditions. The effects of the treatments on turbidity, suspended matter content and viscosity as well as on the chemical characteristics of the molasses is discussed. All three treatments can remove fairly large proportions of the suspended matter and substantially reduce the turbidity and viscosity of the *B*-molasses, sulphitation being the most effective.

Stress analysis of 3000-ton sugar bin at Inkerman mill. G. Cowan and N. Hutton. *Proc. Australian Soc. Sugar Cane Tech.,* 1983, 307-311. – A 3000-tonne sugar bin erected at Inkerman factory for the 1982 crushing season has two full-length hoppers each provided with four individual outlet doors; two flat end plates, when combined with the hoppers, provide a method of direct transference of the hopper load which differs from that used in other types of sugar storage bins. A decision was made to monitor the loading of the new structure, using strain gauges to determine stress levels at various points. Results are discussed, and confirm the validity of the design theory; the bin, capable of holding more than its maximum rated capacity, has proved entirely satisfactory after a season's operation.

Pan and pan stage control. P. G. Wright. *Sugar Tech. Rev.,* 1983, **10,** 39-96. – A review, with 102 references, is presented of the literature on automatic control of boiling in both batch and continuous pans. Despite much effort to obtain better transducers for the indication and control of supersaturation, only limited progress has been made; the most successful practical transducers are the types based on consistency/rheometry for high-purity strikes and on electrical conductivity for lower-purity strikes. Progress towards more absolute practical measurements of fundamental variables such as supersaturation and crystal content remains slow, so that the process is still not optimal and is below the crystallization limits set by nucleation kinetics. However, the advent of computer and micro-computer equipment has triggered a general trend towards adoption of full pan turn-round automation, and this trend is expected to continue. Automation of pan management has been attempted with the aid of computer logic power, but is still under-developed.

BEET SUGAR MANUFACTURE

Recent developments in continuous sucrose crystallization. K. E. Austmeyer. *Paper presented at 17th Gen. Assembly CITS,* 1983, 29 pp *(German).* — Concepts developed at the Braunschweig Technical University on continuous evaporation-crystallization of sugar are explained, and the advantages of continuous boiling with a low massecuite level over conventional batch boiling indicated mathematically, using an equation developed for under-cooled surface ebullition. Mathematical simulation of both continuous and discontinuous boiling was based on application of the equation to heat transfer at the heating surface and on earlier published formulae concerning mass transfer during crystal growth. The benefits of continuous boiling at lower steam pressures are thus demonstrated. The crystal size distribution resulting from boiling in a cascade of ideal continuous stirred vessels is discussed.

Recalcination tests on the Escher-Wyss process at Rain sugar factory of Süddeutsche Zucker-AG in 1980-82. H. Schiweck, J. Henatsch and F. Curtius. *Paper presented at 17th Gen. Assembly CITS,* 1983, 29 pp *(German).* Pilot scale trials of the title process for recalcination of carbonatation mud are reported. The process involves pressing the mud to a dry solids content of >70%, granulation at about 77% dry solids, followed by drying to about 95% dry solids in a fluidized bed, calcination at 900-1000°C in a fluidized bed, cooling in a fluidized bed, and slaking. The effect of calcination temperature on decomposition of clay in the mud to soluble silicates and aluminates was particularly investigated. In trials it was found that some 66% of the fresh lime used in pre- and main liming could be replaced with recalcined mud.

Optimum control of the sucrose crystallization process. S. I. Sirenko and I. S. Gulyi. *Paper presented at 17th Gen. Assembly CITS,* 1983, 4 pp *(French).* — A brief description is given of an automatic control system for pan boiling in which the signals corresponding to the process variables are compared with values obtained from an optimized simulation, and adjustment made automatically. The sequence of control operations is indicated with the aid of a diagram.

Damaged beet and storage time: variations in technological value and of enzymatic activity of the glucidic metabolism. G. Vaccari, P. Spettoli, G. Sgualdino and G. Mantovani. *Ind. Sacc. Ital.,* 1983, **76,** 40-44 *(Italian).* Tests were carried out on storage of beets that had been damaged by falls from different heights. The loss of pol occasioned by the damage, by comparison with that of sound beets, was proportionately greater over short-term than over longer-term storage. Examination of acid and neutral invertase and sucrose synthetase activies in the beets indicated that the first two played a basic role in post-harvest sucrose cleavage.

Matching automatic controls with process and equipment requirements requirements in the sugar industry. J. Pidek and S. Swietlicki. *Gaz. Cukr.,* 1983, **91,** 4-6 *(Polish).* In a discussion of automatic process control in sugar factories it is pointed out that the technological quality of the equipment in an existing factory must be analysed as well as the performance level of individual process stations before planning of any given system of automation. Existing factories are at a disadvantage by comparison with new factories, particularly where equipment is antiquated, while any automation introduced must conform to modern technology in order to be of any value and operate smoothly. The situation in Polish sugar factories is described.

Radio-isotope level indicators in the sugar industry. J. Wajs. *Gaz Cukr.,* 1983, **91,** 7-11 *(Polish).* — The use of radio-isotopes for measurement of level is discussed, and details given of the Polish UPR-24 absorption-type transmitter which uses ^{60}Co or ^{137}Cs, according to the medium measured. Operation of the system is described in the case of charge level in a lime kiln.

The problems of colloids in sugar manufacture. E. Walerianczyk and H. Gruszecka. *Gaz. Cukr.,* 1983, **91,** 25-30 *(Polish).* — The adverse effect of colloids in beet sugar manufacturing processes is discussed, and analyses of beets and raw juices for colloids are reported. Tabulated data show how the contents of colloids and cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+} and Pb) generally fall in beet samples with progress of the year from June to the end of September. Analyses of raw juice from eight factories indicated correlation between processing efficiency and colloid content; colloid contents are also tabulated for raw and thin juices, *A-, B-* and *C*-massecuites and molasses at two factories at the start and end of the campaign. It is pointed out that a certain amount of colouring matter in intermediate products as well as sugar and molasses is attributable to colloids formed by chemical reactions taking place during the various processes and involving basically carbohydrates, acid amides and organic acids. Advice is given on how to minimize colloid formation and maximize the amount removed during processing.

New equipment and apparatus for the beet end. J. Grabka. *Gaz. Cukr.,* 1983, **91,** 30-33 *(Polish).* — A survey is presented of the latest equipment available for beet unloading, conveying, washing and slicing, diffusion, juice purification and settling, and juice heating and evaporation, including steam compressors.

Advances in sugar house equipment. J. Grabka. *Gaz. Cukr.,* 1983, **91,** 49-51 *((Polish).* — Latest developments in sugar house equipment are briefly surveyed, covering batch and continuous vacuum pans, continuous crystallizers, batch and continuous centrifugals, granulators and sugar screens.

Suggestions on modernization of a vibratory sugar screen. P. Wodzinski. *Gaz. Cukr.,* 1983, **91,** 51-54 *(Polish).* Suggestions are put forward regarding modifications that it is considered should be made to a vibratory screen of Polish manufacture. The proposals concern the means of feeding the sugar to the screen, the design of the screen proper, the drive, discharge section and housing.

The problem of optimum cooling of *C*-massecuite in crystallizers. K. Wagnerowski. *Gaz. Cukr.,* 1983, **91,** 55-61 *(Polish).* — The effects of the cooling surface area and of the degree of concentration on crystallization rate in low-grade massecuite cooling were analysed,

reference being made to results of earlier experiments regarding supersaturation and optimum end temperature. Formulae were derived for calculation of crystallization rate and crystal recovery, and a somewhat complex equation developed for cooling rate calculation in terms of temperature based on experimental data for crystal growth with temperature fall and overall recovery as a function of time. By integration, the characteristics of temperature reduction with time have been established for given end temperatures. The positive effects of shortening the cooling period by judicious choice of end temperature have been demonstrated. A nomogram has also been developed for ease of control of the cooling rate on the basis of a computer program, and a simplified algorithm written for optimization of the process.

One of the causes of increased molasses losses. J. Trochonowicz and J. Dobrzycki. *Gaz. Cukr.*, 1983, **91**, 61-62 *(Polish)*. — The authors refer to the tendency of molasses losses to rise in Polish sugar factories from year to year. One of the causes is considered to be excessive dilution of low-grade massecuite during cooling, and a graph is drawn showing the effect of molasses Brix in the range 80°-84° on its purity; by comparison with cooling to 50°C and a corresponding standard Brix of 85-86°, dilution to 80°Bx raises molasses purity by 1.5 units.

Rational diffusion. M. Piotrowski and H. Pyra. *Gaz. Cukr.*, 1983, **91**, 73-77 *(Polish)*. — After examining the basis of diffusion theory, the authors discuss factors governing diffuser performance, with particular reference to the DDS trough-type diffuser. Among the parameters discussed are speed of rotation of the scrolls, quality and type of cossettes, diffusion temperature, juice draft and pH of juice and feed water. Other aspects considered are methods used to control the various parameters, evaluation of juice purity and microbiological control.

The high-performance PSW-1000 vertical pulp press. T. Kotwinski. *Gaz. Cukr.*, 1983, **91**, 78-79 *(Polish)*. Details are given of the Polish PSW-1000 beet pulp press which is designed to give a dry solids content of 18-23% and which, at Opalenica sugar factory, gave a campaign average solids increase of 5.5% (absolute) at a daily throughput corresponding to 700-900 tonnes of beet.

Optimum parameters of pneumatic conveying of carbonatation mud under industrial conditions. M. Dziubinski. *Gaz. Cukr.*, 1983, **91**, 79-82 *(Polish)*. — Investigations of undiluted carbonatation mud flow along horizontal pipelines showed that injection of air into the system reduced the pressure gradient and hence flow resistance by as much as 60%. A method has been devised on the basis of the experiments for calculation of optimum parameters, allowing for pipe diameter, distance between settlers and filters and availability of compressed air.

The effect of low and variable temperatures on sugar beets with reference to their influence on purification of the extracted juice. I. Oglaza, S. Zarzycki and E. Walerianczyk. *Gaz. Cukr.*, 1983, **91**, 115-116 *(Polish)*. Investigations were conducted on the effects of storage temperatures on beet quality and subsequent juice extraction and purification. Beets stored at −5°C for 70 days offered no difficulties in treatment, despite deterioration in their chemical composition; on the other hand, 6 days storage at room temperature after the 70 days at −5°C resulted in such marked deterioration that it was difficult to extract juice. Beets stored for 144 days at 0°C underwent a gradual fall in quality, and the ultimate reduction in purification efficiency was such that the beets could not be considered suitable for normal factory processing.

The AWC-1350 continuous centrifugal. K. Grubiak and E. Krzeczkowski. *Gaz. Cukr.*, 1983, **91**, 103-104 *(Polish)*. Information is given on the Polish AWC-1350 continuous centrifugal which is designed for affination and for treatment of *B*- and *C*-massecuites. Some performance data from test runs during the 1980/81 and 1981/82 campaigns are tabulated.

Tests on invertase inactivation with selected chemical preparations. K. Mossakowska. *Gaz. Cukr.*, 1983, **91**, 116 *(Polish)*. — It is pointed out that a large part of undetermined losses at the end of a campaign is attributable to invertase present in beet cell juice or secreted by micro-organisms. Particular increase in activity of the enzyme occurs during processing of higher quality beet, and in all cases is favoured by a fall in diffusion temperature and reduction in processing rate. Formalin has no effect on invertase activity, so that tests were carried out to find a suitable disinfectant that would act as inhibitor. Of four preparations selected for treatment of a 1% buffered sucrose solution of pH 6.4-6.6 to which yeast had been added, the most effective was one based on isocyanurates; in the concentration range of 0.001-0.002% it reduced sucrose degradation by 18.6-45.5%, and at 0.005-0.1% by 52.2-99.9%. However, for treatment of beet brei it was less effective than a preparation based on maleic acid and another based on chlorinated melamine.

Tests on the use of polypropylene fibres as vacuum filter medium. I. S. Zarzycki and J. Marczynski. *Gaz. Cukr.*, 1983, **91**, 117 *(Polish)*. — Tests are reported in which three variants of polypropylene fibre were immersed in water, acid and alkali baths as a preliminary stage in evaluation of their possible suitability in filter cloths. Results showed that none of the three underwent any distortion at high temperature in a water-bath or in 3% HCl or 3% NaOH, although two variants suffered a fall in water permeability after immersion in acid or alkali, while the third showed a 10% increase in permeability. In all cases, removal of muds from the fibres was better than from the surface of Stylon filter cloths currently in use.

Results of tests on the possibility of treating effluent from citric acid and sugar manufacture. T. Wolski, B. Polec and E. Glabski. *Gaz. Cukr.*, 1983, **91**, 118 *(Polish)*. — Preliminary tests involving anaerobic fermentation of effluent from citric acid plants and sugar factories are briefly discussed. Although the results showed promise in reducing the BOD_5 and COD by some 60%, it is recommended that larger-scale experiments be conducted in view of the diversity of the waste being treated and the smallness of the scale on which the tests were carried out.

Technology in Yugoslavian sugar factories. Development of sugar industry standards. B. Koronsovac. *Cukoripar*, 1983, **36**, 67-71 *(Hungarian)*. — A survey is presented of processes and equipment used in Yugoslavian sugar factories, with details of performances by the various process stations from 1970, when 13 factories were in operation, to 1981 when 21 were working.

SUGAR REFINING

Elimination of colouring matter from sugar solutions. E. Walerianczyk. *Gaz. Cukr.*, 1982, **90**, 201-205 *(Polish)*. Reference is made to tests conducted some years ago at Witaszyce refinery, in which comparison was made between the performances of Asmit 261 and Wofatit ES decolorizing resins (used independently in pairs of columns) on the one hand and that of Carbopol Z-3 on the other, in the treatment of remelt liquor. Results showed that both resins and carbon removed groups of colorants selectively, that the resins were as effective as the carbon, but that the costs of resin treatment to give the same performance were about 60% of those of the carbon. Factors to be considered in the handling and use of resin are indicated, covering temperature, column height, liquor feed pressure, bed treatment with compressed air after liquor decolorization, rinsing of the bed, resin regeneration and possible blockage of resin pores by organic and inorganic impurities.

Pilot-scale anaerobic acidification of waste water containing sucrose and lactate. R. J. Zoetemeyer *et al. Biomass,* 1982, **2**, (3), 201-211; through *S.I.A.*, 1982, **44**, Abs. 82-1672. — Waste water from sugar refineries, unlike that from beet sugar factories, requires acidification before methane fermentation. Sugar refinery waste water, in which the main organic impurities were sucrose, lactate and ethanol, was anaerobically acidified at pH about 5.8 and temperature about 29°C in a 1-m^3 upflow reactor. The residence time was decreased, in steps, from 7.2 to 1.7 hr. Sucrose was effectively metabolized in all cases, whereas lactate was decomposed only at residence times above 3 hr. Ethanol was not converted. The volumetric activity could be increased to 250 $kg.m^{-3}$ per day, and the sludge activity to 14 kg/kg per day. Results indicated that, in order to operate an acidification reactor at its maximum efficiency, attention should be paid to the mixing system and to maintaining a constant pH.

How bulk sugar flows freely to the Transvaal. Anon. *S. African Sugar J.*, 1982, **66**, 479, 485, 487. — Until 1981, all of the 1.1 million tonnes of sugar consumed annually in South Africa was supplied in sealed packs; bulk distribution was not used because of the smallness and scattered nature of the market and because of the risk of lumping of bulk sugar as a consequence of the presence of 0.06% excess moisture. However, in June 1981 the country's first bulk distribution system for refined sugar came on stream. Details are given of the system, which is centred on a conditioning plant at Hulett Refineries in Rossburgh; warm, dry air is forced through a 1000-tonne column of sugar in the 45 m tall silo, and the sugar is fed into rail tankers from a 250-tonne storage bin adjacent to the silo. Three such tankers, of 40-50 tonnes capacity, carry the sugar daily to the bulk depot of the South African Sugar Association at Germiston. The air used to condition the sugar is dried to 20% humidity and cooled to 15°C by a dehumidifier; it is unavoidably reheated as a result of pressure build-up required to blow it through the sugar, but the temperature is reduced to 42°C by a heat exchanger before the air reaches the sugar. A sample of conditioned sugar from each outgoing load is retained by the refinery; in 16 months no caking has occurred. Details are given of the procedure used to charge and discharge the sugar.

New refinery at Noodsberg. R. Grafton. *S. African Sugar J.*, 1982, **66**, 529-531. — Details are given of the new refinery section attached to Noodsberg raw sugar factory. The level of automation in the new section is high, all the processes being controlled and monitored by computer-based equipment. Automatic sensors throughout the plant transmit to a central control room via an electronic network. VDU screens can give instant diagrams in colour of what is happening at any one moment and provide data on factory throughput and production levels. The design capacity of the refinery is 150,000 tonnes of sugar per year, which represents some 16% of South Africa's total refined sugar production. The final goal is for at least 90% of the output of the mill to be in the form of refined sugar. The refinery uses phosphatation (the first occasion of clarification with phosphoric acid in South Africa) as well as ion exchange decolorization.

The system of information depiction in the automatic process control system at "Matulin" sugar refinery, Krasnopresnensk. V. S. Pavlenko *et al. Sakhar. Prom.*, 1983, (2), 30-32 *(Russian)*. — The mimic system used at the title refinery in Moscow as part of the overall system of automation is described.

Experience in washing refined granulated sugar with clairce at Cherkassy sugar refinery. A. U. Dmitrenko, L. V. Ogorodniichuk and E. A. Skorobogatov. *Sakhar. Prom.*, 1983, (4), 39-40 *(Russian)*. — Hitherto, clairce has been used to wash pressed sugar, while water has been used for treatment of granulated sugar so as to avoid lumping in the granulators. However, with the installation of a fluidized bed dryer/cooler at Cherkassy, it became practical to use clairce instead of water and thus increase crystal sugar yield (by 5-8% on massecuite) and reduce fuel consumption as a result of the decrease in the amount of water to be evaporated. The reduction in water and the annual monetary savings from the decrease in fuel consumption are estimated.

Performance of mechanical circulator in boiling of refined massecuites. S. M. Alam, A. Kazi and A. W. Qureshi. *Proc. 18th Ann. Conv. Pakistan Soc. Sugar Tech.*, 1982, 267-273. — Trials on the use of 3-bladed propeller-type massecuite stirrers supplied by Fives-Cail Babcock for use in their refined sugar pans at Dadu Sugar Mills Ltd. in Pakistan are reported. The tabulated results show that, although the stirrers had no significant effect on the boiling period, they increased crystal yield by about 55% and improved crystal quality and uniformity.

Refined Syrups & Sugars Inc. to Refined Sugars Inc. J. F. Dowling. *Sugar y Azúcar*, 1983, **78**, (5), 31-32. An account is given of liquid sugar manufacture by Refined Syrups & Sugars Inc. from 1927, and details are given of modifications to the Yonkers refinery to permit increased manufacture of granulated sugar and reduction in the amount of liquid sugar produced. The refinery is now operated by Refined Sugars Inc., which is jointly owned by Redpath Industries Ltd. and Tate & Lyle Ltd.

NEW BOOKS

Noël Deerr: Classic papers of a sugar cane technologist. Compiled by J. H. Payne. 645 pp; 16.5 x 24.2 cm. (Elsevier Science Publishers, P.O. Box 330, 1000 AH Amsterdam, Holland.) 1983. Price: Dfl. 325.

Noël Deerr was born in 1874 and after training as a technologist at the City & Guilds of London Institute, went in 1896 to the then British Guiana until 1905, interrupted by a two-year post as a chemist in Mauritius in 1901-3. He joined the staff of the Experiment Station of the Hawaiian Sugar Planters' Association in 1906 and remained in Honolulu for nine years, after which he became Superintendent of Centrals Jobabo and Jatibonico in Cuba until 1919. He then worked at the Arbuckle Brothers refinery in New York for two years, and in 1922 became superintendent of the factories of Begg, Sutherland & Co. Ltd. in India, where he remained until retirement in 1936.

During this long career he established his reputation as the foremost sugar technologist of his era, making notable innovations and contributions so the technical knowledge on sugar not in only one area but in many, from agronomy and cane pest control to milling, juice clarification and evaporation, crystallization, boiler operation, and especially factory control. He was a prolific writer, and Dr. John H. Payne, formerly with the HSPA Experiment Station, has collected a number of his more important papers and assembled them in groups with a common topic of interest. Most of these, reproduced as facsimiles of the originals, appeared in either the *Hawaiian Planters' Record* or publications of the H.S.P.A., but a substantial number originally were published in this Journal as was the reprinted obituary notice from our issue of October 1953.

Dr. Payne's purpose in compiling this collection is to enable sugar technologists to have these papers, with their fundamental insight into the basic principles of sugar technology, available outside a large library. From this Journal's point of view they will also serve a use as a guide to the clarity of expression and logical development of an argument or proposition which could well be adopted by present-day contributors.

F. O. Licht International Sugar Economic Yearbook and Directory 1983. Ed. H. Ahlfeld. 454 pp; 20.4 x 29.1 cm (F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany). 1983. Price: DM 122.00.

The Licht yearbook is so well-known that it is almost sufficient to say that the latest edition follows the same format as previously and maintains the same high quality as previous editions. Since not everyone will be familiar with it, we must expand on the above to report that the yearbook provides addresses and personnel information of a remarkable number of international organizations, the text of the South African Sugar Act, authorities, trading companies, organizations, associations, sugar companies and factories and refineries for the beet and cane sugar countries of the world — a total of 129 — which is the most complete available. It also includes articles on natural sweeteners, the South African sugar industry, alcohol fuel developments in the United States, high-intensity sweeteners, the Brazilian alcohol program's adjustment to new realities, new equipment and processes for the sugar industry, improved use of nitrogen fertilizer in beet growing, and sugar cane mechanization. A number of reports are included on suppliers to the industry and on products and services available, with a classified Buyers' Guide and a separate 75-page pull-out booklet in a special pocket which provides world sugar statistics of production, imports, exports, balances, etc. For anyone concerned with the international sugar industry this book is an essential tool.

Australian sugar year book 1983. 272 pp; 18.2 x 23.8 cm (Strand Publishing Pty. Ltd., 432 Queen Street, Brisbane, Australia). 1983. Price: $A 26.00.

The latest in the series of Australian sugar year books maintains the same format as before and embodies a very great deal of information on the industry of that country. A directory of sugar industry organizations with their personnel and functions is provided and an account given of the history, staff and equipment of the sugar factories of Queensland and New South Wales. A review is presented of the 1982 season and comments made by industry leaders. Events affecting the sugar industry and sugar regions during 1982/83 are reviewed, while news concerning some Australian sugar industry personalities is recorded. Brief reports are included on the annual conferences of industry organizations and of the BSES 1982 field days. Extracts are given from the annual reports of the Sugar Board, Sugar Research Institute and the Bureau of Sugar Experiment Stations, while a collection of statistics from the 1981/82 period and previous years end the book. A considerable number of advertisements appear throughout the book as do some fine colour photographs featuring different aspects of the Australian sugar industry.

Tätigkeitsberich (Progress report) 1982/83. Anon. 44 pp; 17 x 24 cm. (Zuckerforschungs-Institut, Zaunergasse 1-3, A-1030 Wien, Austria.) 1983.

The 1982/83 report on the activities of the Austrian Sugar Research Institute is divided into three main sections, covering beet agronomy (including mention of work on pressed pulp silage), factory technology (including a general survey of the 1982/83 campaign) and medical aspects of carbohydrates. A list of scientific papers and works published by staff members is appended, as well as the organization and staffing of the Institute.

The sweet smell of excess. 7 pp; 21.0 x 14.9 cm. (Consumers in the European Community Group, 24 Tufton Street, London SW1P 3RB, England). 1983.

The CECG is an organization which coordinates the views of its members on EEC consumer issues. The present booklet is a criticism of the present system whereby the amount of sugar produced in the Community has risen from 91% of requirements in 1973 to 146% in 1983, resulting in a "sugar mountain" which is one of the major causes of the low prices of sugar on the world market and depression in the industry. The Group calls for reform of the EEC sugar regime, reduction in support prices and a fairer deal for developing countries and consumers, as well as attacking the limits on the production of HFCS which provides a cheaper alternative to sugar for the food industry.

LABORATORY STUDIES

Application of a neutron activation method for routine determination of dirt content in prepared cane. J. Loughran, G. Cowan and V. Mason. *Paper presented to the 18th Congr. ISSCT,* 1983, 21 pp. — A neutron activation method for rapid determination of the dirt content in prepared cane entering the factory is outlined. The method involves activating the silicon and aluminium components in shredded cane samples with a radio-active neutron source. Silicon and aluminium are major elements in Queensland cane soils and the resultant gamma-radiation from ^{28}Al in the prepared cane can be made proportional to the quantity of dirt in the irradiated sample in suitable apparatus. An effective process time of 7½ minutes per sample is possible. Under routine conditions the precision of the method (95% level of significance) is approximately ± 1% dirt content in prepared cane.

Studies on the foam-causing substances in raw cane sugar. H. T. Cheng and W. F. Lin. *Paper presented to the 18th Congr. ISSCT,* 1983, 18 pp. — A test procedure for measuring the foaming power of raw cane sugars has been established. Considerable differences, due to different soil and climatic conditions, have been found in the foaming qualities of cane sugars. An attempt has been made to verify the presence of foaming agents in the high-foam sugar and to identify them. The protein contents of 645 samples of foaming and non-foaming sugars were compared and a significant relationship obtained between foaming and protein content; sugars with protein content below 1000 ppm were non-foaming while those with protein contents above 2000 ppm were foaming. The presence of more than 100 ± 5 ppm of amylose enhances the effect of protein and induces foaming in sugars with 1000-2000 ppm protein. Addition of proteinase or amylase to the syrup in raw sugar manufacture is recommended to reduce sugar foaming.

The measurement of massecuite flow properties. J. N. Ness. *Paper presented to the 18th Congr. ISSCT,* 1983, 22 pp. — Various flow models have been used in the literature to explain the flow properties of massecuites. Massecuites have been considered to be Bingham plastic, pseudo-plastic and Newtonian fluids. Two different viscometers, an efflux-type pipeline viscometer and a Brookfield RVT rotational viscometer, were used to study the flow properties of a number of samples of low-grade cane massecuites. All samples showed pseudo-plastic behaviour and the power law model gave a good fit to the data from both instruments. Some samples tended towards constant apparent viscosity at the higher shear rates in the pipline viscometer. The flow behaviour index obtained from the pipeline studies was independent of tube dimensions. The measured consistency was dependent on tube diameter and length. The rotational viscometer gave a lower flow behaviour index (a higher degree of non-Newtonian behaviour) than the pipeline viscometer.

Density of technical sugar solutions. P. Kadlec, Z. Bubnik and A. Dandar. *Zuckerind.,* 1983, **108,** 453-456 *(German).* — See *I.S.J.,* 1983, **85,** 281.

The melassigenic property of ions. F. Heitz. *Paper presented at 17th Gen. Assembly CITS,* 1983, 27 pp *(French).* — For determination of the melassigenic property of a given quantity of non-sugar added to molasses, i.e. the amount of sugar rendered non-crystallizable, it is necessary to compare the standard purity of the molasses before and after addition, i.e. at the same Brix or viscosity, adjustment of which involves addition of a little water. However, while the melassigenic effect of this water is generally ignored, in fact it is such that a correction should be made to allow for it; although this correction is small, it leads to quite a sizeable correction of the melassigenic coefficients found by various authors for different non-sugars. A number of coefficients have been re-calculated on this basis for anions and cations as well as lactate, glutamate and acetate. Values are given as moles of sugar:mole of non-sugar, heat of ionic hydration (kcal.mole^{-1}) and first heat of dissolution at 25°C (kcal.mole^{-1}).

New measurements of melassigenic properties. P. Devillers, R. Detavernier and J. Roger. *Paper presented at 17th Gen. Assembly CITS,* 1983, 27 pp *(French).* After a historical account of work on the melassigenic properties of non-sugars, with particular mention of the work of Silin, details are given of experiments to determine melassigenic coefficients by four methods: the "apparent" methods of refractometric Brix measurement of a molasses solution diluted to 20 g/100 cm^3 and polarimetry after clarification with lead subacetate, and "true" methods of dry solids determination by oven drying and enzymatic sucrose determination. In all cases the molasses was saturated by mixing with a large quantity of sugar crystals for 16 hours at 50°C. The selected standard molasses parameters are defined. Melassigenic coefficients are given in a table of 32 non-sugars and non-sucrose sugars; in some cases both new and Silin values are given, in some cases only values found by Silin are presented, while in others the impurities have been analysed for the first time. Alkali metal acetates and chlorides were found to be highly melassigenic, while alkali metal sulphites, lactates and pyrrolidone carboxylates were also melassigenic, but less so; sulphates, glutamates, nitrates and invert sugar degradation products in the form of alkali metal salts were only slightly melassigenic. By contrast, all the Ca and Mg salts were non-melassigenic. Application of the findings to diffusion, particularly where additives are intended to facilitate pulp pressing, to juice purification and to crystallization are briefly discussed.

The Australian system for cane quality determination under Indonesian conditions. S. G. Gandana. *Maj. Perusahaan Gula,* 1979, **15,** (1/2), 20-30 *(Indonesian);* through *S.I.A.,* 1983, **45,** Abs. 83-686. — At Jatiroto factory in 1978, direct analysis of cane was carried out by the wet disintegrator and hydraulic press methods; also, first expressed juice was analysed and fibre determined by the washing method. "Commercial cane sugar" values calculated from the different sets of data agreed fairly well. Correlation coefficients between values from analysis of first-expressed juice and from wet disintegration or the hydraulic press were 0.83 and 0.88, respectively.

BY-PRODUCTS

Attritor-milling as a pre-treatment for bagasse prior to enzymic hydrolysis. B. S. Purchase. *Paper presented to the 18th Congr. ISSCT,* 1983, 25 pp. — Attritor-milling caused rapid disintegration of prehydrolysed bagasse but would not disintegrate non-prehydrolysed bagasse. The milling facilitated subsequent enzymic conversion of the bagasse cellulose to glucose. With realistic concentrations of enzyme, 65-70% of the cellulose could be converted to glucose in 24 hours. Yields approaching 100% could be obtained by increasing the enzyme concentration. The required duration of milling depended on the method of prehydrolysis but could be as short as 10 min, giving a mill energy requirement of 0.39 kWh/kg of prehydrolysed bagasse. When steel balls were used for milling they introduced severe inhibition effects when the optimum milling duration was exceeded. High-density ceramic balls of 6 mm diameter proved most successful for routine milling.

Effects of vinasse added to soil on pH and exchangeable aluminium content. A. A. Rodella, E. Zambello and J. Orlando. *Paper presented to the 18th Congr. ISSCT,* 1983, 26 pp. — The liquid phase of vinasse contains large quantities of K, Ca and Mg in soluble form, as well as some soluble C, N and P. Pot trials were carried out with the aim of studying changes in soil pH and exchangeable Al content when vinasse was added. Results showed that the vinasse caused an initial increase in pH and a decrease in exchangeable Al, even in soils of low exchangeable Al content; however, after two weeks' incubation, the effects were reversed. Incubation temperature and soil moisture content affected the results appreciably with time. Titration curves demonstrated that vinasse had a complexing property when added to a solution of Al^{+++}, but the results did not permit the mechanism to be defined. Vinasse application as a fertilizer is widely practised in Brazil.

Tests on microbiologically controlled pressed pulp ensilage. N. Kubadinow, F. Hollaus and L. Wieninger, *Paper presented at 17th Gen. Assembly CITS,* 1983, 34 pp. *(German).* — Tests were carried out to determine conditions for preparation of pressed pulp silage of maximum energy content and requisite mechanical properties. It was found that a large number of undesirable fermentation processes occurred, some due to micro-organisms that survived diffusion and others due to secondary infections in conveying, pressing, etc. All caused either losses in carbohydrate or labile silage, as well as marked CO_2 and H_2 formation in gaseous form or formation of ethanol and butyric acid. Prevention of these processes (by careful choice of starting temperature and/or control of the temperature in the silo) permitted formation of an optimum quantity of lactic acid with about 1-1.2% total sugar; secondary reactions involving *Clostridia* mesophiles can then be suppressed by the acid. Inoculation with *Lactobacillus delbrückii* at 50°C proved favourable in permitting completion of lactic acid formation within a maximum of 10 days. Subsequent cooling of the silage to ambient temperature is essential, since structural losses occur within 30 days if the temperature is maintained constant at 50°C, regardless of inoculation. The presence of disinfectants such as formalin may suppress or stop microbial activity, dependent on concentration; biocides added to press water at 20 ppm on beet have no effect on fermentation. Investigation of the gases will reveal any undesirable reactions at the start of ensilage.

Investigations on the use of bactericides in diffusers and on micro-organisms with reference to fermentation of pressed pulp silage. F. Hollaus, N. Kubadinow and L. Wieninger. *Paper presented at 17th Gen. Assembly CITS,* 1983, 47 pp *(German).* — By use of bactericides such as thiocarbamates instead of formalin to disinfect the middle and upper sections of tower diffusers, it proved possible to reduce the formalin content of pressed pulp and thus remove its adverse effect on ensilage. At a diffusion temperature of 69°C, 10 ppm bactericide on beet added continuously allowed the intervals between formalin dosing in the middle section of the diffuser and in the press water to be extended to more than 24 hours. The lower sections of the diffuser were disinfected with formalin at 8-10 hour intervals. The bactericides had no adverse effect on microbiological conversions during ensilage. Micro-organisms in pressed pulp that affect fermentation were found to be particularly *Lactobacillus* sp. and *Bacillus coagulans;* these caused rapid formation of lactic acid in hot silage. Optimum for lactic acid formation by thermophilic fermentation was a starting temperature of 50°C followed by cooling.

Single-cell protein from cellulose material from cane. A. Herrera, M. Quintana and J. Pérez. *ATAC,* 1982, **41,** (5), 34-41 *(Spanish).* — *Cellulomonas* spp. micro-organisms were grown on cellulosic material obtained by pretreatment of bagasse, pith and trash by the method of Dunlap, as modified by Osman *et al.*[1] Ammonium sulphate was used as N source. Changes in total soluble carbohydrates and reducing sugars with time, and other characteristics of the fermentation are shown in graph form. In a typical fermentation, maximum yield of biomass was achieved after about 60 hours, with a yield of 7-9 $g.litre^{-1}$ containing 45% protein, from a substrate of 40 $g.litre^{-1}$ concentration.

Secondary fines from bagasse pith. II. Effect on paper properties. R. Molina. *Revista ICIDCA,* 1982, **16,** (1), 3-20 *(Spanish).* — The effect of secondary fines — whole fines from highly beaten pith pulp and "crill" isolated from the latter by a 200-mesh wire screen in a Bauer-McNett classifier — on the strength and optical properties of an unbeaten paper pulp prepared from depithed bagasse was studied. Both kinds of fines raised the density and breaking length of the sheet as well as burst strength and elongation, while they impaired tear strength and brightness. The decrease in specific light-scattering coefficient was less pronounced in the case of fines-containing sheets. In contrast to beating, addition of fines left opacity almost unchanged or slightly increased. With a slight beating action, the depithed bagasse pulp was capable of attaining an increase in strength properties which could only be reached by addition of at least 10% of fines to the unbeaten pulp, with a considerable drop in drainage time. Consequently it is not considered advantageous to pulp the pith and add it to the paper furnish, and a more appropriate use could be in the preparation of boards, on account of their high bonding capacity.

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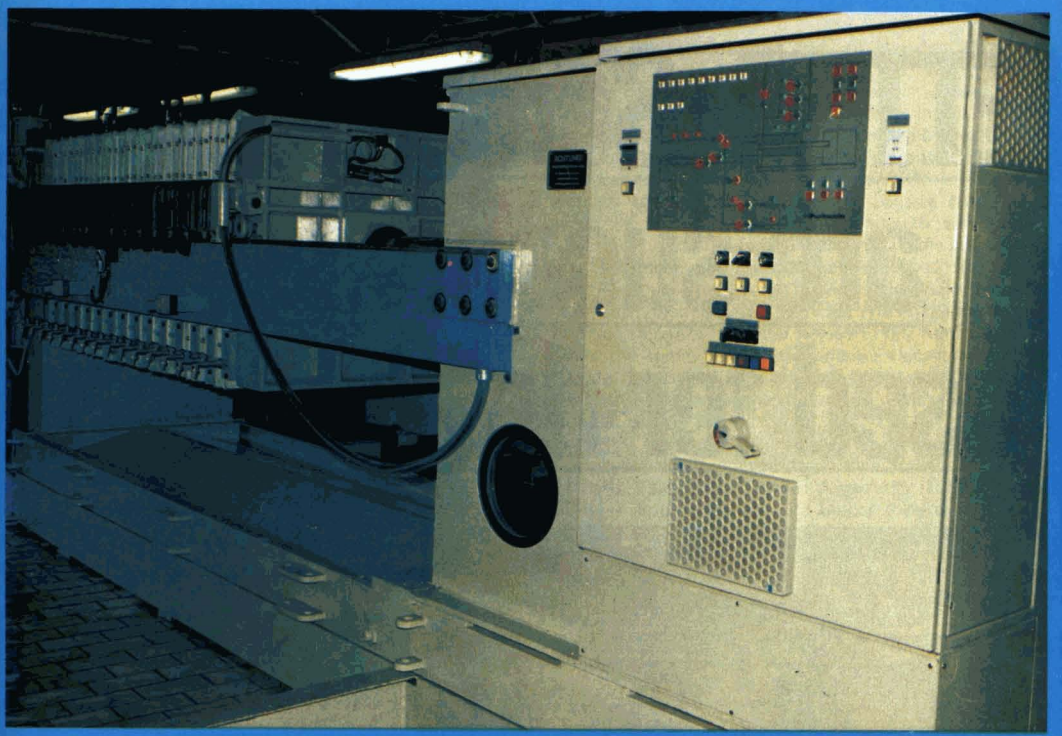

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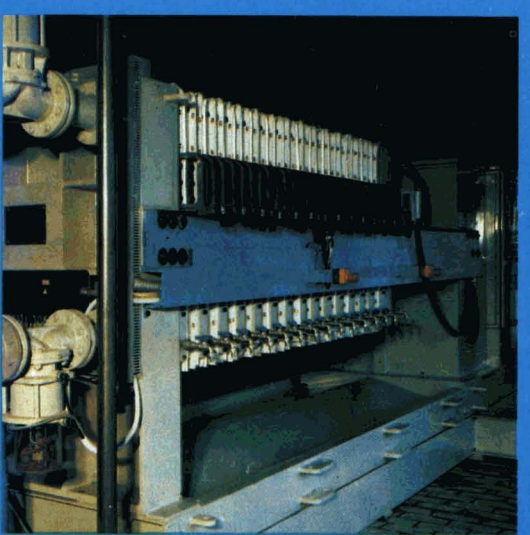

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PATENTS

UNITED KINGDOM

Continuous sugar dissolving plant. Robert Bosch GmbH, of Stuttgart, Germany. **2,056,297.** August 14, 1980; March 18, 1981.

Sugar from container 4 and water from line 5 (and glucose solution from line 6) are fed into a hopper 1 in predetermined quantities and mixed by stirrer 7 before discharge through valve 3 into mixing container 2. Here they are converted into a viscous slurry by stirrer 8. A rotary piston pump 16 delivers the slurry into a pipe 15 which connects via pipe 14 with a coiled pipe 13. A constriction 18 is maintained at the discharge end 17 of this pipe so that pressure within pipe 13 is held at about 4 bars. The coiled pipe 13 is surrounded by a steam jacket 10 having a steam inlet 11 and a condensate discharge 12. The material within pipe 13 is thus raised to a temperature of about 130°C.

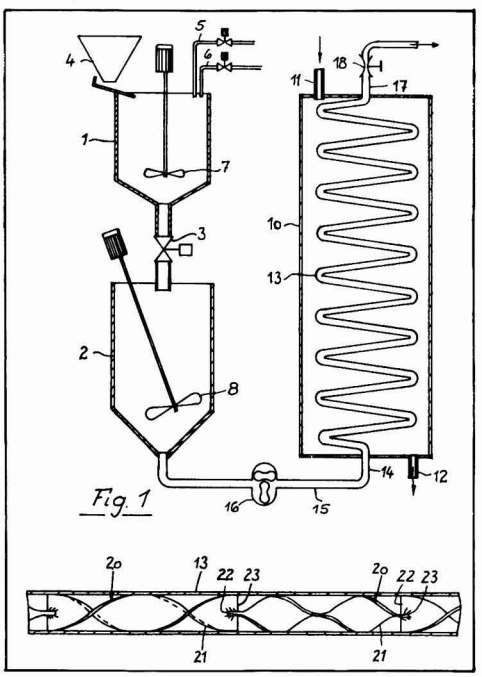


Fig. 1

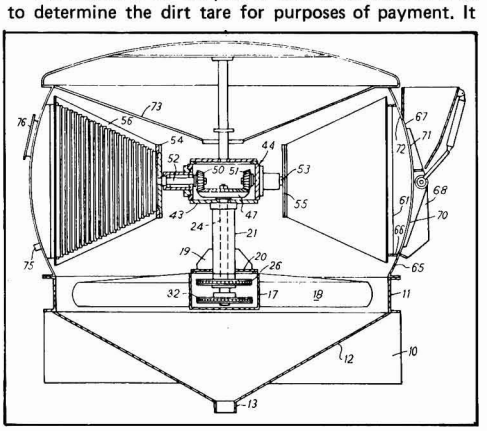
Within the pipe 13 is a static mixing device in the shape of helical surface elements 20 having slots at each end so that they engage with each other but at right angles. The pitch of the elements alternate so causing a change in direction of flow of the contents of the pipe.

Bagasse drying. Entoleter Inc., of Hamden. CT, USA. **2,056,637.** April 25, 1979; March 18, 1981. — Raw bagasse may be subjected to a size reduction and partial drying and is conveyed pneumatically into a reaction zone where it encounters an atmosphere of hot flue gas and is subjected to a centrifugal impact. It is carried by the flue gas stream to a zone in which the linear flow changes to vortical flow, causing bagasse particles to separated from the gas. The gas is treated with a liquid to scrub and cool it before discharge to the atmosphere and this liquid may then be used to preheat air used for combustion in the factory boilers, which burn the separated and dried bagasse particles. This generates steam and hot flue gas; the latter is used to dry further bagasse while the steam is used to generate electricity and for process operation. Use of dried bagasse and preheated combustion air raises the thermal efficiency of the boiler installation.

Preparation of sucroglycerides. Rhone-Poulenc Industries, of Paris, France. **2,057,436.** August 15, 1980; April 1, 1981. — Sucroglycerides are prepared by transesterification of sucrose and triglycerides which comprises subjecting the latter to a limited alcoholysis (i.e. the liberation of one or two of the alcohol groups from the triglyceride) before it is reacted with the sucrose. This is performed by reacting the glyceride (of a C_{14}-C_{20} fatty acid, e.g. palm oil or tallow) and an alcohol [2-30% (4-5%) w/w of ethanol with or without 0-5% (1-2%) glycerol] in the presence of [1.5-4% (2%) of] an alcoholysis catalyst ($KHCO_3$, K_2CO_3, KOH, KOEt) at 80-180°C [and 0-0.3% (0.1-0.2%) water], optionally under pressure [under reflux for 1½-4 hr (2-2½ hr)], and thereafter the sucrose (15-45% on weight of triglyceride) and basic transesterification catalyst (5-6% of K_2CO_3 with or without $KHCO_3$) are introduced [over a period of 10-120 (30) minutes] [at 110°-140°C (120°-130°C)] into the reaction mixture (under an atmosphere of an inert gas) which contains [3-15% (7-10%) of] of K soap formed in the first stage, and is kept at 120-145°C (130-135°C) optionally under reduced pressure [for 2-6 hr (4-5 hr)].

Beet sample washer. Cocksedge & Co. Ltd., of Ipswich, Suffolk, England. **2,058,554.** August 3, 1979; April 15, 1981.

The washer is for samples of beet to be cleaned so as to determine the dirt tare for purposes of payment. It



Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.75 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

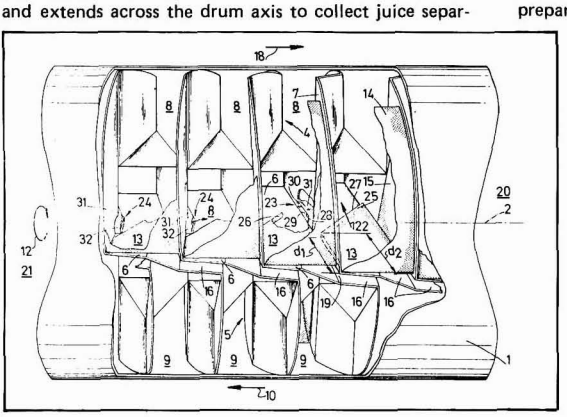
comprises a frusto-spherical housing 65 beneath which a ring 11, mounted over a funnel 12, carries a chain casing 17 within which are chain drives 26 and 32 for two concentric shafts, provided with suitable bearings and able to rotate centrally in the housing. The inner shaft is connected to the horizontal gear 47 which drives vertical bevel pinions 50 and 51 which, through shafts 52, turn the conical wash chambers formed by discs 55 and the spaced rings supported by ribs 56.

A flexible sealing 66 is in permanent contact with the interior of the housing while jets 75 deliver wash water into the rotating chambers, water and dirt falling through the gaps between the spaced rings and so into the funnel 12. At one point in the housing, a large circular opening 67 is provided with a fixed band 68 and a lower hinged discharge door 70 and an upper charging door 71. The drive to chain wheel 26 is intermittent and timed so as to bring each chamber in turn to the charging/discharging point; the washed beets are emptied by opening the bottom door, which is then closed and a fresh sample introduced through the upper door which is closed before the next chamber is brought round by chain wheel 26.

Beet diffuser. Raffinerie Tirlemontoise, of Brussels, Belgium. **2,059,798.** September 18, 1980; April 29, 1981.

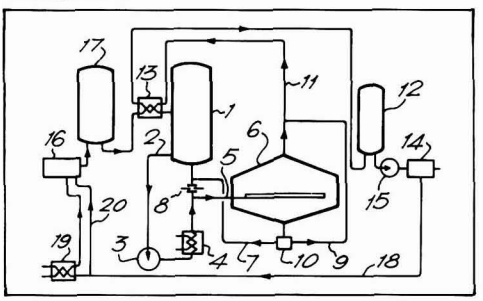
The diffuser is of the known type with two conveying screws 4, 5 nesting within one another, coaxial with drum 1. Partitions 6 passing through axis 2 of the drum, together with the radial walls 7 of the screws, form two series of cells 8, 9 in which cossettes are carried along in the direction 10, advancing in the same direction within the series of cells but without mixing. Each cell from both series comprises a basket formed from perforated walls 13, 14 and 15. Axial channels 16 are provided for the juice and extend along from the drum circumference, along axis 12 and slant relative to it so as to cause the juice to flow in the direction 18, opposite to that of the cossettes. Each channel connects through partition wall 6 and openings 19 in wall 7, so connecting one cell 8 to the following cell 9.

Each part of the diametral partition 6 separating cells 8 and 9 as well as the basket next to it, is staggered by an angle of 180° divided by the number of cells, so as to balance the drum. For better separation of juice from cossettes a liquid channel 23 or 24 is associated with the axial channel 16 and is located inside each cell 8 or 9 and extends across the drum axis to collect juice separated from the cossettes and flowing over partition 6 when the latter lies in a position adjacent the horizontal. The channels 23 and 24 are obtained by extending the wall 13 of each basket beyond the drum axis. This extension 25 is partly perforated to allow passage of the juice and is connected on one hand to both radial screw walls 7 and on the other to partition 6 through a solid wall 26 extending along the free edge 27 of extension 25 between the walls 7. The wall 26 is set at an angle of 30° to the axis 2.



Continuous alcohol fermentation. A. G. (Patents) Ltd., of London, England. **2,059,988.** May 30, 1980; April 29, 1981.

The fermentation vessel 1 is provided with a recirculation loop 2 including a pump 3 and a heat exchanger 4. A line 5 leads to a pressurized settling tank 6 from which a line 7 leads back to the loop. A constriction 8 in the loop 2 causes liquid impelled by pump 3 to pass through settling tank 6. A line 9 leads from line 7 via a valve system 10 serving to control the volume ratio of liquid passing along lines 7 and 9, respectively. Line 11 leads from the top of tank 6 via a heat exchanger 13 to a fermentation product storage tank 12 from which alcohol solution can pass to the still 14 via a feed pump 15. Line 9 feeds into line 11 so that a proportion of the yeast-enriched liquid from the bottom of tank 6 is mixed with the relatively clear liquid from the top of settling tank 6.



Carbohydrate (molasses) wort is prepared in vessel 16 and passes to storage tank 17 and thence through heat exchanger 13 to the fermenter 1, being cooled by the relatively cool liquid in line 9. Hot spent liquid from the still 14 is conducted by line 18 through heat exchanger 19 to the wort preparation vessel 16. A line 20 leads part of the hot spent liquid from the still direct to the wort preparation vessel. Thus the fermentation vessel 1 contains yeast substantially homogeneously distributed at a very high concentration in the wort in order to increase the rate of fermentation, improve efficiency of carbohydrate conversion and suppress yeast growth. The portion withdrawn to settling tank 6 is separated into a yeast-depleted fraction which is sent to storage tank 12 and so to distillation, while the yeast-enriched fraction from the bottom of tank 6 is returned to the fermenter 1, apart from such an amount as to provide an approximately constant amount of yeast in the fermenter. Return of spent liquid from the still to the wort preparation tanks provides some of the nutrients required. The pressure in tank 6 is sufficiently high as to prevent formation of gaseous CO_2.

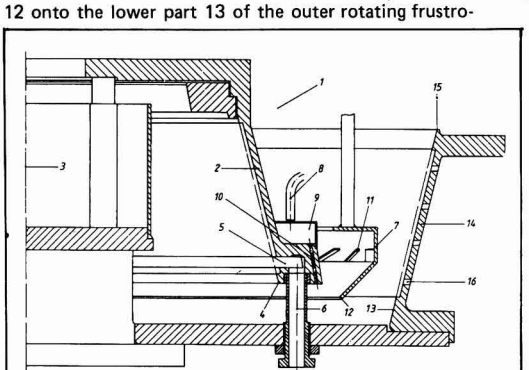
Pig feeds. E. Citterio, of Milan, Italy. **2,060,346.**

October 10, 1980; May 7, 1981. — Pig feed suitable for long-term preservation is prepared by mixing ground wet cereal plus 10-15% (11%) on cereal weight of oil or fat used in animal husbandry and 8-18% (14%) of molasses. Bicalcium phosphate (or 4% of a 75% phosphoric acid solution) is added to bring the pH to 2-3.

Production of ethanol from sugar cane. F. W. Hayes and D. C. Lennon, of London, England. **2,060,688.** October 15, 1980; May 7, 1981. — Cane is chopped and shredded to provide a digestion mass of juice and fibre. This is subjected (at ambient temperature) to the hydrolytic action of a hemicellulose enzyme in a first continuous digestion zone in order to break down at least some of the hemicellulose content of the cane fibre into fermentable sugars. The product is separated into a liquid fraction containing fermentable sugars and a fibrous residue which is then subjected (at elevated temperature) in a second continuous digestion zone to the combined action of a cellulase enzyme and an alcohol-producing fermentation culture in order to break down the cellulose in the fibre to fermentable sugars and to convert (at least partly) this and any residual fermentable sugars from the first stage into alcohol. The liquid fraction from this stage is separated, mixed with the first liquid fraction and subjected to a fermentation process to produce alcohol, while the residual fibre is (pressed and) burnt to provide substantially all the heat requirements of the process, pressed juice being sent to the fermentation. The second liquid fraction and pressed juice are flashed to recover alcohol before adding them to the first liquid fraction.

Continuous centrifugal. Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **2,064,351.** October 27, 1980; June 17, 1981.

The continuous centrifugal 1, suitable for low-purity massecuite, has an inner, frustro-conical pre-curing drum 2 which opens downwardly and rotates about vertical axis 3. The drum is provided with a separating screen and separates massecuite into molasses and pre-cured sugar. The molasses passes through the screen, collects in ring 5 and leaves via ducts 6 whilst the pre-cured sugar passes over the rim 4 and is collected by the mingling device 7 which is either stationary or rotates at low speed. This device has one or a number of circumferentially distributed inclined blades 11 which aid the mingling of the sugar with liquid supplied via pipe 8 to collecting vessel 9 and is distributed by centrifugal force through ducts 10 to mix with the pre-cured sugar as it passes from rim 4 to the device 7. The mingled pre-cured sugar fills the device 7 and then flows continuously over rim 12 onto the lower part 13 of the outer rotating frustro-conical drum 14. This opens upwardly and is provided with a screen whereby the sugar passes upwards and is discharged over the upper rim 15 whilst the liquid, which contains impurities washed from the pre-cured sugar, passes through the perforations 16 in the drum.



Beet juice purification. Rhone-Poulenc Industries, of Paris, France. **2,064,581.** Novermber 28, 1980; June 17, 1981. — The juice is (limed and) filtered and brought into contact (at $\leqslant 85°C$) with two ion exchangers, each having an exchange capacity of < 2meq/g and comprising a porous inorganic carrier coated with less than 15 $mg.m^{-2}$ of a film of cross-linked polymer, one carrying quaternary ammonium groups and the other sulphonic groups. The carriers have a granulometry of 50 μm to 5 mm, a specific surface of 5-600 $m^2.g^{-1}$, a pore diameter of 60-2000 Å and a pore volume of 0.4-2 $ml.g^{-1}$. They are of alumina or silica and may be the same or different for the two ion exchangers. The quaternary ammonium groups on the cation exchange resin are of the form NR_4^+ where the R groups are C_1-C_4 alkyl or hydroxyalkyl and may be the same or different. The crosslinked polymer coating on the carrier surface is obtained from epoxy or vinyl monomers or formaldehyde. The impurities retained by the ion exchangers may be eluted in the form of N-enriched fractions and the purified juice is sent to process.

Surfactant containing sucrose esters. Tate & Lyle Ltd., of London, England. **2,065,634.** July 23, 1980; July 1, 1981. — A starting mixture is prepared of (27.5-40% w/w of) solid sucrose, at least one triglyceride of a fatty acid having at least 8 C atoms and a basic transesterification catalyst (K_2CO_3) at 110-140°C, at atmospheric pressure and in the absence of any solvent; the mixture also contains a di and/or monoglyceride sufficient to provide a hydroxyl value >500, [1000-7500 (1500-5000)] mg KOH/100 g of starting mixture and at least 10% (at least 15%), (at least 20%), (25-30%) w/w of a fatty acid soap in addition to the catalyst [the soap being at least 50% (at least 75%) a potassium soap]. When there is less than 20% w/w of soap, at least 25% w/w of the mixture is sucrose. The fatty acid moiety of the soap is different from that of the glycerides and the soap is formed *in situ* in the mixture before addition of the sucrose. The reaction mixture is circulated by pumping through a loop of pipework and the process may be operated continuously by withdrawing continously part of the reaction mixture from the loop and replacing it with fresh ingredients.

Animal fodder supplement. S. A. Azucarera Argentina Comercial e Industrial, of Buenos Aires, Argentina. **2,066,038.** November 11, 1980; July 8, 1981. — A protein/vitamin supplement for animal fodder is a product of the (anaerobic) fermentation of a *Torula* or *Candida utilis* suspension on cachaza or clarifier mud [in the presence of a *Lactobacillus* culture (*L. plantarum*)]. It contains 3-6% of proteins and vitamin B (3, 3.5% of proteins). The *Torula* yeast is added in the form of a pre-fermentation of a mixture of vinasse and ammonium (ammonium sulphate or phosphate) and phosphate salts (K, Ca or ammonium phosphate or superphosphate).

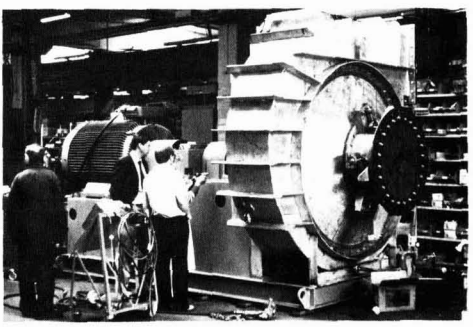
Forming bagasse fibres into boards. Intercane Systems Inc., of Windsor, Ont., Canada. **2,067,454.** January 17, 1981. — See US Patent 4,212,616[1].

[1] *I.S.J.*, 1982, **84**, 315.

TRADE NOTICES

Centrifugal fans for use with vapour compression. Nokia Industrial Fans, P.O. Box 44, SF-01511 Vantaa 51, Finland.

A new design of high-efficiency centrifugal fan is capable of providing pressures up to 60 kPa in one stage and is particularly suitable for use with mechanical vapour recompression. The Nokia Exvel fan can accommodate inlet conditions from 0.1 to 20 bar, while the patented aerodynamic design of the impeller gives pressures up to 100 kPa for a two-stage unit, thus matching the performance ratings of low-pressure compressers commonly used in vapour compression circuits.



The fan illustrated above has the advantages of simplicity (it has only three moving parts), low noise and vibration levels, low maintenance requirements and high reliability.

The MOD 30 control system. Taylor Instrument Division of Combustion Engineering Ltd., Gunnels Wood Road, Stevenage, Herts. SG1 2EL, England.

The MOD 30 is a new generation of control equipment of great power and flexibility introduced by Taylor Instrument to serve a wide range of industries and functions. It is based on four universal instruments: a controller, a math(ematical) unit, a sequence and logic controller and a recorder. Each has an extensive microprocessor data base and can operate alone or in groups of up to 16 over an instrument communications network; they are linked by a simple two-wire connexion which transfers control data among the instruments and can also be connected to colour V.D.U. terminals ideal for up to 60 loop systems and providing remote operation. The instruments themselves are standard size modules so that they can be used for replacing units in an existing panel or can be established in a new panel. The system has in-built security, with indication by various means of failure in any part should it occur and means of self-diagnosis of the fault. Further, the system holds the failed instrument's last values so that information is not lost.

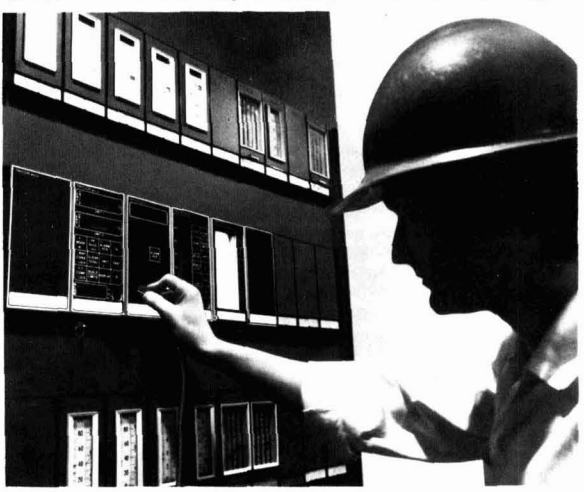
The Controller face presents a vacuum fluorescent display which shows considerably more information than other analogue or digital instruments, including process variables, output, set points, alarm trip points, digital readouts, analogue variables, etc. Eleven touch-type switches are provided and eight alarm points. The controller can operate as a simple PID unit or a more complex one with feed-forward/feed-back, adaptive reset. The Math unit contains two sections, each of which may be configured independently to perform any of five algorithm functions. It provides unparalleled computing versatility, while the Sequence and Logic instrument provides the capability for integration of sequential control functions normally handled by timers or programmable controllers. It can store several different recipes and control sequential on-off times of outputs required for these recipes in increments of 0.25 seconds to 99.9 hours. The Recorder is designed to record up to three trends from a combination of three analogue signals or three digital inputs. It prints both the chart grid and trend information on a 4-inch strip of high thermal paper, printing also the date, time of day and bottom of range engineering units; other features include alarm, fault indicators, etc. Approximate prices are £800-900 for the Control unit, £1200-1300 for the Math unit, £2000 for the Sequence and Logic unit, and £1100 for the Recorder.

Moisture determination. Baird & Tatlock (London) Ltd., P.O. Box 1, Romford, Essex RM1 1HA, England.

For fast and accurate measurement of moisture in solid samples, Baird & Tatlock offer a turbo-titrator which embodies a high-speed blending system (timed for up to 15 minutes) and a means of automatic Karl Fischer titration of the homogenized sample.

Microprocessor-controlled belt weighers. Richard Simon & Sons, Park Lane, Basford, Nottingham NG6 0DT, England.

A new range of microprocessor-based belt weighers



has been developed by Richard Simon & Sons to ensure accurate and reliable recording and monitoring of material throughput on conveyor belts. The microprocessor module will, at the push of a button, automatically compensate for changes in tare build-up; since such calibration is so easy it can be carried out much more frequently than with conventional methods, thus providing a high degree of accuracy. Voltage-free contacts and visual displays of machine ready, totalizing the belt overload are incorporated in the electronic system, which also features a large number of design parameters which can be called up on the local display when the machine is being calibrated, including tare and span limits, sampling times and other useful management information such as rate, weight per metre, speed and total throughput. The belt weighers may be readily incorporated in any handling system having belt widths from 450 to 2200 mm and operating at rates up to 5000 tonnes/hr.

PUBLICATIONS RECEIVED

Fully-automatic centrifugals. Tsukishima Kikai Co. Ltd., 17-15 Tsukuda 2-chome, Chuo-ku, Tokyo 104, Japan.

A 6-page brochure in English and Spanish gives details of the TSK fully-automatic centrifugals available in a number of capacities for use in beet and cane sugar manufacture and refining.

Pumps. Weir Pumps Ltd., Cathcart, Glasgow G44 4EX, Scotland.

A new 8-page full-colour folder produced by Weir Pumps Ltd. illustrates the company's complete range of pumps and auxiliary plant suitable for use in a number of industries, including beet sugar manufacture.

Ultrafiltration. Paterson Candy International Ltd., Reverse Osmosis Division, Laverstoke Mill, Whitchurch, Hants. RG28 7NR, England.

A new brochure entitled "PCI ultrafiltration systems" is now available. It gives an introduction to the process, its potential applications and the benefits of the PCI open tubular system. Typical commercial installations are shown and applications listed.

BMA Information. Braunschweigische Maschinenbauanstalt AG, P.O. Box 3225, D-3300 Braunschweig, Germany.

The latest available issue of BMA Information carries descriptions of various pieces of BMA equipment and brief reports on projects incorporating BMA machinery. Included is a BMA-Balster mechanical dewatering centrifuge for mud emanating from beet flume and wash water; it embodies two baskets, linked by a common horizontal shaft and mounted on a common base frame with the hydro-differential drive system. The two baskets are charged and discharged alternately; charging is continuous, while spinning and drying are semi-continuous and adjustable with regard to cycle time. Power consumption is low (0.5-1 kWh per m^3 of sludge). In pilot plant trials in 1982, the dry solids content was raised from 15% to 75-80%; a larger machine has been built for an hourly capacity of approx. 15 tonnes of dry matter. Use of a programmable control system permits operation to be adjusted to prevailing conditions. Also mentioned in the brochure is the reconstruction and modernization of Uelzen AG sugar factory which was completed in 1982; BMA supplied two new tower diffusers, a beet washer, twin-spindle pulp presses, tubular preheaters for juice, tanks for juice in juice purification, a complete evaporator, centrifugals, vacuum pan and rotary filter. BMA participation in expansion and modernization of the Quebec beet sugar factory of Raffinerie de Sucre du Québec and in the construction, together with Snamprogetti SpA, of a turn-key industrial complex at Ben Bechir in Tunisia (to include a beet sugar factory and yeast plant) is described. Details are also given of a BMA falling-film evaporator, Biothane waste water treatment plants, a new vertical preliming tank, the use of computerization as an aid to calculation of cyclones for dust separation from beet pulp dryer vapour, the BMA G series batch centrifugal (nine of which have been installed since the machine's initial successful operation in 1981), BMA tower diffusers installed at Dutch sugar factories, the new sugar refinery commissioned at Hawamdieh in Egypt, a new settling tank at Aarberg in Switzerland and a new cane diffuser at Triangle sugar factory in Zimbabwe. Mention is made of a BMA continuous fructose dryer/cooler and of the activities of BMA subsidiary companies, including the manufacture of electroformed centrifugal screens by Balco Filtertechnik GmbH, conclusion of a contract between Starcosa GmbH and Société des Sucreries et de Distillerie d'Egypte for the supply of a complete wet baker's yeast factory, and participation of Starcosa and BMA in a pilot plant to test the latest technology on ethanol and biogas recovery from waste products (the plant was jointly built by Zuckerfabrik Franken GmbH and Süddeutsche Zucker-AG).

Steam generators, Lancaster Distral Group, P.O. Box 1414, Englewood Cliffs, NJ 07632, U.S.A.

The Distral company of Bogotá, Colombia, was established in 1949 and has developed into a major supplier of steam raising plant for many industries. They range up to 2 million lb/hr with maximum design pressure of 2800 psig and maximum steam temperature of 540°C (1005°F), with balanced draught or pressurized operation. A range of fuels is suitable, including bagasse, and sugar industry customers shown in a list of boilers sold include companies in Trinidad and Peru, as well as many of the sugar factories of Colombia. Sales are effected through the US office as well as others in Florida, Germany and Venezuela as well as the Bogotá office.

Flowmeters. Litre Meter Ltd., 50-53 Rabans Close, Rabans Lane Industrial Estate, Aylesbury, Bucks. HP19 3RS, England.

Catalogue No. 581 describes the LM and MM series of Litre Meter flowmeters which operate on the Pelton wheel principle. The larger MM series is capable of measuring up to 22,000 litres/min.

Bagasse board. G. Siempelkamp GmbH & Co., Siempelkampstrasse 75, D-4150 Krefeld, Germany.

A colourful brochure outlines the stages involved in the manufacture of particle board from bagasse, as well as describing the processing of the boards and their applications.

Perforated screens. Ferguson Perforating & Wire Co., 130 Ernest Street, Providence, RI 02905, U.S.A.

A new general catalogue from Ferguson describes their perforated patterns available for various types of panel as well as strainer and filter screens. Materials processed include steel, aluminium, stainless steel and most alloys as well as plastics.

Dust separation. Dust Control Equipment Ltd., Thurmaston, Leicester LE4 8HP, England.

A new brochure, No. 391, describes the DCE Dalamatic Series DLM 10 and 15 automatic reverse jet dust filters with air volume capacities in the range from 2500 to more than 300,000 $m^3.hr^{-1}$. Suitable for heavy-duty continuous process applications requiring high collection efficiencies, the filters are used in most industries and contain flat pad-shaped filter elements in two basic module sizes (10 m^2 in the Series 10 and 15 m^2 in the Series 15). The modules are built up in banks and tiers and make the Dalamatic filters exceptionally compact.

Moisture analyser. Moisture Systems Ltd., The Old School, Station Road, Cogenhoe, Northampton NN7 1LT, England.

A brochure from Moisture Systems describes the Quadra-Beam infra-red moisture analyser which uses measuring and reference beams of light (one absorbed by moisture and the other not); the reflected energy from the sample illuminates a detector which provides an electrical signal proportional to the moisture content. Additional optical channels compensate for instability in the optical components. A signal representing the true ratio of reference to measured reflected energy levels is displayed digitally. Among applications mentioned for which the analyser is suitable are beet pulp and icing sugar.

Pumps. The Weir Group plc, Cathcart, Glasgow G44 4EX, Scotland.

A comprehensive 36-page colour brochure describes the Weir Group's pump products and services, including 21 main types of pump as well as auxiliary plant. Among applications noted are those in beet and cane sugar manufacture, particular mention being made of an order received from Italy for pumps in the beet end of factories, and in irrigation.

Dust filters. Carter-Midac, Carter Industrial Products Ltd., Bedford Road, Birmingham B11 1AY, England.

A revised and improved version of Publication No. 1307e gives details of Carter-Midac modular reverse-jet filters, including comprehensive design and applications information.

Flowmeters. Permex Ltd., Lodge House, Lodge Road, Hendon, London NW4 4 DQ, England.

Literature available from Permex Ltd. describes the company's range of flowmeters, including plastic and bronze disc meters, rotary piston meters in aluminium and stainless steel, and turbine meters in cast iron, bronze and stainless steel.

Trade notices

Apex equipment. Apex Construction Ltd., Apex House, London Road, Northfleet, Kent DA11 9NX, England.

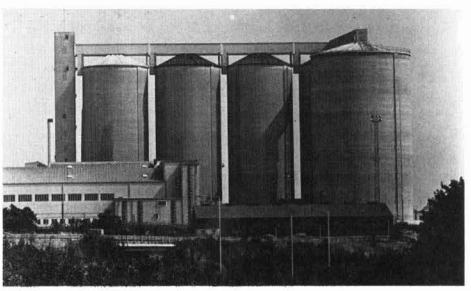
A 10-page brochure outlines the equipment manufactured by Apex for size reduction, size enlargement and granulation, mixing, drying, tabletting and compressing, pressing and various processes for which small-scale, pilot-plant equipment is available. A comprehensive service is also offered for the design, fabrication, erection and commissioning of complete plants.

Conveyors and elevators. Ewart Chainbelt Co. Ltd., Colombo Street, Derby DE3 8LX, England.

Conveyors and elevators available from Ewart are outlined in a new introductory leaflet (CE/IG: Conveyors and elevators) which covers screw conveyors and vertical screw elevators, oscillating and vibratory conveyors, bucket elevators, apron and slat conveyors, and drag-link and scraper types. The leaflet also carries information on Ewart's heavy-duty steel chain for conveying and drive applications.

Brazil sugar factory expansion. — The milling capacity of Usina Barbacena, in Pontal, São Paulo, has been increased by installation of two new 32 in x 60 in mills, together with turbine drives, carriers, Donnelly chute and press rollers. All the equipment was supplied by Zanini S.A. Equipamentos Pesados.

Sugar silo drying equipment. — Ambient Heating Group have completed installation of air conditioning units for the supply of dried air to the base of each of four 12,000-tonne sugar silos at the Bury St. Edmunds sugar factory of British Sugar plc. A top-mounted extraction system draws the air through the sugar and thus eliminates increase in the moisture content and hence caking. The work on the silos, which are shown in the illustration, took only six weeks so as to allow the system to go into operation at the start of the current campaign.



Control valve and actuator manufacture. — Ivco Process Valves Ltd. have announced that they are now manufacturing and marketing the range of process control valves and actuators previously made by Drayton Controls Ltd. The products, widely used in processing, fluid handling and environmental control applications for more than 25 years, will now carry the Ivco name; they include Series 70 control valves, VA2 electric actuators and Nos. 5, 9 and 11 pneumatic actuators as well as pneumatic and electric "Redstops".

Silo and centrifugal orders. — Nils Weibull AB. has received orders totalling $3,500,000 for the delivery of 36 ASEA-Weibull batch-type centrifugals to a customer in Latin America and a 22,500-ton white sugar silo to be constructed under licence by Chicago Bridge & Iron Co. at the Crookston sugar factory of American Crystal Sugar Co. The orders bring the number of sugar silos delivered to 98 and the number of centrifugals to more than 2000.

Liquid sugar volume measurement. — Tate & Lyle Refineries Ltd. have purchased and installed 49 microprocessor-based programmable digital units for the measurement of liquid sugar volume at Thames refinery. The liquid blending plant at the refinery comprises many storage vessels of varying shapes and capacities up to 72 tonnes; the vessels are continually filled and emptied in the production of many different blends of liquid sugar, and the previous measuring technique required prolonged calibration for each vessel, with use of dry dips and range potentiometers for adjustment. The new Model 3090 instruments have been programmed to measure the contents by a method developed by the suppliers, Computing Techniques (Mfg.) Ltd., of Billinghurst, Sussex, which allows the analogue input from transducers located in the vessels to be linearized so as to provide a direct and continuous read-out of the contents. The instruments are also located at the road tanker loading bay, so that both filling and emptying of each vessel can be monitored from two separate control panels. Tate & Lyle have already standarized on CT digital display panel instruments for many measuring requirements, particularly the 3080 series for provision of direct linear measurement of temperature, pressure and level.

Evco Chemicals. — Edgar Vaughan & Co. Ltd. have announced the formation of a subsidiary company, Evco Chemicals Ltd. The move is seen as a natural development from the company's base as a supplier of processing chemicals to the pulp and paper industry, and chemicals, for among other fields sugar manufacture, have already been developed under the Evco name. Further development work will include chemicals for water and effluent treatment.

Dryer manufacturers. — Richard Simon & Sons (Dryers), formerly part of the Dobson Park Industries group, has been sold to the existing management and is now known as R. Simon (Dryers) Ltd. The company, established more than 100 years ago, will continue to manufacture drying equipment for a number of industries, including sugar.

Flocculant supplier move. — Crosmill Flocculants Ltd., suppliers of synthetic polyelectrolytes for aid in waste water treatment in a number of industries including sugar manufacture, have moved to 85E Main Road, Goostrey, Cheshire CW4 8JB, England.

New bagasse paper consultancey address. — Joseph E. Atchison Consultants Inc., international consultants to the pulp and paper industry, have moved their headquarters to 2 East Avenue, Suite 212, Larchmont, NY 10538, U.S.A. Dr. Atchison, president of the company, is well known in the sugar industry as an authority on bagasse pulp and paper manufacture.

Dust extraction in sugar packaging plant. — The illustration shows Carter Midac Type R reverse-jet dust extraction units at the new £18 million granulated sugar packaging plant at the Bury St. Edmunds factory of British Sugar plc. As Europe's most modern sugar packaging complex, the plant handles 200,000 tonnes of sugar per year, i.e. 40% of British Sugar's total packeted sugar production; it is highly automated and will ultimately have a storage capacity of some 20,000 tonnes of packeted sugar. Details of all palleted orders are stored on a computer against a customer reference so that a pallet or details of its contents can be called upon at any time. The four dust extraction units, manufactured by the Carter-Midac Division of Carter Industrial Products Ltd., are equipped with a newly-developed filtration medium consisting of laminated PTFE which permits filtration down to sub-micron particle size in the primary stage. Secondary filtration is carried out with panel filters installed in off-takes from the reverse-jet filters, the secondary filtration medium comprising electrostatically-charged fibres impregnated with resin. The dust extraction points are connected to the main sugar feed bin and ducting, to two vibratory screens, four distribution bins and a four-branch line to each of the eight packeting units. Also included is provision for winter recirculation of warm, dust-free air. The filters will operate efficiently at temperatures up to 260°C and have no mechanical moving parts, so that the jet tubes, venturi tubes, support cages and bags may be released quickly and access easily gained to the clean side of the filter for maintenance purposes. A compressed air jet tube across each row of filter bags supplies a pulse of high pressure air in the reverse direction to the normal air flow so as to shake the dust free from the outer surface of the bags and allow it to fall into a hopper.

World sugar production estimate, 1983/84 [1]

	1983/84	1982/83	1981/82
	tonnes, raw value		
BEET SUGAR			
Belgium	835,000	1,200,000	1,120,000
Denmark	397,000	584,000	522,000
France	3,650,000	4,822,000	5,567,000
Germany, West	2,720,000	3,589,000	3,689,000
Greece	326,000	322,000	351,000
Holland	815,000	1,229,000	1,135,000
Ireland	198,000	242,000	183,000
Italy	1,335,000	1,282,000	2,226,000
UK	1,130,000	1,543,000	1,187,000
Total EEC	*11,406,000*	*14,813,000*	*15,980,000*
Austria	370,000	612,000	486,000
Finland	139,000	116,000	95,000
Spain	1,302,000	1,226,000	1,097,000
Sweden	304,000	389,000	347,000
Switzerland	117,000	120,000	135,000
Turkey	1,700,000	1,860,000	1,521,000
Yugoslavia	790,000	712,000	871,000
Total Western Europe	*16,128,000*	*19,848,000*	*20,559,000*
Albania	40,000	42,000	40,000
Bulgaria	160,000	180,000	145,000
Czechoslovakia	790,000	885,000	747,000
Germany, East	700,000	710,000	739,000
Hungary	535,000	587,000	601,000
Poland	1,900,000	2,012,000	1,873,000
Rumania	630,000	652,000	663,000
USSR	7,400,000	6,800,000	6,200,000
Total Eastern Europe	*12,155,000*	*11,868,000*	*11,008,000*
Afghanistan	4,000	4,000	4,000
Algeria	10,000	10,000	10,000
Azores	9,000	9,000	9,000
Canada	140,000	122,000	140,000
Chile	325,000	232,000	137,000
China	890,000	810,000	717,000
Egypt	60,000	24,000	18,000
Iran	390,000	330,000	260,000
Iraq	20,000	20,000	10,000
Japan	550,000	668,000	542,000
Lebanon	5,000	6,000	6,000
Morocco	395,000	345,000	310,000
Pakistan	33,000	20,000	32,000
Syria	88,000	87,000	47,000
Tunisia	4,000	4,000	6,000
Uruguay	49,000	51,000	56,000
USA	2,480,000	2,465,000	3,074,000
Total other continents	*5,452,000*	*5,207,000*	*5,378,000*
World Beet Sugar	33,735,000	36,923,000	36,945,000
CANE SUGAR			
Spain	18,000	17,000	18,000
Total Europe	*18,000*	*17,000*	*18,000*
Barbados	115,000	85,000	88,000
Belize	115,000	121,000	113,000
Costa Rica	225,000	215,000	195,000
Cuba	7,500,000	7,250,000	8,279,000
Dominican Republic	1,200,000	1,150,000	1,217,000
Guadeloupe	64,000	68,000	78,000
Guatemala	550,000	575,000	627,000
Haiti	50,000	55,000	66,000
Honduras	225,000	215,000	218,000
Jamaica	205,000	198,000	202,000
Martinique	2,000	2,000	3,000
Mexico	2,900,000	3,106,000	2,870,000
Nicaragua	265,000	276,000	237,000
Panama	245,000	240,000	239,000
St. Kitts	35,000	29,000	37,000
El Salvador	275,000	247,000	185,000
Puerto Rico	92,000	90,000	102,000
Trinidad	70,000	77,000	79,000
US – Hawaii*	870,000	941,000	892,000
Mainland	1,790,000	1,885,000	1,619,000
Total N. & C. America	*16,793,000*	*16,825,000*	*17,346,000*

	1983/84	1982/83	1981/82
	tonnes, raw value		
Argentina	1,643,000	1,623,000	1,623,000
Bolivia	230,000	226,000	260,000
Brazil	9,360,000	9,314,000	8,393,000
Colombia*	1,400,000	1,385,000	1,318,000
Ecuador	150,000	254,000	322,000
Guyana*	300,000	290,000	305,000
Paraguay	90,000	81,000	77,000
Peru*	514,000	462,000	631,000
Surinam	8,000	8,000	6,000
Uruguay	45,000	45,000	38,000
Venezuela	390,000	385,000	367,000
Total S. America	*14,130,000*	*14,073,000*	*13,340,000*
Angola	30,000	27,000	35,000
Cameroun	65,000	70,000	70,000
Chad	26,000	24,000	19,000
Congo	40,000	28,000	16,000
Egypt	745,000	731,000	730,000
Ethiopia	194,000	192,000	172,000
Gabon	20,000	20,000	20,000
Ghana	0	0	6,000
Ivory Coast	187,000	187,000	166,000
Kenya	412,000	355,000	335,000
Madagascar	105,000	87,000	112,000
Madeira	1,000	1,000	1,000
Malawi	184,000	183,000	177,000
Mali	13,000	10,000	6,000
Mauritius	647,000	729,000	609,000
Morocco	75,000	54,000	59,000
Mozambique	110,000	140,000	177,000
Nigeria	60,000	65,000	50,000
Réunion	220,000	272,000	267,000
Ruanda	2,000	2,000	2,000
Senegal	52,000	50,000	48,000
Somalia	30,000	29,000	29,000
South Africa	1,590,000	2,304,000	2,218,000
Sudan	490,000	390,000	259,000
Swaziland	405,000	403,000	368,000
Tanzania	135,000	117,000	124,000
Uganda	6,000	2,000	1,000
Upper Volta	27,000	28,000	28,000
Zaire	47,000	46,000	39,000
Zambia	110,000	117,000	102,000
Zimbabwe	438,000	405,000	391,000
Total Africa	*6,466,000*	*7,068,000*	*6,636,000*
Bangladesh	186,000	196,000	219,000
Burma	54,000	43,000	46,000
China	3,110,000	3,375,000	2,978,000
India	8,100,000	8,945,000	9,168,000
Indonesia	1,806,000	1,770,000	1,354,000
Iran	150,000	140,000	115,000
Iraq	10,000	10,000	15,000
Japan	267,000	255,000	240,000
Malaysia	74,000	71,000	62,000
Nepal	14,000	14,000	13,000
Pakistan	1,195,000	1,227,000	1,378,000
Philippines	2,500,000	2,465,000	2,527,000
Sri Lanka	31,000	27,000	27,000
Taiwan	634,000	658,000	771,000
Thailand	1,650,000	2,265,000	2,930,000
Vietnam	150,000	130,000	110,000
Total Asia	*19,931,000*	*21,591,000*	*21,953,000*
Australia	3,100,000	3,634,000	3,527,000
Fiji	290,000	505,000	489,000
Papua New Guinea	20,000	11,000	0
Total Oceania	*3,410,000*	*4,150,000*	*4,016,000*
Total cane sugar	60,748,000	63,724,000	63,309,000
Total beet sugar	33,735,000	36,923,000	36,945,000
World sugar production	94,483,000	100,647,000	100,254,000

* 1984, 1983, 1982.

[1] F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 527-531.

BREVITIES

Sugar Industry Technologists Inc. Meade Award. — The Executive Committee of the S.I.T. has approved the selection of the Meade Award Committee for the best paper presented at the New York meeting in 1983. The award will be made to MM. J. Cuel and C. Longue Epée of Beghin-Say, Paris, for their paper "Continuous crystallization in vacuum crystallizers of the Beghin-Say sugar refinery in Nantes, France".

Hawaiian Sugar Technologists 1983 Conference. — The theme of the 42nd HST Annual Conference held during November 7-9 was "Rising to the competitive challenge". About 375 members representing agriculture, field engineering and factory operations were expected to take part, and several distinguished speakers were to address the general sessions, including Dr. Don Heinz, Director of the HSPA Experiment Station, and John Bunker, President and Chief Executive of California & Hawaiian Sugar Co. A total of 29 agricultural papers were presented, 13 papers or panels concerned with field engineering, and 20 papers with technology. A trade show included 22 participants.

ICUMSA 18th Session. — The 18th Session of the International Commission for Uniform Methods of Sugar Analysis was held in Dublin in June 1982 under its President, Prof. Dr. E. Reinefeld. The *Proceedings* of the Session has now been published and is available, at a price of £16.00 by seamail or £22.00 airmail, from ICUMSA Publications, P.O. Box 35, Wharf Road, Peterborough, Cambs. PE2 9PU, England. It is emphasized that some of the methods included in the 1979 book "Sugar Analysis: ICUMSA Methods" have been abandoned or modified in accordance with decisions taken in 1982. However, copies of the book and of the *Proceedings* of earlier Sessions of ICUMSA are available from the same address.

EEC sugar production levy, 1982/83. — The EEC Commission has decided that the full B-production levy of 37.5% of the white sugar intervention price is to be applied for the 1982/83 marketing year. This is to take account not only of spending on sugar market support, including ACP sugar, but also the deficit in the production levy funds for the previous season. The basic production levy has been set at 10.282 e.c.u. per tonne, i.e. 2% of the intervention price for white sugar, while the B-sugar levy has been set at 192.788 e.c.u. per tonne. For HFCS the basic levy has been set at 4.205 e.c.u. per tonne and that for B-quota HFCS at 79.403 e.c.u. per tonne, dry matter basis. The levy is imposed to finance the export of surplus B-quota sugar which is the "insurance surplus" allowed for in case of failure of producers to provide the whole of the A-quota which is that required to cover the Community's needs. At present the B-quota is the rather excessive 27½% of the A-quota, while C- or non-quota sugar must be sold on the world market at the risk and expense of the producer, without subsidy. The B-sugar levy also pays for the cost of re-exporting the 1.3 million tonnes of cane raw sugar imported by the EEC under the Lomé Convention and is considered as a form of development aid to the ACP countries.

Indonesian sugar expansion program[1]. — In addition to the project at Paliahari in South Kalimantan[2], six sugar factories and plantations are currently being established and twelve further factories are to be developed by private investors during the five-year economic plan period starting in April 1984. Opportunities exist for foreign investment in cane growing and sugar processing joint ventures outside the islands of Java and Bali.

Bangladesh sugar industry rehabilitation loan[3]. — A $20 million IDA credit for a sugar rehabilitation and intensification project has been signed in Washington. The loan is to help boost the country's third most valuable cash crop and three factories are to be assisted in the rehabilitation program.

US beet sugar factory sale[4]. — Great Western Sugar Company has sold its factory at Johnstown, Colorado, to Adolph Coors Company which plans to cease sugar and HFCS manufacture and use the plant for making refined starches for use in brewing and/or chemicals by fermentation.

Ecuador sugar importation. — The Minister of Industry & Trade has announced that Ecuador would import 60,000 tonnes of sugar in the first quarter of 1984[5]. In 1980 and 1981 Ecuador exported sugar — 71,757 and 52,554 tonnes, respectively, all to the US[6] — but imports began at some 20,000 tonnes in 1982, have risen in 1983 and now are to continue in 1984. The imports are said to be necessary to cover shortfalls in domestic production caused by heavy rains and floods earlier in 1983.

French West Indies sugar production, 1982[7]. — The five sugar factories in Guadeloupe crushed 839,818 tonnes of cane in 1982 to produce 71,757 tonnes of sugar, tel quel; this compares with 59,446 tonnes of sugar from 788,321 tonnes of cane in 1981 and 92,320 tonnes of sugar from 973,209 tonnes of cane in 1980. In Martinique sugar production fell to 1995 tonnes from 3079 tonnes in 1981 and 6346 tonnes in 1980. It seems a matter of time before the Lareinty sugar factory is closed or, like Galion factory, adapted to rum manufacture.

Sri Lanka sugar expansion plans[8]. — Sri Lanka's sugar production is to be increased from the current 25,000 tonnes to 177,000 tonnes by 1990, according to the Minister of Agricultural Development and Research. He said that if all sugar producing companies achieve their targets, the country could produce at least 70% of domestic requirements. These are set at around 250,000 tonnes per year over the next few years and slightly lower than this at present. Sugar imports cost $82 million in 1981 and 1982 and are expected to be higher in 1983.

Puerto Rico sugar importation[9]. — For the first time in over 100 years, Puerto Rico has had to import sugar to cover its domestic requirements.

Cane alcohol project in Botswana[10]. — The government of Botswana wants to establish a plant to manufacture alcohol from sugar cane in Okavango, near Manu. This project would also require development of infrastructure and communications. The government is looking for investors able to provide technical and financial support.

Tate & Lyle offer for Portuguese sugar refinery[11]. — Tate & Lyle PLC has made an offer for shares in Alcantara Sociedade de Empreendimentos Açucareiros S.A.R.L. which owns the Sidul refinery in Lisbon.

Gabon sugar production, 1982[12]. — Société Sucrière du Haut-Ogooué (Sosuho) produced 13,500 tonnes of white sugar in 1982, of which 5500 tonnes have been exported. Total production capacity of the factory is 30,000 tonnes annually but production in 1983 is forecast to reach 15,000 tonnes.

Mali alcohol plant finance[13]. — A World Bank loan of $7.8 million, repayable in fifty years with a grace period of ten years, will finance the first project for renewable energy in Mali. It will be an alcohol plant utilizing molasses from two sugar factories.

Australia-China sugar trade agreement[14]. — Australia will supply China with more than 750,000 tonnes of raw sugar over the three-year period 1984-86 under a long-term contract. Details remain confidential but it has been stated that the tonnage is slightly more than under the contract for 750,000 tonnes which finished at the end of December 1983. No details of the pricing arrangements for the new or the old contract have been made public.

Indian sugar production 1982/83[15]. — Sugar production in the 1982/83 season (October/September) was 8,232,000 tonnes, white value, down 200,000 tonnes from the previous season. Total offtake in 1982/83 was 6,465,000 tonnes for domestic consumption and 425,000 tonnes for export, compared with 5,531,000 tonnes for domestic consumption and 415,000 tonnes for export in the previous season. Total closing stock with factories at the end of September 1983 was 4,605,000 tonnes against 3,262,000 tonnes at the same time in 1982.

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1 *Indonesia Development News*, 1983, **7**, (1), 2.
2 *I.S.J.*, 1983, **85**, 384.
3 *Standard Chartered Review*, October 1983, 26.
4 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 557.
5 *World Sugar J.*, 1983, **6**, (4), 29.
6 *I.S.O. Stat. Bull.*, 1983, **42**, (9), vii.
7 *Zuckerind.*, 1983, **108**, 993-994.
8 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 560-561.
9 *Zuckerind.*, 1983, **108**, 995.
10 *Westway Newsletter*, 1983, (120), 9.
11 *Tate & Lyle News*, November 1983, 1.
12 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 574.
13 *Westway Newsletter*, 1983, (120), 10.
14 *Reuter Sugar Newsletter*, October 7, 1983.
15 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 578.

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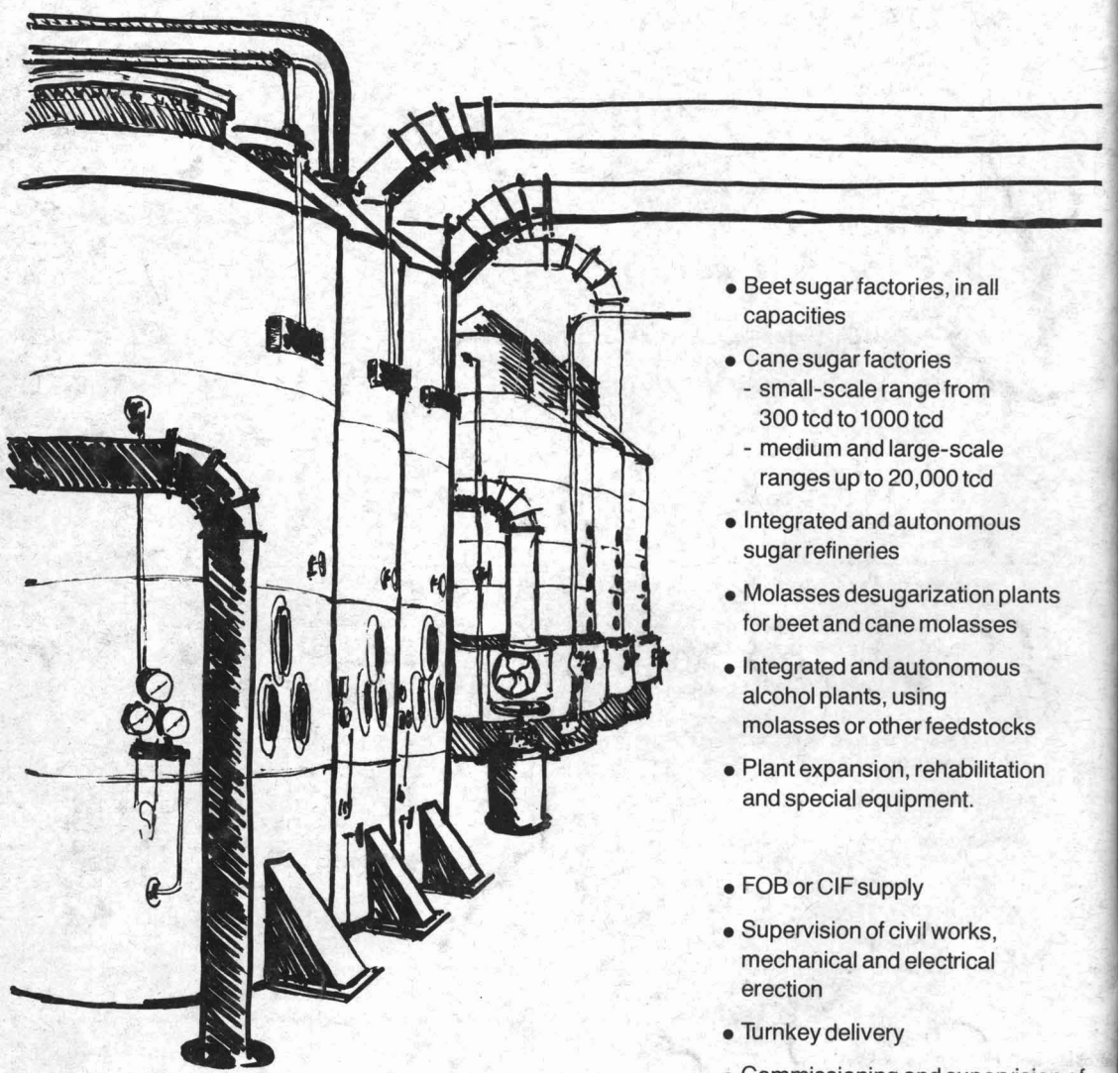

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