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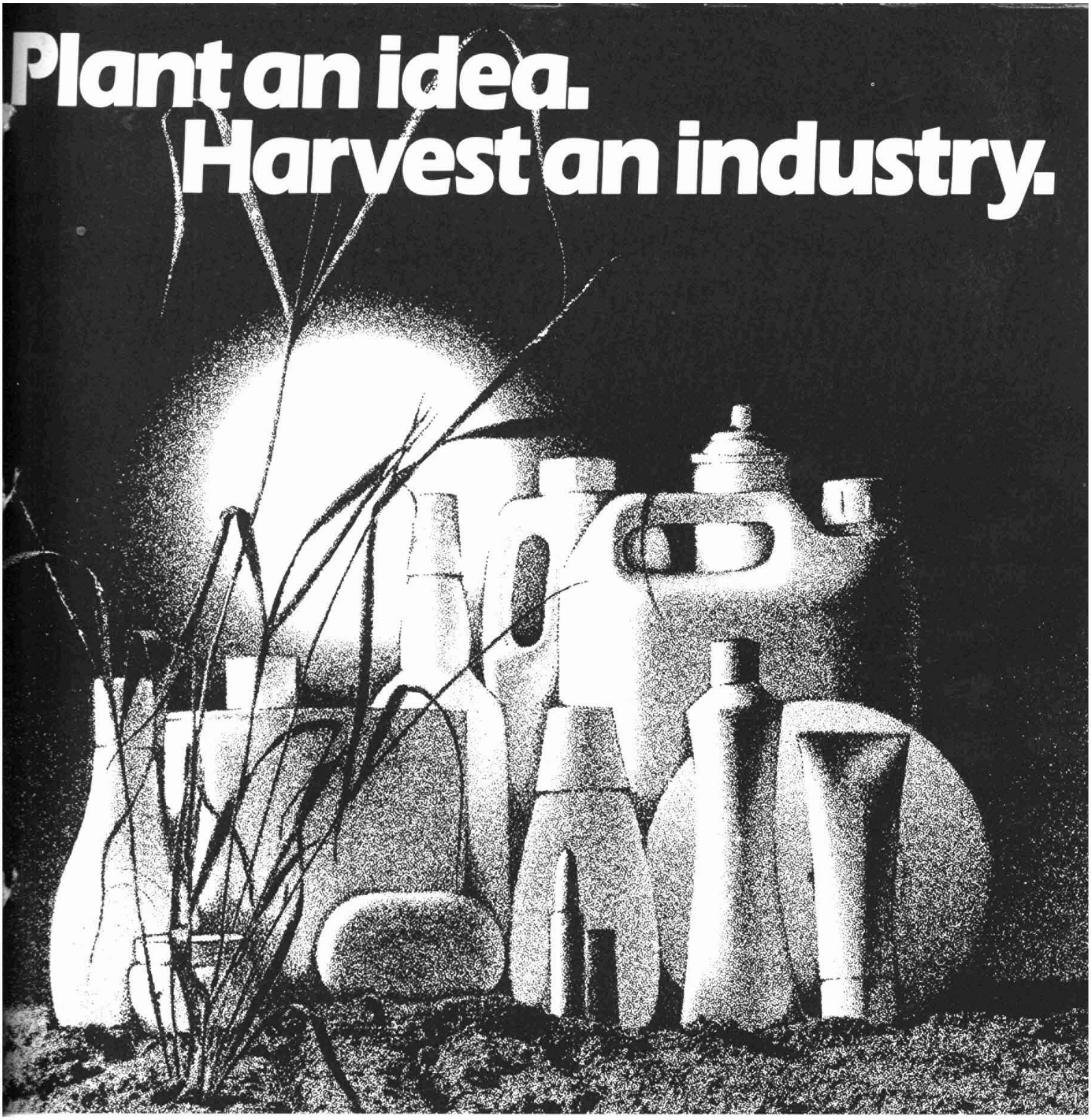

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NOTES AND COMMENTS

ISJ Panel of Referees

With the increasing amount of agricultural material submitted to us for publication the need has been felt to increase the number of specialists on our Panel of Referees able to scrutinize and advise on the manuscripts offered. We are most fortunate that two of the most distinguished agricultural scientists engaged in the sugar industry have consented to join the Panel, namely Dr. Don J. Heinz and Dr. James E. Irvine.

Dr. Heinz is well known as Director of the Hawaiian Sugar Planters' Association Experiment Station and has a considerable career in plant breeding to his credit. Dr. Irvine, a noted plant physiologist and agronomist, has worked in Louisiana for many years and is Director of the US Sugarcane Laboratory in Houma.

This Journal is privileged to be able to call on the sevices of the two new Referees whose efforts will be appreciated by all our readers in the agricultural sector of the industry.

Sugar consumption in 1985

Many observers have been surprised by the much greater than expected elasticity of demand, relative to price, shown by sugar consumers in the developed countries in recent months. This has led to reassessments of sugar balances and has had a strong influence in easing sugar prices from the highs of 1980.

Mr. Albert Viton, writing in F. O. Licht's *International Sugar Report*[1], has reassessed demand in the period to 1985 by comparison with his views in 1979, when the prices contemplated were in the range of high tens and low twenties (cents per pound) whereas they rose in reality to the forties. He has assumed that the declining trend of the last few years in population and income growth will continue, the latter at only 1.5 - 2.5% except in relatively minor cases such as the petroleum-exporting countries. He considers that a small decline – say 7 - 8% – in the real price of sugar is realistic and notes that in low-income countries the high priority given to sugar shows no sign of declining and in many seems even to be rising. On this basis, the revised forecast for 1985, as given in the table, totals 101 million tonnes of sugar and 4.5 million tonnes of HFCS, dry basis.

Although in the US total sweetener usage is expected to even increase slightly, sugar usage is declining, with substitution by HFCS, while per caput consumption in developed countries as a whole has ceased to grow and in many seems to have set in a slight decline. "The greatest deflation of expectations has taken place with regard to China mainland. . . The transformation from the medieval structures of production and distribution to highly productive modern systems has proceeded much more slowly than most Western enthusiasts foresaw. . . . The government has given sugar low priority in the allocation of both agricultural resources for domestic production and of financial resources for imports. . . . Poorer land is used for beet and cane cultivation; the best lands are reserved for cereals, vegetables and some fibre crops. Such sugar factories as are constructed are small and primitive by western standards; the expected push to factories of above 4000 tonnes capacity has not yet materialized. . . . China alone thus accounts for most of the decline in the 1985 estimates.

"The assumption of slightly lower income and population in the low-income countries of Asia, Africa and Latin America, as compared with previous projections, has only very small effects on the 1985 consumption-demand estimates. These countries remain the area of future growth – indeed, for all practical purposes, almost the sole areas of growth."

Sugar consumption 1979/80 and estimated 1985
(million tonnes, raw value)

	1979/80	*1985*
EEC	10.4	11.0
Spain	1.1	1.3
Other W. Europe*	2.9	3.1
USSR	12.2	13.2
Other East Europe	5.0	5.3
Canada	1.0	0.98
USA	9.4	8.2
South Africa	1.2	1.4
Japan	3.1	3.3
Australia & New Zealand	1.0	1.0
	47.3	48.78
Developing countries		
Argentina	1.05	1.25
Brazil	5.9	7.1
Colombia	0.95	1.1
Mexico	3.3	4.15
Peru	0.55	0.61
Venezuela	0.74	0.85
India	5.9	7.4
Indonesia	1.82	2.15
Iran	1.35	1.55
Iraq	0.5	0.68
Korea	0.46	0.58
Malaysia	0.48	0.60
Pakistan	0.84	0.95
Philippines	1.20	1.45
Taiwan	0.46	0.49
Thailand	0.62	0.76
Turkey	1.26	1.42
Egypt	1.10	1.34
Morocco	0.66	0.70
Sudan	0.38	0.46
Other developing countries	9.10	11.10
	38.62	46.80
China and Asian Centrally-Planned Economies	4.25	5.40
World total	90.2	101.0
HFCS	2.5	4.5

*Except Turkey.

World sugar prices

The London Daily Price for raw sugar at the beginning of February was £246 per tonne and at the end was £255, having ranged between £240 and £260 for almost the whole of the month with a few short periods outside this range to as low as £235 and as high as £285. The LDP(W) was maintained at a premium of £25 - £30 throughout almost the whole of the month. The highest levels were reached when the market reacted to purchases by the Soviet Union of some 750,000 tonnes of sugar but they were not sustained, in spite of news of smaller purchases by other importing countries and a report that Poland required 200,000 tonnes, although the latter is dependant on finding a source of loan funds to pay for it. News that India had banned sugar imports caused some strengthening of the market towards the end of the month.

[1] 1981, **113**, 20 - 24.

According to the *Public Ledger's Commodity Week*[2], "Some kind of consensus seems to be developing to explain sugar's performance – or rather lack of it. In sum this amounts to the belief that the market is in the process of finding a new equilibrium of sufficient strength to balance the easy availability of physical sugar with the existence of offtake that analysts know, statistically, should be there........ The market's new and more restrained behaviour reflects the widespread view that the heady days of 1980 are definitely over, that consumption has been hit by high prices to a greater degree than was anticipated and that, apart from the odd buying flurry on the futures market on reports of physical purchases, a gentle downward slide is the best that is likely to happen".

UK beet sugar factory closures

On February 16 the British Sugar Corporation announced that four of its factories (Ely, Felsted, Nottingham and Selby) are to be closed before the start of the 1981/82 campaign, with the loss of some 750 permanent and 500 seasonal jobs. Production capacity will thereby be reduced from over 1.25 million tonnes to around 1.15 million tonnes, the level of the EEC A- plus B-quotas which the UK Minister of Agriculture has stated as being acceptable. The total cost to the company will be about £23 million of which £8.5 million will be closure costs and the remainder the write-off of the company's assets.

The four factories were small and cost of production was higher than at the bigger plants; the only way they could have been kept in production was to increase beet supplies for manufacture of C-quota sugar to be sold on a volatile world market, and this was not considered a responsible alternative. The present level of beet area, at about 210-215,000 hectares, will not be affected and the Corporation will pay the extra transport costs for delivery in 1981/82 to other factories by farmers contracted to supply the closed units.

C. Czarnikow Ltd.[3] note: "The closures by both Tate & Lyle and the British Sugar Corporation reflect the fall of about 300,000 tonnes in sugar consumption which has taken place in the United Kingdom during the past few years. The reduction in capacity also presumably marks an acceptance of the end of the country's role as a major in-transit refiner. In any case, total exports in recent years have rarely exceeded 100,000 tonnes, though that tonnage may be exceeded in 1981 as a consequence of the sale of a block of BSC sugar to the Soviet Union. Some years ago exports of British refined sugar were regularly in excess of half a million tonnes".

EEC farm prices, 1981/82

On February 18 the EEC Commission proposed increases of between 6 and 12% to farmers in a package that, according to the Farm Commissioner, would raise consumer prices by 2.5% in the year from April 1981. The proposals include measures whereby producers would contribute much more to the finance required to dispose of Community surpluses and the "green" currencies – a form of national subsidy to farmers – would be reduced in the cases of the UK and West Germany (where there is a substantial difference between the undervalued "green" currency and the real ones) and eliminated in the case of the Benelux countries (where the difference is small).

In the sugar sector, the Commission proposed increases of 7.5% in the payment for beet, from 33.10 to 35.58 e.c.u. per tonne, and in the intervention price for white sugar from 432.7 to 465.2 e.c.u./tonne. The proposed storage cost levy for white sugar is raised by 20.4% to 34.8 e.c.u./tonne, while the refining margin is set 7.5% higher at 38.9 e.c.u./tonne. The production levy which is proposed to be introduced amounts to 2.5% on A-quota sugar (11.6 e.c.u./tonne) and a total of 40% on B-quota sugar (18.61 e.c.u./tonne).

Predictably, the proposals met with strong criticism from the EEC's farmer organizations who wanted higher prices, and from consumer organizations who considered them too high. Nevertheless, the Farm Ministers of the ten member countries of the EEC agreed on the proposals for all the agricultural commodities except for the Italian Minister who, at the end of the month, remained adamant in rejecting the proposals concerning sugar. The Italian government is determined to boost sugar production in order to cover domestic consumption which, in 1980, reached 1.9 million tonnes, and this is directly counter to the intention of the proposals to reduce production. The Italian Minister was due to report his governments views to another meeting of the Council on March 10. In the meantime, the whole package remains blocked.

EEC sugar balance [4]

From the latest estimates by member countries, the following balance has been drawn up to show Community consumption and export availabilities for the crop year commencing October 1, 1980, together with corresponding figures for the previous year:

	1980/81		1979/80	
	tonnes, white value			
1. Opening stock		1,766,000		1,514,000
2. Production				
(a) C-quota sugar	1,057,000		1,446,000	
(b) Max. quota	10,975,000		10,843,000	
		12,032,000		12,289,000
3. Imports		1,443,000		1,504,000
4. Total availability for domestic use (1 + 2b + 3)		14,184,000		13,861,000
5. Planned closing stock		1,306,000		1,766,000
6. Consumption		9,420,000		9,452,000
7. Exports with subsidy levy				
(a) Sugar as such	3,164,000		2,323,000	
(b) Sugar in processed products	294,000		294,000	
		3,458,000		2,617,000
8. Total export availability (2a + 7a)		4,221,000		3,769,000

International Sugar Agreement [5]

A meeting of the Executive Committee of the International Sugar Council took place in London on February 6 and membership of the Finance and Statistical Committees was decided for 1981 while a panel was appointed to examine any claims which might be made of *force majeure* in respect of shipments by exporting members in 1980. A number of countries are reported to have made such claims – Colombia, Cuba, Dominican Republic, India, Mauritius, Panama, Peru, South Africa and Thailand – and, although quotas were not operative last year, these exporters will wish to establish claims to the extent that actual exports fell short of their basic export tonnages since performance in 1980 is a factor in the formula by which BET levels will be calculated for 1981.

2 February 21, 1981.
3 *Sugar Review*, 1981, (1532), 28.
4 *World Sugar J.*, 1981, 3, (7), 16.
5 C. Czarnikow, *Sugar Review*, 1981, (1531), 23-24.

The AMS Sucro clarifier

By C. M. MADRAZO and R. N. MARCELINO
(Sucro Industrial Corporation, Philippines)

Introduction

Juice clarification, defined by V. E. Baikow as "the precipitation and removal of all possible non-sugars, organic and inorganic, and the preservation of sucrose and reducing sugars as much as possible in the clarified juice", is a very critical stage in sugar processing and necessitates well-designed equipment to obtain the best results.

In designing a clarifier there are two important factors to be considered, namely, the velocity of the juice inside the clarifier, and the volume of the mud chamber. For best results there is a limit to the juice velocity, especially at the clear juice withdrawal point and in the regions of mud travel towards the thickening chamber. The ideal velocity, according to Hugot[2], is 10 – 20 ft.hr^{-1}, when perfectly laminar flow occurs. At 20 – 40 ft. hr^{-1} flow is steady and favours a still excellent subsidation, while at 40 – 50 ft.hr^{-1} irregularities begin, although settling is still possible but erratic. At 50 ft.hr^{-1} or more, flow is turbulent and subsidation becomes impossible.

Enough volume must be provided in the mud chamber, as well as a good mud thickening system, since the volume for mud thickening determines the normal working capacity of the clarifier.

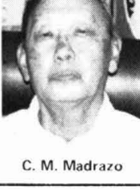
With these guidelines in mind, many studies and researches have been made to improve existing clarifiers. However, clarification is a seemingly simple process but is complicated by the fact that juices to be clarified vary from place to place and from one season to another; furthermore, juice extracted by a diffusion process has higher non-sugars, waxes and other extraneous matter than that from conventional mills. As a consequence, no design has yet been considered perfect for all juices, although each design has its own merits.

Clarifier performance criteria

There are five important considerations to be taken into account in assessing the performance of a clarifier; these are:

(1) *Clarity of clarified juice.* A high-clarity juice will give good quality sugar. High-clarity juice will also help in improving evaporator performance since scale formation in the tubes will be reduced. The good quality syrup will be easier to boil in the vacuum pans and the massecuites will be more mobile so that there will be not only a shorter boiling time but the separation of crystals and molasses at the centrifugal station will be easier. As a result of all these, there will be an overall increase in boiling house recovery.

(2) *Retention time in the clarifier.* Reduction of retention time of juice inside the clarifier will give a two-fold benefit – (a) reduction of sucrose losses due to exposure to higher temperature and the action of thermophilic bacteria, and (b) increase in the effective capacity of the given clarifier volume which can permit use of a smaller and cheaper clarifier.



C. M. Madrazo

R. N. Marcelino

(3) *Consistency or thickness of mud.* Thicker mud will increase the capacity of the filter station, lessen the volume of filtrate to be recirculated to the clarifier and at the same time decrease the loss of pol in mud.

(4) *Sucrose losses inside the clarifier.* Sucrose losses in the clarifier are mainly due to inversion and destruction of invert sugar which, as mentioned above, will be reduced when the retention time of juice in the clarifier is shorter.

High temperature is necessary to reduce the viscosity of juice and to afford proper conditions for the coagulation of albumin and nitrogenous substances such that calcium phosphate flocs are formed in the juice. However, this may lead to the destruction of invert sugar, especially at higher pH, since invert sugar is stable at pH 3.0. On the other hand, sucrose is stable at pH 7.0 and above but is inverted at pH below 7.0. Juice is normally limed to a pH above 7.0 so that it is the invert sugar which is destroyed. When this happens, acidic substances are formed which tend to reduce the pH; this in turn can result in the destruction of sucrose and formation of more organic acids, resulting in further sucrose inversion.

The overall result is the production of high-purity final molasses and, since sucrose replaces the destroyed invert in the final molasses, the final yield of crystal sugar is reduced[1].

During clarification there is a pH drop of about 0.5 – 1.0 and, as a result, it is usual to lime juice to a pH of about 7.8 so that, even if the pH of the juice falls, it will not go below 7.0. Whilst this minimizes sucrose losses, the colour-forming bodies in the clarified juice are increased and invert sugar destruction is hastened.

(5) *Simplicity and reliability of operation.* A good clarifier must be simple and reliable to operate. Cleaning of internal parts must be easy and important parts must be resistant to wear and tear.

The AMS Sucro clarifier

The AMS Sucro clarifier has five upper stationary trays sloping inwards from the circumference of the tank, and four rotating trays sloping outwards from the centre (Fig. 1). It may be provided with more trays, however, without affecting its performance or efficiency. In fact, any number of trays can be fitted, the only limiting factor being the height of the clarifier because, if the number of trays is increased, there must be a corresponding increase in the volume of the bottom mud compartment. This volume should be about 27% of the total juice volume in the clarifier.

The clarifier body comprises a vertical steel cylinder A covered by a top C and with an inverted 45° conical bottom B. It also has a concentrated mud receiving

[1] "Manufacture and refining of raw cane sugar" (Elsevier, Amsterdam), 1967.
[2] "Handbook of cane sugar engineering" 2nd Ed. Transl. Jenkins. (Elsevier, Amsterdam), 1972.

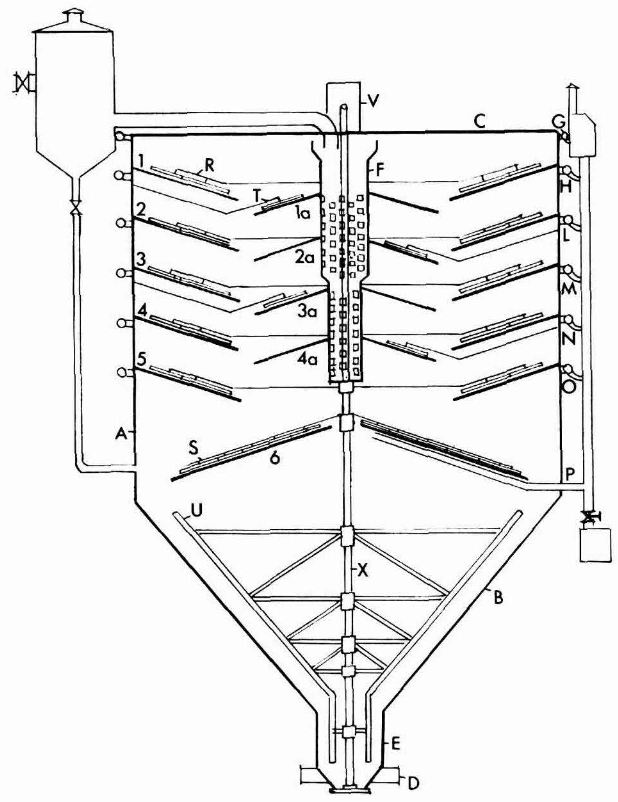


Fig. 1

sump E and a discharge pipe D for the concentrated mud. A vertical revolving pipe F, into which juice to be clarified is fed, is located at the centre of the clarifier. Shaft X drives the scrapers R and S for the stationary trays and mud thickening chamber B, respectively, which are attached to the bottom of pipe F. The scrapers for the inner rotating trays T are stationary and are attached to the stationary outer trays.

The five stationary trays 1, 2, 3, 4 and 5, sloping inwards with a slope of 15°, are welded to the cylindrical body A, while the four outwardly sloping rotating trays 1a, 2a, 3a and 4a are attached to the rotating feed pipe F. Spaces are provided between the ends of the stationary and rotating trays to allow passage of incoming juice and descent of the settling mud into the mud thickening chamber B.

A bottom tray 6 slopes downwardly from the centre to the periphery and receives the mud from the upper trays. An annular space provided between the edge of tray 6 and the shell of the clarifier body allows passage of mud to the thickening chamber B. Mud on tray 6 is carried to its periphery by means of the scrapers provided.

Perforations are provided in the central feed pipe F so that the juice feed passes through and is distributed between trays 1a, 2a, 3a, 4a and 6. Part of the juice crosses the space between the stationary and rotating trays and part moves upwardly to the upper tray and towards the periphery. Here juice flow is laminar, with a velocity less tha 20 $ft.hr^{-1}$, so that the incoming juice will not disturb the already formed mud, and subsidation is favoured.

The Seip-Graver principle of "upward filtration" applies when the rising juice passes through the descending curtain of settling mud particles when the juice flow is laminar; under these conditions the flow of mud continues to trap the flocs in the incoming juice and clarity is enhanced.

Around the periphery of the shell body, just below the uppermost parts of the stationary trays, juice rings with holes of different sizes are provided from which clarified juice is withdrawn to the juice pipes G, H, L, M, N, O and P. The sizes of the holes are calculated so that juice withdrawal is uniform around the entire juice ring, and the hole farthest from the withdrawal point is the largest. The reason for this is that, at the highest point of the outermost periphery of the shell, the juice velocity is lowest (only about 3.3 $ft.hr^{-1}$). This system of juice withdrawal is a unique feature of the AMS Sucro clarifier and gives maximum possible capacity for juice with high clarity.

Pipes G, H, L, M, N, and O are provided with partition plates with perforations of different sizes to ensure uniformity of juice withdrawal.

From tray 6 the mud which is distributed to the periphery of the inverted cone B is gently conveyed by arms U towards the mud receiving sump E. Clear juice in cone B moves upwardly and is drawn off through pipe P. The scrapers are connected to the lower shaft of the central feed pipe which, together with the attached trays, rotates at one revolution per 15 minutes. A valve or diaphragm pump is provided for regulating the amount of mud withdrawn from the clarifier. A clarified juice box is also provided and each of the draw-off pipes emptying into it is fitted with a butterfly valve so that the flow of juice may be governed to control clarity.

The stirrer driver comprises a 10 h.p. electric motor operating through an enclosed worm reduction gear, chain and sprockets and finally a suitably-lubricated worm gearing. A perforated annular pipe is provided through which a solution of soda-ash, magnesium oxide, etc. can be injected whether by gravity or using a chemical dosing pump. The clarifier is also provided with its own flash tank.

Operation of the AMS Sucro clarifier

Mixed juice delivered to the clarifier need not be limed to pH 7.8 – 8.0 but only to about pH 7.5. This minimizes losses through destruction of invert sugar and

Suma Products

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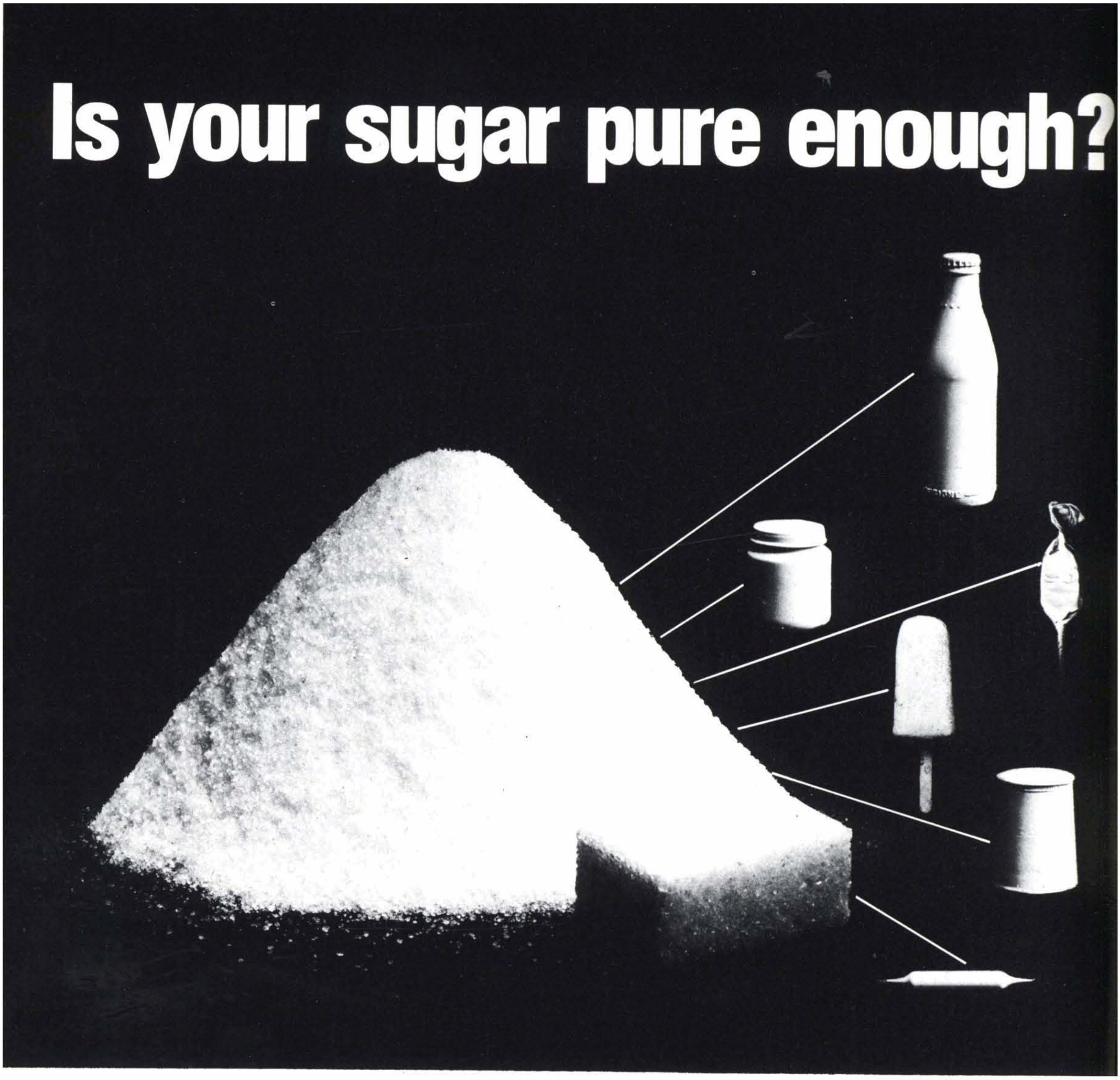

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at the same time gives lighter-coloured sugar. The mud drawn off is of higher pH, so that the filtrate is of higher purity and losses are smaller.

Heated limed juice is admitted at the inlet of the flash tank where excess steam is separated and flocculation of impurities in the juice begins. The juice enters the clarifier through a funnel at the top of the feed pipe which distributes it uniformly by means of the perforations. Mud settling on the trays is directed by the scrapers to the spaces between the fixed and rotating trays and falls as an annular curtain onto the tray 6. Scrapers direct it to the edge of the tray and it falls onto the conical surface of B, is thickened by arms U rotating with shaft X, and collects in sump E. The thickened mud is withdrawn through pipe D by gravity, but a mud pump may have to be used at the start of operations after a shut-down when it becomes very dense. Valves regulate the flow of mud discharged to a mud box.

Clarified juice flows from each compartment through the holes around the periphery and is discharged at the clear juice box through a pipe for each clear juice path, under the regulation of a butterfly valve to ensure clarity control.

The Don Pedro installation

Fig. 2 shows the AMS Sucro clarifier installed at Central Azucarera Don Pedro in Nasugbu, Batangas, Philippines. It has a working volume of 18,000 ft^3 for a crushing capacity of 8000 t.c.d.; this includes an allowance for return to the clarifier of 10% filtrate on mixed juice. At a volume of 32 ft^3 of juice per tonne of cane,

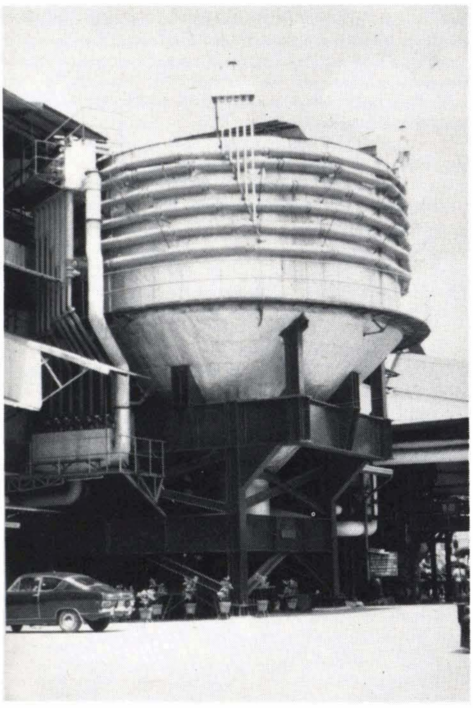

Fig. 2

8000 t.c.d. will produce 256,000 ft^3 per day of mixed juice and the clarifier thus has to handle a combined juice + filtrate volume of 256,000 ft^3 plus 25,600 ft^3 = 281,600 ft^3 per day. The retention time in the clarifier is thus

$$18{,}000\ ft^3 \times \frac{24\ hr}{281{,}600\ ft^3}$$

$$= 1.53\ hours.$$

Evaluation of the AMS Sucro clarifier

The AMS Sucro design incorporates various features for increasing capacity, to give a better quality clarified juice, reduce sucrose losses and produce a good quality filter mud. The units constructed have proven simple to operate and reliable; no major repairs have been required for important parts of the clarifiers. Manholes and hand-holds provided have facilitated cleaning of the interior of the clarifier.

In Table I are recorded comparative data from Lopez Sugar Corporation (LSC) and Central Azucarera Don Pedro (CADP) showing the improvement in clarity of juice and in raw sugar quality arising from installation of the clarifier.

Table I

	LSC		CADP	
	Before installation	After installation	Before installation	After installation
Mixed juice				
Brix	13.75	14.45	18.69	19.74
Pol	10.65	11.47	15.07	16.02
Purity	77.45	79.38	80.63	81.16
Clarified juice				
Brix	13.86	14.48	19.04	20.18
Pol	10.88	11.70	15.46	16.47
Purity	78.50	80.82	81.20	81.62
pH	6.72	6.83	6.20	6.90
Clarity K	19.69	22.02	23.00	28.00
Syrup				
pH	6.51	6.57	6.20	6.20
Raw sugar				
Pol	97.39	97.25	97.56	97.56
Moisture %	0.54	0.48	0.60	0.49
Clarity K	40.88	43.85	43.00	52.00
Molasses				
Gal/tonne cane	6.68	6.20	8.62	8.51
Gal/tonne sugar	86.95	65.61	74.89	70.39
Recovery				
Tonnes commercial sugar per tonne gross cane	7.68	9.44	11.52	12.10
Reduced overall recovery, ESG	77.89	82.99	84.41	83.69

Summary

A description is given of the AMS Sucro clarifier and its operation together with comparative data which indicate that its use has improved quality of clear juice and sugar at two Philippines sugar factories.

Der AMS Sucro-Dekanteur

Der AMS Sucro-Dekanteur und sein Betrieb werden beschrieben zusammen mit vergleichenden Unterlagen, die zeigen, daß seine Anwendung die Qualität des Klarsaftes und des Zuckers in zwei philippinischen Zuckerfabriken verbessert hat.

Le clarificateur AMS Sucro

Une description est donnée du clarificateur AMS Sucro et de son fonctionnement, avec des données comparatives qui indiquent que son emploi a amélioré la qualité du jus clair et du sucre dans deux sucreries des Philippines.

El decantador AMS Sucro

Se describen el decantador marca AMS Sucro y su operación y se presentan datos comparativos que indican que su uso ha mejorado la calidad de jugo claro y de azúcar a dos ingenios de las Islas Filipinas.

Enzymic colour formation in sugar beet

Characterization of enzymes using catecholamines

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Part 1

Introduction

Phenolic compounds in juices from sugar beets have been studied[1] and, from the investigations, it was concluded that catecholamines were found in substantial quantities in raw juice. Among the predominant catecholamines were dopa and norepinephrine. The common structural features of these compounds are their being catechols *(ortho*-dihydroxybenzenes*)* and containing an amino group in their aliphatic side chain.

Having identified these compounds, it is obviously of interest to investigate their formation and the possible reactions in which they can take part. In order to achieve a better understanding of these matters, a study has been carried out to identify the most important enzymes which by their activities play a considerable role in the contents of the individual compounds in the raw juice. The results obtained will be presented in this paper. The potential contribution from the phenolic compounds to the colour in final sugar is dependent on all the alternative reactions in which the compounds can take part.

As has been pointed out, the links between the phenols are of enzymic nature in the beet[1]. Enzymes have been classified according to an enzyme nomenclature system[2] in which the enzymes are listed according to numbers. Taking L-phenylalanine, this compound can be oxidized to L-tyrosine by phenylalanine 4-monooxygenase (1.14.16.1). A second oxidation by tyrosine 3-monooxygenase (1.14.16.2) or monophenol monooxygenase (1.14.18.1) leads to L-dopa. By the action of aromatic-L-amino-acid decarboxylase (4.1.1.28) dopamine can be formed. Dopamine β-monooxygenase (1.14.17.1) converts this substrate to L-norepinephrine. The synthesis of L-epinephrine is finished by the action of an enzyme called phenylethanolamine-N-methyl transferase. These enzymes and the necessary coenzymes have been discussed in the literature[3],[4]. Other known enzymic reactions include the oxidation of dopa to 3,4-dihydroxyphenylserine[5]

In addition to the reactions mentioned, the catecholamines are known to undergo series of oxidation and cyclization reactions[6]. The amino group in the aliphatic side chain cyclizes in a nucleophilic attack on the catechol body, and an indoline compound occurs. This is further oxidized to an iminoquinone which rearranges to a dihydroxyindole. The rates of cyclization can be determined by electrochemical studies, and there are dramatic differences between the compounds in question. The possible reactions are numerous and include interactions between the individual catecholamines[7].

To our knowledge, the reaction scheme leading to the betalain-pigment system is not fully elucidated, but we believe that these reactions are of major importance and should be studied in detail. The knowledge of enzyme-catalysed formation of colour in cane juice is improving, and the conclusion reached emphasizes the importance of the matter[8].

The experiments presented in this paper are contributions to the information needed in the work of improving beet sugar quality with respect to colour. Below, a method for isolating enzymes from sugar beet material will be presented, the important enzymic conversions of catecholamines will be shown, the features of the enzymes will be demonstrated, and aspects of the results will be discussed.

EXPERIMENTAL

Isolation of enzymes from sugar beet

Publications concerning isolation of enzymes from sugar-beet materials are few. An extraction procedure yielding 60 mg protein with tyrosinase activity (1.10.3.1) from 6 kg beet tissue has been published[9]. The procedure includes washing with acetone at -30°C, extraction with water and phosphate buffer, centrifugations and precipitations, and a number of other time-consuming purification steps.

The procedure has been tried in our laboratory several times, but we were unable to replicate the published results. Therefore, we decided to develop a procedure of our own, leading to products which were highly useful for our purposes.

Procedure for extraction of enzymes

All operations are carried out at 4°C. To 5.00 kg sliced beet material is added 5.00 kg cold deionized water. The material is mixed thoroughly for 40 seconds

B. Winstrøm-Olsen

[1] Winstrom-Olsen *et al.*: *I.S.J.*, 1979, **81**, 332-336, 362-367.
[2] International Union of Biochemistry: "Enzyme Nomenclature 1978" (Academic Press Inc., New York), 1979.
[3] Landsberg: "Catecholamines". In "Clinics in Endocrinology and Metabolism" Vol. 6 (3). (W. B. Saunders Company Ltd., London), 1977.
[4] Hanson & Navir: *Recent Adv. in Phytochem.*, 1977, **12**, 91-137.
[5] Towers & Subba Rao: *ibid.*, 1972, **4**, 1-41.
[6] Chavdarian, Karashima & Castagnoli: *J. Medicinal Chemistry*, 1978, **21**, 548-554.
[7] Taylor & Battersby: "Oxidative coupling of phenols". (Marcel Dekker Inc., New York), 1967.
[8] Goodacre, Hutson & Coombs: *I.S.J.*, 1980, **83**, 11-14, 51-54.
[9] Gross & Coombs: *ibid.*, 1976, **78**, 69-73, 106-109.

in a blender to uniformity and centrifuged for 15 min at 3,000 g. The supernatant (approx. 4.4 kg) is collected and the cellular debris discarded. During a period of 20 min 40% on supernatant volume of a saturated solution of ammonium sulphate (3.875 M) is added to the collected supernatant while stirring. The pH of the sample is adjusted to 4.0 with N HCl and the precipitate formed is separated from the sample by centrifugation at 3,000 g for 15 min. The supernatant is discarded and the precipitate collected.

The weight of the achieved product depends on the beet material used. From the root, normally 200 g is achieved. From the green material 100-150 g is collected.

Representative 10-g samples of the crude enzyme were subjected to dialysis through Visking tubing against deionized water for three days. Afterwards, the dialysed samples were dried, and the nitrogen contents were determined according to a modified Kjeldahl method. In all samples, the contents of protein turned out to be between 56 and 58% of the dry weight of the dialysed material when using a factor of 6.37 in the conversion from nitrogen to protein. The content of protein in the crude enzyme preparation was about 2.8%. Hence, 1 kg of sliced beet gave 1.1 g protein according to the above procedure.

This crude enzyme preparation was used either directly, or the product was further purified by gel-permeation chromatography (GPC).

Purification by GPC

This step is carried out at 4°C overnight. The experimental arrangement is that of Madsen *et al.*[10]

A 0.02 M phosphate buffer with 1% sodium chloride adjusted to pH 6.0 is used at a flow rate of 25 cm^3 per hour for a 2.6 cm diameter column. 10-20 g of crude enzyme is placed on top of the column filled with Bio-Gel P-6. Fractions of 5.0 cm^3 are collected and the absorption of the eluant measured at 280 nm.

The free enzymes from the sample are easily detected in the first part of the chromatogram, by collecting the liquid containing the proteins and removing the water by freeze-drying.

Oxidation of tyrosine

From the literature[9], it might be anticipated that the enzyme preparation could oxidize tyrosine to dopa. A crude enzyme preparation of 5.25 g from September-lifted beets was used; 3.50 g was mixed with approx. 25 cm^3 water, transferred to Visking dialysis tubing (2.5 cm inflated diameter), and 0.03 cm^3 toluene added. The preparation was dialysed for 48 hours against 2 x 10 litres of deionized water. Afterwards, the dialysed material was divided into two parts, A and B. The rest of the crude enzyme was named C.

To each sample, A, B and C, 0.2 g KH_2PO_4 plus 0.0250 g tyrosine in water was added, the pH adjusted to 6.0, followed by dilution with water to 100 cm^3. To sample B 0.025 g $CuSO_4 \cdot 5H_2O$ was also added. The samples were incubated at 37°C for 60 min, then filtered and analysed by HPLC, using the procedure published earlier[1]. Representative chromatograms are shown in Figs. 1 and 2. Peaks at 13.6 and 14.0 represent tyrosine, while peaks at 10.9 and 10.7 correspond to dopa. A chromatogram of sample B is practically identical to Fig. 1.

From these and several other studies, we have concluded that the crude enzyme preparation contains an enzyme able to oxidize tyrosine to dopa. The enzyme seems not to require copper as co-factor. This is contrary to what is expected from the literature[2,4,11].

We have found that, on applying GPC to the

crude enzyme preparation, no eluant contains activity able to oxidize tyrosine to dopa. However, the rest of

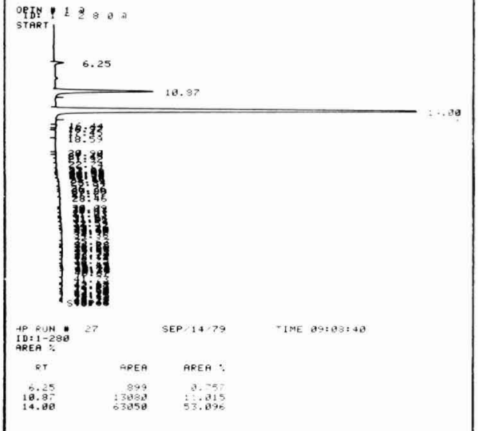

Fig. 1. Enzymic formation of dopa (RT 10.87) from tyrosine (RT 14.00). The crude enzyme preparation (1.75g) was dialysed before incubation with a 100 cm^3 solution of 250 ppm tyrosine, pH 6.0, at 37°C for one hour

the crude enzyme preparation on the top of the GPC column has almost all the activity of the original preparation although more than 500 cm^3 of eluant has washed the sample. Hence, this enzyme activity must be

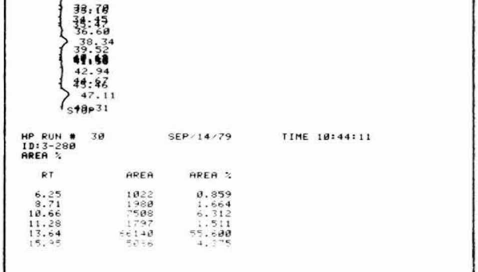

Fig. 2. Enzymic formation of dopa (RT 10.66) from tyrosine (RT 13.64). The experimental conditions were the same as those for Fig. 1 except that the crude enzyme was not dialysed

[10] *Sugar Tech. Rev.*, 1978/79, 6, 49-115.

[11] Mathews & Parpia: "Advances in Food Research", Vol. 19. (Academic Press, New York), 1971, 75-145.

tightly bonded to the solid material precipitated by the addition of the sodium sulphate solution.

Tyrosine in juice from sugar beet

A number of analyses of the composition of amino acids in juices from our factories has been made. Surprisingly, we have found between 0 and 68 ppm in raw juice (RDS equal to 15), and in 2nd carbonatation filtrate from 39 to 104 ppm. Tyrosine has been recovered in the thick juice (RDS 70), and the contents found to be approx. 5 to 6 times higher than that in thick juice from sugar cane which we have found to be approximately 60 ppm (RDS 70).

Tyrosine is formed by oxidation of phenylalanine[2,12] of which we have found 10 to 67 ppm in raw juice, but much less in 2nd carbonatation filtrate. According to the references, the hydroxylation is carried out by the action of phenylalanine hydroxylase which requires dihydrobioopterin as coenzyme and an associated reduction of NADPH.

Our preliminary studies have shown that oxidation of L-phenylalanine to L-tyrosine can be achieved by addition of a crude enzyme preparation to a solution of L-phenylalanine and NADH at pH 6.0. The separation of the two amino acids was achieved by HPLC, and the detection was done at 260 nm.

Enzymic conversions of catecholamines

It was soon realised that by adding either the crude enzyme or the purified enzyme preparation to a solution of a catecholamine at pH 6.0, the sample turned red within a short time. As far as we know, the reactions in question, using enzymes from sugar beet, have not been studied, and hence an internationally accepted method and conditions for testing the enzymes have not been established. The following method has been found useful and is recommended for the crude enzyme preparation.

Incubation: To 50 cm^3 0.02 M phosphate buffer containing 250 ppm norepinephrine 1.00 g crude enzyme preparation is added and mixed thoroughly. The sample is placed in a water bath at 25°C for 30 min. Immediately afterwards, the sample is filtered through a glass microfibre paper (Whatman GF/A) and then through a Selectron filter with pore size 0.45 μm, giving a clear pink to red solution. The sample is analysed as soon as possible because the red colour developed is not permanent. The sample is stored in a cold room at 4°C.

Analysing by HPLC. The catecholamine and the product formed can be separated by HPLC, using a Waters "μ-Bondapak C_{18}" column (10 μm average particle size, 3.9 mm i.d. x 30 cm). In the experiments discussed in this paper, two of these columns were used in series. The Waters apparatus and the experimental conditions used in this work are identical to the procedure published earlier[1].

Example. In Fig. 3, a representative chromatogram is given. A peak at 6.84 is norepinephrine. The compound represented at 14.33 is formed from norepinephrine. By visual inspection of the effluent from the detector, it was concluded that the compound formed is red, and for the sake of convenience, from now on it will be named rednorepinephrine. The compound which represents the peak at 8.42 is probably formed enzymically.

The sample which was used for Fig. 3 was also diluted 10 times, and a spectrum of absorption was recorded, using a Pye Unicam SP8-100 spectrophotometer (10 mm light pathway). The spectrum is given in Fig. 4, showing a definite maximum at 485 nm.

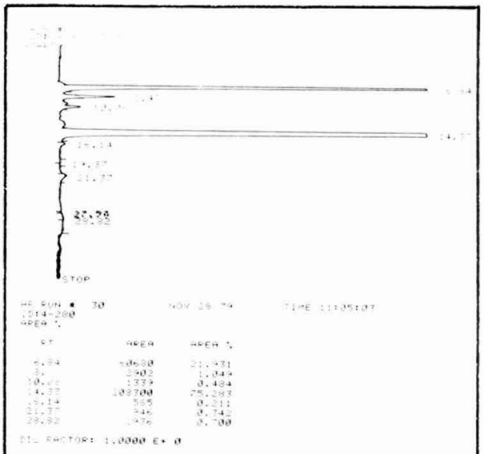

Fig. 3. Enzymic conversion of norepinephrine (RT 6.84) to a red compound (RT 14.33). Separation by HPLC and detection at 280 nm

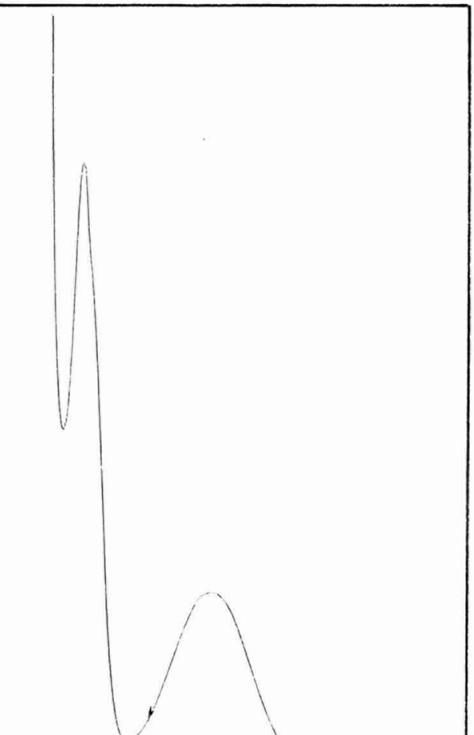

Fig. 4. The spectrum of the same sample which was separated by HPLC, Fig. 3, but for this purpose diluted 10 times with 0.02 M phosphate buffer, pH 6.0

12 Lehninger: "Biochemistry". (Worth Publishers Inc., New York), 1971, 442.

Dopa and dopamine

Experiments similar to those mentioned with norepinephrine have been made. Red compounds are also formed enzymically from these two catecholamines. The intensity of the colour formed is somewhat less than from norepinephrine (about 60-80%), but in all cases the maximum of absorption has been found at 485 nm. The red compounds formed can all be separated by HPLC. The red compounds from dopa and dopamine are both found later in the chromatogram than rednorepinephrine.

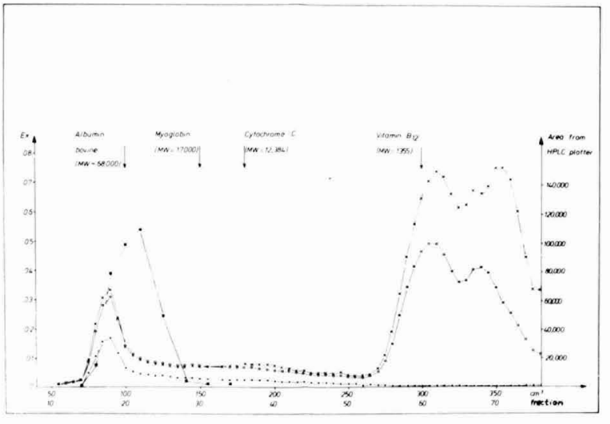

Fig. 5. Gel-permeation chromatogram on Bio-Gel P-60 of a preparation of enzymes isolated from green material of sugar beet. The effluent was collected in fractions of 5 cm , and the absorptions of the samples were measured at 340 nm (·—·), 280 nm (o—o), and 260 (x—x). Afterwards the samples were mixed with a norepinephrine solution, incubated and finally analysed by HPLC (■—■).

Addition of an enzyme preparation to a solution containing more than one catecholamine gives chromatograms showing complicated relationships when more than one substrate is involved. Normally, increasing the concentration of substrate within certain limits leads to an increase of the amount of compounds formed. However, for instance, high concentrations of both dopa and norepinephrine seem to give less product formations than lower concentrations of these compounds.

Dopa is converted more easily to its correspondinq red product than dopamine and norepinephrine which are converted independently according to our provisional studies.

Phenolic compounds

In addition to the catecholamines mentioned, many other phenolic compounds have been studied, as seen in Table I of the earlier paper[1]. All catecholamines are enzymically converted to red products. Solutions of catechol and pyrogallol turn yellow when enzyme preparations are added. No colour is formed when enzymes are added to solutions containing compounds such as resorcinol, hydroquinone, 3-methoxy-tyramine, methanephrine, 3,4-dihydroxyphenyl acetic acid, 3, 4-dihydroxymandelic acid, caffeic acid, etc.

INVESTIGATIONS OF THE PROPERTIES OF THE ENZYME

Molecular weight

Above, an enzyme capable of forming red compounds from catecholamines has been introduced. It is not known whether there is one or more than one enzyme, but for the time being, the activity will for convenience be considered as coming from just one enzyme.

The presentation of the activity is in agreement with a separation of purified enzyme on Bio-Gel P-60, 100-200 mesh. As sample was used 0.28 g of freeze-dried material obtained from a crude preparation of enzymes from sugar beet stalks purified on Bio-Gel P-6. The chromatogram from the effluent of the Bio-Gel P-60 column is shown in Fig. 5. The extinctions of 5 cm^3 samples at 340 nm, 280 nm, and 260 nm are depicted. In addition, the enzyme activity of the effluent is shown in terms of the area plotted by the HPLC integrator. An example is shown in Fig. 6. The sample for HPLC (25 mm) was achieved by mixing 4 cm of fraction No. 22 (see Fig. 5) with 6 cm of a norepinephrine solution, giving an initial concentration of 250 ppm norepinephrine at pH 6.0. This sample was incubated at 25°C for 30 min, then filtered and finally injected. A number of samples from fractions later in the chromatogram than those shown were incubated with norepinephrine, but no further enzyme activity was revealed. Hence, the enzyme was eluted as a single peak.

Before and after the enzyme chromatogram was made, a mixture of compounds with known molecular weights (MW) was used as sample. The compounds were

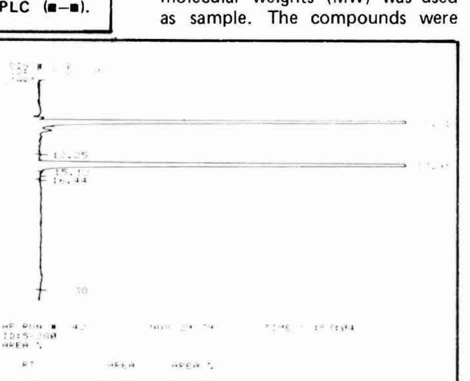

Fig. 6. Chromatogram of norepinephrine (RT 6.81) and rednorepinephrine (RT 13.91) separated by HPLC. Fraction No. 22 (see Fig. 5) was mixed with a norepinephrine and incubated at 25°C for 30 min. After incubation, the extinction of the solution was 1.30 at 485 nm.

bovine albumin (MW 60,000-68,000) myoglobin (MW 17,000), cytochrome C (MW 12,384), and vitamin B_{12} (MW 1,355). By analysing the data achieved, we have concluded that the molecular weight of the enzyme is approx. 50,000.

(To be continued)

Juice decalcification and its effect on molasses production*

By J. F. T. OLDFIELD, M. SHORE, N.W. BROUGHTON and G. C. JONES

Part 1

Introduction

The removal of calcium from water, to prevent scale formation, was the oldest commercial application of ion exchange and it is many years since a similar technique was first applied to the treatment of sugar juices. The decalcification of second carbonatation juice is of great importance in the prevention of scale formation in the evaporators, and the process is installed at more than two-thirds of the factories of the British Sugar Corporation.

Previous papers[1, 2, 3] have dealt with various aspects of the decalcification process as applied within British Sugar. It is the aim of this paper to discuss some of the chemical processes taking place during decalcification and their likely effects on molasses production.

Background chemistry of decalcification

Decalcification of second carbonatation juice is accomplished using a strongly acidic cation exchange resin in the sodium form. It is normally considered simply as an exchange of calcium ions in the juice for sodium ions on the resin, according to the following equilibrium:

$$2\ Resin^-.Na^+ + Ca^{2+} \rightleftharpoons (Resin^-)_2.Ca^{2+} + 2Na^+$$

In practice, the resin does not remove all the calcium ions from the juice, for two reasons:

(i) some of the calcium is present as complexes which, being negatively charged, do not participate in exchange reactions with the resin. Calcium forms complexes with certain carboxylic acid anions: in British Sugar's experience only citrate is of any quantitative significance in this respect in second carbonatation juice[4], but complexes of calcium with tartrate[5] and other organic acid anions[6] which might be present in this juice at very low concentrations have also been postulated.

(ii) other cation exchange reactions occur besides that of calcium for sodium which compete for sites on the resin or, indeed, displace calcium from the resin. Potassium, sodium and ammonium are the principal cations in second carbonatation juice and these can be exchanged for the sodium ions originally on the resin:

$$Resin^-.Na^+ + M^+ \rightleftharpoons Resin^-.M^+ + Na^+$$

Moreover, the high concentrations of these three cations in juice relative to calcium drive the main exchange reaction by which calcium is removed from the juice in the reverse direction, thus:

$$(Resin^-)_2.Ca^{2+} + 2M^+ \rightleftharpoons 2\ Resin^-.M^+ + Ca^{2+},$$

even though the resin has a higher affinity for calcium than for the monovalent ions. This mechanism is probably of particular importance within British Sugar, where the lime salts achieved at second carbonatation are generally lower than those normally reported for other beet sugar factories in Europe or America.

Ion exchange of calcium for sodium alters the non-sugars composition of the juice, and the total weight of non-sugars. Thus the exchange of 1.0 kiloequivalent calcium in the juice for 1.0 kiloequivalent sodium from the resin would give an increase in the weight of non-sugars in juice of 0.15 kg/kg calcium removed.

This situation is modified by the amount of exchange of other cations which occurs by the mechanisms outlined above. The working capacity of decalcification resins which can be achieved in British Sugar operations is about 0.7 kiloequivalents calcium/m^3 resin (1.2 lb CaO/ft$_3$ resin[1]) but the total capacity of the resin in good condition exceeds 2.0 kiloequivalents/m^3, so that under ideal conditions as much as 1.3 kiloequivalents of the other cations per m^3 of resin could also be exchanged for sodium. For example, the exchange of 0.7 kiloequivalents calcium and 1.3 kiloequivalents potassium for 2.0 kiloequivalents sodium would give a decrease in juice non-sugars of 1.34 kg/kg calcium exchanged, or 0.29 kg/kg potassium plus calcium exchanged onto the resin.

* *Paper presented to the 25th Tech. Conf. British Sugar Corp.*, 1980

1 Carruthers & Oldfield: *Paper presented to the 13th Tech. Conf. British Sugar Corp.*, 1960; *Zeitsch. Zuckerind.*, 1961, **11**, 23-30, 85-90.

2 Lubienski & Mackay: *Paper presented to the 22nd Tech. Conf. British Sugar Corp.*, 1974.

3 Oldfield, Harvey & Shore: *I.S.J.*, 1973, **75**, 70-74, 103-105.

4 Carruthers, Oldfield, Shore & Wootton: *Paper presented to the 9th Tech. Conf. British Sugar Corp.*, 1956.

5 Schneider, Emmerich & Schneider: *Zucker-Beihefte*, 1952, **1**, (5), 57-70.

6 Silin: "Technology of Beet Sugar Production & Refining". Moscow, 1958.

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As these examples illustrate, the extent to which the various exchange reactions occur in decalcification will have a marked effect on the non-sugars composition of juice. The influence of these changes on the formation of molasses will be discussed later in this paper.

To establish what occurs in typical conditions, several workers abroad[7, 8, 9] have investigated the relative amounts of sodium/calcium and other cation exchange reactions taking place during decalcification. Their findings are generally not directly transferable to British Sugar factories, which tend to operate with lower lime salts concentrations in second carbonatation juice than those in the reported work. As a result, for the reason discussed earlier, sodium/potassium exchange plays a greater part in British Sugar in determining the change in non-sugars which occurs during decalcification than it does overseas.

Laboratory investigations

Columns containing 10 cm^3 of Zerolit 525 resin were put through a series of exhaustion/regeneration cycles. The "juice" used to exhaust the resin was a synthetic mixture containing, per litre, 160g sucrose, 1300mg K as potassium chloride, 300mg Na as sodium chloride, 140mg NH_3 as ammonium chloride, and 40mg Ca as calcium chloride.

Regeneration was with 2.5 bed volumes of 10% w/v sodium chloride solution. Factory general hot water is largely second condensate, containing a considerable amount of ammonium ions, and therefore the columns were rinsed with water containing 230ppm ammonia $^w/_v$ at the appropriate points in the cycle. The spent rinse-water was recycled for use in regenerant dilution and the initial washing after regeneration, exactly as in the full-scale decalcification cycle.

After three cycles to attain equilibrium conditions, the column outputs were monitored for potassium and sodium (measured by flame photometry), calcium (measured by titration with EDTA), and ammonium (measured by colorimetric determination with Moore & Stein reagent). The mean results are quoted, to the appropriate precision, in Table I below.

Table I. Cation exchange in laboratory decalcification

Bed volumes treated	K^+	NH_4^+	Ca^{++}	Na^+
		μeq.cm^{-3}		
20	7	2.9	0.0	46
40	19	7.4	0.1	30
60	30	8.4	0.1	18
80	35	8.4	0.2	13
Input "juice"	33.3	8.4	2.0	13.0

It was found that, during the initial part of the exhaustion cycle, first the ammonium and then the potassium concentrations in the column outputs rose from zero to about the level in the input solution, while the sodium concentration decreased from an initially high level to about the input level. During the whole run, the calcium concentration in the output increased slowly, and the exhaustions were terminated after about 350 bed volumes when the calcium content of the output reached 15 $\mu g.cm^{-3}$. These observations are illustrated graphically in Fig. 1.

These results suggested that at the beginning of the exhaustion cycle sodium was being displaced from the resin by ammonium and potassium in the juice. From the results obtained, it was possible to calculate the approximate amounts of potassium, ammonium and

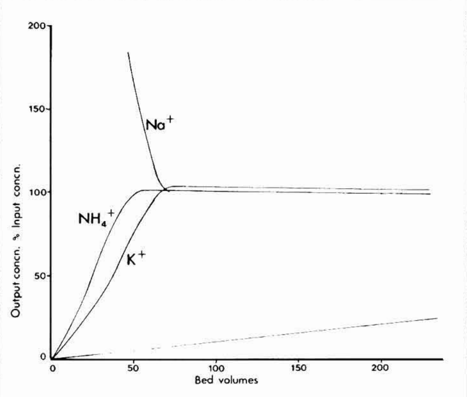


Fig. 1. Cation exchange in laboratory decalcification

calcium which had been adsorbed on to the resin up to that point in the exhaustion when the concentrations of potassium and ammonium in the eluate were the same as in the untreated juice. It was also possible to calculate the quantity of sodium ions which had been displaced from the resin up to that point, and hence the residual sodium content of the resin. These values are quoted in Table II below, expressed as milliequivalents of cation per cm^3 of resin.

Table II. Cations adsorbed on resin during exhaustion

Cation	meq. adsorbed during initial part of cycle (80 bed volumes)	meq. adsorbed during complete cycle (350 bed volumes)
K^+	1.0	0.6
NH_4^+	0.25	0.25
Ca^{++}	0.1	0.5
Na^+	0.7	0.7
Total	2.05	2.05

At the end of the exhaustion cycle, the columns were treated with an excess of 7% $^w/_v$ lithium chloride solution to displace all other cations, and the eluates were analysed. From these results, the quantity of each ion on the resin at the end of the cycle was calculated, and is quoted in Table II, as milliequivalents per cm^3 of resin.

The relative concentrations of the ions reported in Table II clearly show that the main reaction initially was the exchange of sodium ions on the resin for potassium, with a lesser amount of sodium being exchanged for ammonium and even less for calcium ions during this part of the exhaustion cycle. The results show that 0.4 meq of these adsorbed potassium ions per cm^3 of resin were then exchanged for calcium ions in the juice during the remainder of the exhaustion stage. There was neither calcium/sodium nor ammonium/sodium exchange in this second part of the exhaustion.

[7] Zagrodzki & Zaorska: *Sucr. Belge,* 1961, **81**, 137-145.
[8] Durdík & Buriánek: *Listy Cukr.*, 1960, **76**, 2-7.
[9] Wieninger & Kubadinow: *Jahresber. Zuckerforschungs-Institut* (Wien), 1969/70, 107-109.

The overall result was, for each cm^3 of resin, the replacement of 1.35 milliequivalents of potassium plus ammonium plus calcium in the juice by 1.35 milliequivalents of sodium. This exchange corresponds to a net decrease in juice non-sugars of 6.9 mg per cm^3 of resin.

The ammonium ions removed from the juice by the resin would otherwise be lost as ammonia during evaporation[10,11]. This would adversely affect the acid-base balance through the evaporators[12]. To retain the balance in the absence of decalcification, the stoichiometric equivalent quantity of soda-ash (or even more, depending on the buffer capacity of the juice) would have to be added at second carbonatation. Thus, whether there is decalcification or not, ammonia is almost certainly normally replaced by a non-sugar which is not eliminated.

In these experiments, 4.5 mg ammonium ions per cm^3 resin were replaced in the juice by 5.8 mg sodium ions per cm^3 resin by ion exchange but, as explained, this increase of 1.3 mg non-sugar per cm^3 resin would have been brought about anyway in the absence of ion exchange by the addition of soda-ash. Omitting the net effect of this ammonium/sodium exchange, therefore, the effective decrease in non-sugars as a result of ion exchange was 8.2 mg per cm^3 resin.

A second series of experiments was carried out in which the columns were rinsed with deionized water instead of water containing ammonia. The results suggested that the ammonia in factory general hot water would have a negligible effect on decalcification.

Factory investigations

To obtain a better indication of the relative importance of the different ion exchange reactions taking place during the decalcification process, a detailed study of an actual factory plant in operation was carried out at Wissington factory late in the 1979/80 campaign.

The Wissington plant was selected because:

(a) it was currently reducing juice lime salts from about 0.035 grams CaO per 100° Brix before decalcification to 0.010 grams CaO per 100° Brix in the combined decalcified juice from all columns on stream. Individual column outputs would be expected to range from 0.006 to 0.020 grams CaO per 100° Brix according to the length of time on stream. These are all typical values within British Sugar.

(b) it was currently being regenerated efficiently, at an average of 7 kg CaO removed per 100 kg salt used. Experience has shown that under factory conditions efficiences of up to 8 kg CaO per 100 kg salt can be achieved[1].

(c) the ion exchange resin was in good condition when assessed by the standard methods[3] before the start of the 1979/80 campaign.

The plant is the largest within British Sugar, and consists of four columns, each holding 9 m^3 (320 ft^3) of ion exchange resin. Three columns are normally "on stream" at any given time, while the fourth is regenerated and left on stand-by until required. During the period of study, a column would be "on stream" for about twenty hours at an average juice flow rate of 450 g.p.m. (per column) before requiring regeneration.

The plant was monitored continuously over a period of 48 hours, and during this time samples were taken for five regeneration sequences and four exhaustions with juice. These samples were analysed for sodium and potassium (by flame photometry), for calcium (by titration with EDTA), and for ammonia (by a colorimetric method based on the Berthelot reaction). Regenerant samples were also analysed for chloride (by potentiometric titration with silver nitrate). The complete results are tabulated in the Appendix.

(a) Exhaustion

Using the results in the Appendix, the ion exchange reactions taking place during the exhaustion stage of a typical cycle have been illustrated in Fig. 2. This shows the changes with time in the concentrations of the individual cations in juice after decalcification, expressed as milliequivalents per 100 grams apparent sucrose. The average composition of juice before decalcification is also given for comparison.

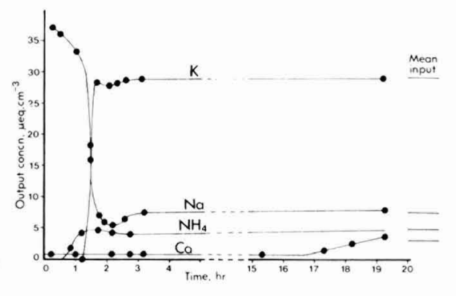


Fig.2 Typical exhaustion cycle of Wissington decalcification column

It can be seen that initially the cations in the juice were largely exchanged for the sodium ions on the resin, to give a decalcified juice with a very high sodium content. Thus, immediately after the column had come on stream the juice contained no measurable ammonium or potassium ions, and more than four times as much sodium as the input juice. The lowered ammonia content of the treated juice might cause a temporary change in juice pH in the first effect of the evaporators[10,11].

After about an hour, the potassium and ammonium concentrations in the decalcified juice started to rise, with a corresponding fall in the sodium concentration, until they reached the levels in untreated juice, indicating that no further sodium/potassium or sodium/ammonium exchange was taking place. This initial part of the exhaustion cycle was typically completed in 2 hours.

The composition of the decalcified juice then remained fairly constant for 16 hours, during which time about 80% of the calcium in the input juice was being exchanged for the various other ions on the resin. This compares with virtually 100% removal of calcium during the generally similar water softening process – the reasons for this difference in removal have been explained above. At the end of this period the calcium content in the treated juice increased rapidly and within two hours it was the same as in the input juice. The column was taken off stream ready for regeneration as soon as the increasing calcium concentration was detected by the routine lime salts measurements carried out by the factory laboratory.

[10] Carruthers, Oldfield, Shore & Wootton: *Paper presented to the 7th Tech. Conf. British Sugar Corp.*, 1954; *I.S.J.*, 1954, **56**, 218.

[11] Carruthers, Dutton, Oldfield, Shore & Teague: *Paper presented to the 12th Tech. Conf. British Sugar Corp.*, 1959; *I.S.J.*, 1959, **61**, 376.

[12] Oldfield, Shore & Senior: *I.S.J.*, 1970, **72**, 323-327; 355-359.

FS in the Philippines

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

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

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

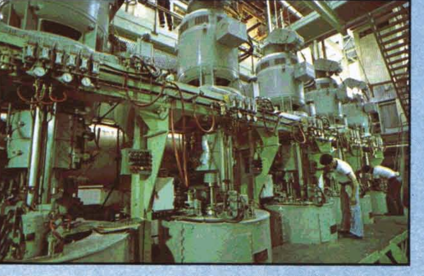
The Batangas refinery will play an important role in the Philippine Sugar Commission's (PHILSUCOM) strategy for improving the quality of sugar produced in the islands and so encourage the further development of local industries such as soft drinks and fruit canning without the need for importing the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

FS Turnkey Projects in the Philippines

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

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




There is a striking similarity between the general pattern of these observations and that found in the laboratory experiments already described. Similar results were obtained for the other cycles monitored at Wissington, and also during studies of decalcification plants at other factories in previous campaigns.

The amount of each ion exchanged during the initial part of each cycle was calculated from the analytical data and is reported in Table III below, for the four Wissington cycles, for a cycle on the Felsted factory plant monitored in the 1973/74 campaign, and for laboratory data from Table II. The total exchange capacity of each resin, as measured on the relevant end-of-campaign samples by the standard method[3], is also given for comparison. All results are expressed as kiloequivalents per cubic metre of resin.

Table III. Cation exchange during initial part of exhaustion

	Ions removed from juice (keq per m^3 resin)				Resin capacity (keq per m^3)
	K^+	NH^{4+}	Ca^{++}	Total	
Wissington cycle 1	0.68	0.08	0.04	0.80	1.63
" 2	0.73	0.07	0.02	0.82	1.63
" 3	0.59	0.03	0.03	0.65	1.47
" 4	0.76	0.06	0.02	0.84	1.47
Felsted	0.58	0.03	0.02	0.63	1.42
Laboratory	1.0	0.25	0.1	1.35	2.05

The results in Table III show that, in the factory, some 44-57% of the total resin capacity was utilized in exchange reactions in the first 2 hours of the exhaustion cycle. By far the greatest exchange during this period was of potassium in the juice for sodium from the resin (40-52% of total resin capacity) with very much smaller amounts of ammonium (2-5%) and calcium (1-2%) also being exchanged on to the resin. The laboratory results from synthetic juice were similar, although the relative proportions of the exchange reactions are slightly different from the factory pattern.

(b) Regeneration

The ion exchange reactions taking place during the later part of the exhaustion process cannot be estimated accurately from the small compositional differences which there are between juice before and after decalcification during that part of the cycle. To calculate the overall exchange of juice cations during a cycle it is therefore necessary to determine the total quantity of each ion displaced from the resin during the regeneration sequence.

There are five separate stages of this part of the operating cycle, although, as explained below, only negligible proportions of the total ions would normally be expected to be present in the eluates from the two drain stages. To determine the quantity of ions eluted during the other stages, the flow rate for each had to be established.

Plant operating data for the five regeneration cycles monitored at Wissington are given in Table IV below.

Table IV Regeneration sequence

Stage	Time (min)	To column: Liquid	To column: Volume (gallons)	To column: Calculated flow rate (g.p.m.)	From column
Regeneration	17-18	10 NaCl	4800	275	To sewer
Wash	9-13	Spent rinse	1600-2600	190	To sewer
Drain					To sewer
Rinse	14-17	Hot water	6400-7400	445	Re-used in regeneration and wash (Rinse and Drain)
Drain					

Stage times were recorded directly. Volumes were calculated from vessel dimensions and the positions of level switches. It is the variation in drain volume from cycle to cycle which causes the observed variation in volume of rinse, and therefore in the volume of wash. Flow rates were calculated from the stage times and liquid volumes.

During each regeneration sequence monitored, the output from the appropriate column was sampled every five minutes, and frequent samples of the input regenerant and wash water were also taken. The samples were analysed for chloride by potentiometric titration, and the results are given in the Appendix.

The chloride ions from the sodium chloride regenerant are not removed from solution during the regeneration process. Therefore, the total amounts of chloride ions in and out of a column during the regeneration sequence must be equal, assuming that the wash and rinse stages are sufficiently thorough to displace all added chloride from the column.

This principle was used to check whether the set of samples collected during each regeneration sequence gave an adequate representation of that sequence. The chloride concentrations in the column output samples for a typical regeneration are plotted in Fig. 3, expressed as milliequivalents per litre.

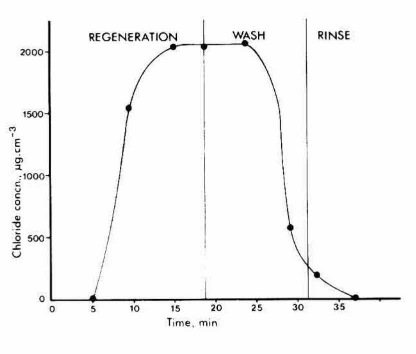


Fig. 3. Typical chloride content of column output liquors during regeneration sequence

Fig. 3 shows that the column output at the start of the regeneration stage contained no chloride. This was to be expected because the liquid in the column at that time was factory hot water from a backwash stage. The chloride content of the output decreased during the wash stage as regenerant was displaced by spent rinse. The drain stage following wash is not shown: the volume of liquid displaced during this stage is small, and provided that the chloride content of the effluent at the end of the wash stage is already low, the omission of this step from consideration is not significant. The rinse stage has been curtailed in Fig. 3 because the chloride content of the eluate had fallen to zero well before the end of the stage. The drain stage following rinse has been omitted from consideration for this reason.

(To be continued)

SUGAR CANE AGRONOMY

Nitrogen, phosphorus and potassium requirements of sugar cane (Co 1163) under Vidarbha conditions. B. A. Lakhdive, J. R. Kakde, V. N. Deshmukh and S. H. Daterao. *Indian Sugar,* 1979, **29,** 149-151. – A field trial conducted during 1974-75, 1976-77 and 1977-78 is reported. Results show a significant yield response to 125 $kg.ha^{-1}$ N and 100 $kg.ha^{-1}$ P_2O_5, but not to K. Cane juice quality was unaffected by treatment.

The climate and sugar cane crop in Taiwan. The 1978 climate and the 1978-79 crop year sugar cane. W. H. Tung and R. T. Tong. *Rpt. Taiwan Sugar Research Inst.,* 1979, (84), 11 - 24 *(Chinese).* – From analysis of past weather records, it is concluded that the most important factors affecting cane growth in Taiwan are: the temperature in Febrary-March, rainfall in April-May, and typhoon and rainfall distribution in summer. Solar radiation and the growth rate during the ripening stage have a greater effect on sugar content than on cane yield. Predictions of crop yield and sugar content on the basis of the meteorological data were higher than actual in two out of six cases, lower than actual in one case, and in close agreement in the other three cases

Reclamation of saline soils with a high impermeable layer. P. L. Wang, S. J. Yang and Y. T. Chang. *Rpt. Taiwan Sugar Research Inst.,* 1979, (84), 31 - 41 *(Chinese).* – After an impermeable soil layer, containing a high percentage of compacted silt and located 100-250 cm below the surface, had created drainage problems, tests were carried out with a two-level system comprising alternately a shallow drain at a 100 cm and a deep drain at a 150 cm, spaced 25 m apart horizontally. A single-level system of tile drains spaced 30 m apart and 150 cm below the surface was used as control. After heavy rain, the peak discharge rate for the two-level system was 21.6 mm/day compared with 3.9 mm/day for the control. Determination of electrical conductivity as an indication of leaching efficiency showed that the desalination proceeded more rapidly with the two-level system; after 5 months, the conductivity in the top 15 cm layer had dropped from 15.67 to 3 $mmhos.cm^{-1}$, compared with a fall from 22 to 18 $mmhos.cm^{-1}$ with the control; in deep soil layers, the conductivity even increased in the control plot. The changes in exchangeable sodium and the sodium adsoption ratio followed patterns similar to the conductivity curves. pH changes were very small.

Effects of long term phosphorus and potassium applications on soils and cane yield. C. C. Wang and I. J. Fang. *Rpt. Taiwan Sugar Research Inst.,* 1979, (84), 43-66 *(Chinese).* – Long-term P and K fertilization trials conducted during 7-15 crops at five plantations are reported. Results showed that cane yield generally rose with increasing rates of application of both fertilizers, while cane sugar content was unaffected provided the soil supplied sufficient P and K for growth. Accumulation of total P in the soil as a result of long-term application of 50-200 kg P_2O_5 per ha was greater in the surface layers than in the subsoil, while continued K_2O application at 300 $kg.ha^{-1}$ had little or no effect on K accumulation.

First observations by electron microscope of nitrogen-fixing bacteria in the roots of sugar cane *(Saccharum officinarum* L.). Anon. *La Hacienda,* 1979, **74,** (3), 42–44 *(Spanish).* – Sections of roots of 2-months old NA 56–62 greenhouse-grown cane were incubated in an aseptic nutrient medium and were shown by an acetylene reduction technique to contain nitrogenase activity. Electron microscope examination showed the presence of N-fixing bacteria at the surface and within the roots; they were identified as *Azotobacter* and *Spirillum* spp.

Productivity and fertilization of sugar cane: inter-relations between various factors. L. Rodrigues Freire. *Brasil Açuc.,* 1979, **94,** 26–35 *(Portuguese).* – The highest productivity in terms of sugar per unit area will result from optimum conditions of soil, climate, cultivation and plant, and the effect of the last is demonstrated by differences in the yields obtained from different varieties and between plant and ratoon cane. Use of fertilizer corrects the inadequacy of levels of nutrients which are limiting to plant growth and so allows higher yields to be obtained. A complicating factor is, however, the effect of plant nutrients on juice quality and thus recoverable sugar, which can vary from positive to negative with the nutrient level. Trace elements can also have a limiting effect, as can the soil organic matter content and pH.

"In situ" study of the influence of herbicides on the microflora of a cane soil of the Peruvian coast. T. Yengle P. A. González V. and J. Pinna C. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6,** 50–71 *(Spanish).* – Atrazine, Terbutilazine and Asulam decreased bacterial counts in soil to which they were applied during the first four days, but they had recovered by the 16th day. In the case of an Ametryne-Atrazine mixture, recovery took 32 days. Atrazine, Asulam and 2,4–D had no action on fungi, but Ametryne inhibited fungal flora at 16 days. Terbutilazine increased fungal flora up to the 4th day, reduction occurring thereafter. Atrazine, Ametryne and Terbutilazine reduced the counts of *Streptomyces* colonies.

Effect of late application of nitrogen to H 32–8560 cane cultivar. II. Influence of increasing doses on the yield, quality and nutrients as well as its variation with age. S. Valdivia V., H. Tello A. and J. Pinna C. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6,** 146–177 *(Spanish).* – An initial application of between 65 and 400 $kg.ha^{-1}$ of N was made to ten plots of cane in the Casa Grande sugar factory area of Peru, and a second application of 54 $kg.ha^{-1}$ was made at 12 months of age. The maximum yield of sugar was obtained with a total of 390 $kg.ha^{-1}$, while the economic optimum was with an application of 342 $kg.ha^{-1}$. Increasing amounts of N did not significantly affect pol, Brix, purity or reducing sugars in the cane, so that limiting N application for fear of lowering the sugar content is not justified. Increased N fertilizer usage raised the N content and reduced its P content. Use of the small late application did not affect cane quality. The effects of the N fertilizer were produced in the early stages of growth and continued until harvest.

Brief review of phosphatic and potash manuring of sugar cane crops in relation to soil test values of available P_2O_5 and K_2O. K. V. Joshi. *Maharashtra Sugar,* 1979, **4**, (9), 9, 11–12, 14, 16–28, 30. – N-P-K trials conducted over a number of years at various locations representing six different soil types in the Deccan Canal tract of India are reviewed. Results are tabulated in terms of cane yield.

Fertilization: experiences with sugar cane. Anon. *La Ind Azuc.,* 1979, **86**, 105–117, 143–158 *(Spanish).* An account is given with tabulated results and graphs of trials conducted between 1969 and 1974 in various parts of Argentina to identify optimum dosages of fertilizer to apply for different cane varieties in both plant and ratoon crops.

Chemical ripening of sugar cane with Glyphosate ripeners. M. Y. Gonzales and A. P. Tianco. *Sugar News* (Philippines), 1979, **55**, 210–214. – Two ripeners, Mon 0139 and Mon 2139, were applied to plant cane of variety Phil 58–226 eight weeks before harvest. At 0.67 kg a.i. per ha they increased the sugar yield per tonne of cane by 14.8 and 15.4%, respectively, by comparison with the control. At 1.12 kg a.i. per ha there was little further improvement. Polaris had no effect on rendement at these two rates. Mon 2139 at 0.67 kg a.i. per ha increased the sugar yield per tonne of cane by 27.3% when applied to VMC 67–611 cane. In all cases, there was a non-significant fall in cane yield by comparison with the control.

Seasonal variation in the level of soil available phosphorus in a sugar cane field. C. C. Wang. *Taiwan Sugar,* 1979, **26**, 118–122. – Investigations showed that available P in the soil, as determined by a modification of Bray's No. 1 method, varied greatly during the cane growing season. Reasons for this are put forward. The value found in an air-dried sample correlated highly with that of a moist sample. The standard deviation of soil P determinations for subsoil was much higher than for surface soil, and it is recommended to take samples from the topsoil rather than the subsoil, and to sample in January-February and in the period from mid-September to mid-October, when fluctuations are minimal.

Study of correlation between cane yield and different attributing characters. H. V. L. Bathla. *Sugarland,* 1979, **16**, (2), 9–10. – See *I.S.J.,* 1980, **82**, 149.

(Effects of) Chemicals on the tillering ability of variety Phil 56–226. P. V. Madrid and E. L. Rosario. *Sugarland,* 1979, **16**, (2), 11–13. – Single-bud setts were presoaked for 12 hours in various concentrations of Ethrel, 2,4–D, Bualta, Racuza and coconut water before planting. A significant increase in the number of tillers was obtained with 70 ppm Bualta, while coconut water gave promising results; plant height was greater than the control with 70 ppm Bualta and 50% coconut water v/v.

Tissue testing of Florida sugar cane. G. J. Gascho and A. M. O. El Wali. *Sugar J.,* 1979, **42**, (3), 15–16. – The nutrient contents of more than 1600 tissue samples have been determined over the past 10 years, representing both ratoon and plant cane. Each sample consisted of 10–15 top visible dewlap (TVD) leaf blades after the midrib had been discarded. The samples were dried at 70° and ground before analysis by various techniques according to the nutrient. Values were plotted against the corresponding cane yield to establish "normal" levels associated with high cane and sugar yields. "Critical" and "excessive" levels were obtained by examination of scatter diagrams of cane and sugar yields *vs.* nutrient concentration. The reference norms were established by means of the DRIS procedure[1]. Tabulated results are discussed.

The effect of four planting dates upon the yield parameters of five sugar cane varieties in the Lower Rio Grande valley of Texas. S. A. Reeves. *Sugar J.,* 1979, **42**, (3), 27–31. – Trials to establish the effect of planting date on yields involved two early-maturing varieties (L 62–96 and CP 57–614), two mid-season varieties (CP 65–357 and CP 61–37) and one late variety (N:Co 310). Planting dates for the 1975-76 trials were November 17, December 15, February 9 and March 17; for the 1976-77 trials they were October 10, February 18, March 22 and April 29. The tabulated results are discussed in some detail, and consistently demonstrated the superiority of autumn planting; very substantial falls in yield occurred when planting was carried out after February.

Suitability and management of Puerto Rico's soils for intensive biomass production. J. A. Bonnet. *Sugar y Azúcar,* 1979, **74**, (11), 21–23, 26–28, 71, 75. – The soil types in Puerto Rico are recorded and their potential for cane growing is discussed. The average cane sugar and fibre contents in the period 1944–78 are indicated. Total yield in the period ranged from 770,000 tonnes in 1978 to nearly 3 million tonnes in 1950. Almost 24% of the total soil area is suitable for mechanical planting of cane, while 4000 acres of unused marginal land and 240,000 acres of unused mountain area having slopes greater than 20% could be used for cane.

Sugar cane production in Kenya. Costs and returns to growers 1973–1977. W. W. Wapakala and D. P. Nyongesa. *Sugar y Azúcar,* 1979, **74**, (11), 36–37, 42–43, 46. – In a survey of cane production costs in Kenya in 1973–77 it is stated that the contribution of the small farmer became greater than that of the large estates. In the period, the costs rose because of: the high prices of petroleum products, high prices of machinery and/or unavailability of spare parts, high labour costs without regard to productivity, and rising prices of herbicides and fertilizers.

Response of sugar cane to nitrogen and phosphate in calcareous soils. K. Thakur, P. K. Bose, B. P. Sahi and R. P. R. Sharma. *Indian Sugar,* 1979, **29**, 177–180. In an experiment on two calcareous soils, a significant positive interaction was found between N and P in their effect on cane yield. Under the conditions, 200 kg.ha^{-1} N was the maximum limit, after which juice quality fell, while at least 50 kg.ha^{-1} P_2O_5 was needed for increase in the effectiveness of N. P application without N had a very poor and uneconomical effect on yield at all dosage rates.

Burnt cane: review of its behaviour and characteristics. F. A. Fogliata. *La Hacienda,* 1979, **74**, (5), 14, 30–31, 38 *(Spanish).* – A review is presented of work which has been reported in the literature on the deter-

[1] Beaufils & Sumner: *I.S.J.,* 1979, **81**, 110.

ioration of cane after burning and harvesting compared with unburnt cane; the losses of burnt standing cane; losses in billet and whole cane; invertases in cane; and effects on factory processing.

Sugar cane agriculture in El Salvador. H. Tobar. *Sugar J.*, 1979, **42**, (4), 26. – Cane agricultural practices in El Salvador are summarized.

Effect of short-duration winter vegetables as intercrops grown in autumn-planted cane on the yield of millable canes, juice quality and economics. K. S. Parashar, P. N. Arora and R. P. Sharma. *Indian Sugar*, 1979, **29**, 217–223. – Experiments showed that cane yield was reduced by intercropping, most of all by garlic and least by onions. Cane + carrots gave the highest net profit per ha, while the highest return on unit investment was obtained from cane + peas and cane + methi.

Louisiana guide to controlling Johnson grass seedlings and annual weeds in sugar cane after planting in summer and fall, 1979. L. L. McCormick. *Sugar Bull.*, 1979, **58**, (1), 10, 12–13. – Recommendations are given on chemical control of annual grasses, broad-leaf weeds, itch grass and Johnson grass in cane fields.

A case study of varietal, maturity and physiological aspects of sugar cane lodging. S. C. Sharma and G. S. C. Rao. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.1–Ag.12. – Investigations of the effects of lodging showed that it had a marked influence on cane yield and quality, although the extent of losses differed with variety. An inclination of up to 60° from the vertical had no effect. Falls in purity were greatest when the cane was at its peak of maturity. The low juice sugar content found in lodged cane was associated with an unusually high acid invertase activity in the middle and top portions of the stalk and with a low total chlorophyll content in the leaf blades.

Effect of herbicides on weeds, yield and quality of autumn-planted sugar cane. *(Saccharum officinarum* **L.**) G. Singh and P. P. Singh. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.13–Ag.21. – Herbicide trials in two successive years are reported. The only treatment to give a sugar yield per ha and a juice sugar content almost comparable to those in a weed-free crop was 2,4–D + Dalapon (1 + 2.5 kg a.i. per ha), while none of the treatments gave as high a cane yield as with weed-free crops. In general, chemical treatment gave results comparable to that obtained by hand hoeing. Weed infestation had a marked adverse effect on yield parameters.

The concept of rate of change of tissue moisture and nitrogen and their effect on sugar yield of sugar cane. K. R. Perumal. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.35–Ag.46 + ii pp. – Investigations showed that increase in leaf sheath moisture and leaf N content in the major growth period caused a fall in sugar content and cane yield, whereas reduction in moisture and N contents during the period from 4 months after planting to harvest caused a linear increase in cane and sugar yield, provided the rate of fall was sufficiently high. It is thus concluded that withholding irrigation 3–4 weeks before harvesting will not increase sugar yield and that dehydration should be brought about through physiological processes but not by physical drying.

Leguminous intercrops for sugar cane. B. S. Nadagoudar, K. Kenchaiah, C. Shankaraiah, D. V. R. Krishna, G. V. Lokeshwarappa and R. Vijayamma. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.47–Ag.53. – Intercropping trials were conducted in two successive years; considerable variation occurred in the results between the two years as regards effect on cane yield and the relative values of the crops. In all cases, the total crop value was greater than without intercropping, despite falls in cane yield in some cases; the maximum value was given by cane + groundnut in the earlier year and by cane + cowpea in the later year.

Studies on the possibility of raising short-duration crops of sugar cane. K. K. Prasadarao, B. Gopalam, D. V. N. Raju and B. J. Rao. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.55–Ag.62 + iii pp. See *I.S.J.*, 1980, **82**, 116.

Effect of treatments with *Azotobacter* cultures on the yield of sugar cane in the varying agroclimatic conditions of Bihar. B. P. Sahi, N. Ahmad, M. Rai and N. L. Yadav. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.63–Ag.66. – Field trials at seven locations representing varying soil characteristics involved addition of *Azotobacter* culture in two equal amounts, half mixed with surface soil which was then used to cover 3-budded setts, and half applied in water to the root zone. Nitrogen was applied as three split doses in the form of urea at a total of 35 and 50 $kg.ha^{-1}$. Results showed that application of the culture increased yield by some 12% with the lower N dosage rate and by some 10% with the higher, by comparison with N fertilization.

Is earthing up necessary for adsali sugar cane? J. D. Chougule and B. R. Patil. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.75–Ag.79. – See *I.S.J.*, 1980, **82**, 87.

Effect of bacterization with *Azotobacter* and *Bacillus megaterium* on the yield and juice quality of sugar cane in calcareous soil. N. Ahmad, M. Rai and B. P. Sahi. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.93–Ag.97. – Experiments are reported in which two strains of *Azotobacter chroococcum* (tested individually) and one strain of *A.agilis* were added separately or as a mixed culture to pot soil in which single-budded setts were then planted; a further application was made 3 months later. The cultures enhanced the effect of 35 $kg.ha^{-1}$ N in regard to yield and juice quality, while *B.megaterium* (a P–solubilizing organism) increased the effect still further in the case of *A.agilis* and one strain of *A.chroococcum*; the strain of *A. chroococcum* was sufficiently effective on its own. Use of the cultures would allow the amount of N required to be halved.

Studies on the effect of nitrogen and moisture regimes on yield and quality of sugar cane M. R. Reddy, S. C. Reddy, A. Vekatachari and H. L. Kulkarny. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.99–Ag.121. – See *I.S.J.*, 1979, **81**, 239.

Recent cane production technology. R. S. Kanwar. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.135–Ag.143. – Cane agricultural practices in India are outlined.

CANE PESTS AND DISEASES

Heat treating. C. Richard. *Sugar Bull.*, 1979, **57**, (22), 6. – Heat treatment of seed cane for control of ratoon stunting disease is briefly discussed. While hot air has been the most widely used medium in Louisiana, hot water has increased in popularity and is particularly suited to bulk handling, while many farmers have been adopting aerated steam treatment; this is suitable for use with small, individual lots, although some factories and large growers have central steam treatment units. The choice of method is left to the individual farmer, but recommendations for optimum conditions with each method and concerning harvesting and handling of the cane to be treated should be strictly observed. RSD is responsible for a 10-20% fall in potential yield in Louisiana, equivalent to 2-5 tons per acre.

Rat damage survey in the Victorias mill district. P. H. Porquez and F. C. Barredo. *Sugar News* (Philippines), 1979, **55**, 128-131. – A survey showed that rat damage in cane growing in unbaited lowland fields was somewhat greater than in unbaited mountain areas. Baiting reduced the number of damaged millable stalks and dead stalks by some 44%. The monetary losses due to rat damage are discussed, and control means described.

Electric fences exclude wallabies from cane. R. E. Kerkwyk. *Cane Growers' Quarterly Bull.*, 1979, **43**, 25. – The use of a single electric wire placed 10-14 cm above the ground beneath a 4-strand barbed wire fence (which had failed to exclude wallabies) kept the animals outside a cane field until the cane had reached that stage of growth where it was no longer attractive to them. The positioning of the electric wire (just over halfway from the ground to the bottom barbed wire) was important, since wallabies tend to go under and not over fences.

Studies on the action of some systemic insecticides on sugar cane. G. C. Sachan and S. K. Manchanda. *Indian Sugar*, 1979, **29**, 153-156, 159. – Results are given of trials with organo-phosphate and carbamate insecticides, with gamma-BHC used as standard for purposes of comparison. The aim was to determine the effect of various dosage rates on cane germination and on the root and shoot systems. Results indicated that both groups of test insecticides benefit the cane root and shoot systems and may be used in place of gamma-BHC at the same dosage rate.

Volunteers and RSD. Anon. *S. African Sugar J.*, 1979, **63**, 336. – It is estimated that some 30% of the cane fields in South Africa are infected with ratoon stunting disease, which causes a 5% fall in annual sugar production. The two most important means by which the disease attacks a newly planted field are: the planting of infected seed cane and contamination from infected volunteer cane. Hot water treatment and care in seed cane nursery management will ensure the planting of undiseased cane, but there is need for eradication of diseased volunteer cane if these measures are not to lose their value. Eradication is also of importance in the elimination of other diseases such as smut and mosaic, so that it becomes a means of generally improving the health of cane.

Biological study and bahviour of *Elasmopalpus lignosellus* Zeller in sugar cane. E.E. Carbonell T. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru, 1978, **6**, 21–41 *(Spanish)*. – A biological study has been carried out under laboratory conditions of the title borer. The biological cycle lasted an average of 52.43 days, the females laid an average of 125.3 eggs and the egg stage was approximately 5.2 days. It presented six larval stages during its larval cycle of 30.33 days; the pupal cycle is of 10.96 days duration.

Effect of hydrothermotherapy on the germination of cane cultivars H 50–7209 and H 50–2036. E. Pisfil D. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6**, 42–49 *(Spanish)*. – Hot water treatment of setts at 51°C for 2½ hours, in order to control ratoon stunting disease, was found to cause a marked reduction in germination of the two varieties with an emergence of only 1985 shoots per ha in treated H 50–2036 cane against 32,035 for the untreated control, and comparable figures of 7595 and 33,159 for H 50–7209.

Effect of different doses of nitrogen on the population density of sugar cane phyto-nematodes. C.F. Villanueva, J. A. de Guerra and E. E. Carbonell. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6**, 72–85 *(Spanish)*. – Nitrogen was applied at five different rates between 150 and 450 kg. ha^{-1} to a N-deficient silty loam soil of alkaline pH. It was found to reduce the population of *Xiphinema, Helicotylenchus* and *Tylenchorhyncus* spp. but not significantly, slightly greater reductions occurring at the higher dose rates.

Description of the damage caused by *Elasmopalpus lignosellus* Zeller in sugar cane and of some of its biological controllers. E. Carbonell T. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6**, 118–145 *(Spanish)*. – An account is given of the damage observed in cane fields as a consequence of attack by the title borer, which affects both plant and ratoon crops. The severity of the attack depends on the numbers of larvae, and it was found that a proportion of damaged plants recovered (28–29% in plant cane, 48–57% in ratoons). Tillering was reduced by the attack to the extent of 13.56% in plant cane and 64.6% in ratoons. *E. lignosellus* may be controlled by a number of parasites, of which the tachinid *Stomatomya meridionalis* was the most effective.

Effects of varying rates of Carbofuran on nematode population and sugar cane yield. F. T. Gargantiel and F. C. Barredo *Sugar News* (Philippines), 1979, **56**, 169–172. – Of four different rates at which Carbofuran was applied to cane at planting and then three months later (two equal doses), 2kg a.i. per ha gave the highest cane and sugar yield (20.6% and 26.8% increase, respectively, on the control); these results were only slightly better than those given by 1 kg a.i. per ha, while 4 and 8 kg a.i. per ha were much less effective. The numbers of plant-parasites nematodes fell after the first application, and even more so after the second, but the populations started to increase within six months of the second treatment.

Testing sugar cane varieties against red rot disease. M. R. Gupta. *Indian Sugar,* 1979, **29,** 213–216. – Details are given of tests for red rot resistance. Of the 12 varieties involved, 5 were resistant or moderately resistant. Details of results for three years are tabulated.

Diseases of sugar cane and their control. M. B. Bachchhav. *Indian Sugar,* 1979, **29,** 271–276. – The symptoms and possible control of a number of cane diseases that occur in Maharashtra are described.

Survey of the sugar cane scale insect *Melanaspis glomerata* (Green), its incidence and distribution in some districts of eastern Uttar Pradesh. G. S. Shukla and N. Tripathi. *Indian Sugar,* 1979, **29,** 281–283. – The incidence of *M. glomerata* in plant and ratoon cane in ten factory areas is indicated.

Scale insects – a potential danger for the sugar industry in eastern Uttar Pradesh. A. P. Gupta. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, Ag.67–Ag. 74. – Despite the considerable damage to cane by *Melanaspis glomerata* in eastern U.P., where up to three-quarters of the fields in some factory districts were infested in 1977–78, there is no official control measure, although the pest was first discovered in the region in 1970–71. Tables show the intensity of infestation in a number of districts, the varieties of cane affected and the effect on Brix and purity. Some control measures are suggested.

New records of white grubs and their hosts in Maharashtra. A. S. Patil, B. P. Gajare and D. G. Hapase. *Maharashtra Sugar,* 1979, **4,** (9), 46. – Brief mention is made of four species of white grub found in the area of a cane research station in Maharashtra in addition to *Holotrichia serrata.* Of the four, two are new to the state, while the other two were found on new hosts.

Methods of control of the cane rat *Holochilus brasiliensis balnearum* Thomas. M. A. Costilla and H. Izquierdo. *La Hacienda,* 1979, **74,** (4), 58, 60 *(Spanish).* – Damage by cane rats has been minor previously, but in the period 1973-75 increased markedly in Argentina, causing losses of 20–30% in an area of 20,000 ha. The principal pest is the nutria rat, *H. brasiliensis balnearum.* Recommendations are made for determining whether a crop is infested and to what extent, and preventive methods for control of the pest are indicated, including removing all cane at harvest, cleaning canals and roads to remove shelters for the rats, and protecting natural enemies. When infestation is shown by trapping or stalk damage to warrant it, chemical control may be employed. The most common rodenticides are the anticoagulants (Warfarin, etc.) as well as zinc phosphide, thallium sulphate, etc., and techniques for their use are summarized.

Detection of viruses or virus-like agents in vegetatively propagated plant importations under quarantine in the United States, 1968–1978. R. P. Kahn *et al. Plant Disease Reporter,* 1979, **63,** 775–779. – Of 1906 samples of *Saccharum* spp. and related grasses imported into the USA in 1968–78, 23 were found to be infected with mosaic virus and 11 with Fiji disease virus; of 493 samples from Mainland US, 12 were infected with mosaic virus. The mosaic-infected imports came from India (12), Pakistan (10) and Japan (1); Fiji disease was found in cane from New Guinea (10) and the New Hebrides (1).

BSES research on rust disease continues. Anon. *Cane Growers' Quarterly Bull.,* 1979, **43,** 32 33. – Since *Puccinia melanocephala* was first discovered in Queensland late in 1978, it has spread rapidly along the coastal areas as a result of spore dispersal by the wind. A monitoring program has started in most cane-growing areas to assess the pattern of development of the disease and variental susceptibility. A number of studies have been initiated, including development of a screening technique and evaluation of fungicides that could be of use in yield loss assessment. It is currently considered that broadcast application of fungicides to control the disease is uneconomical.

Billet quality key to prevention of sett rot. D. J. Olsson. *Cane Growers' Quarterly Bull.,* 1979, **43,** 46–47. Introduction of the cane billet planter has been accompanied by problems, including poor germination associated with a sett rot disease that produced reddish discoloration of the internal tissue; while the disease has been found in cane planted by the cutter-planter as well as by a billet planter, it is more severe in the latter case. Cane planted in May and early June is more prone to infection, apparently as a result of cold, wet conditions immediately after planting; N:Co 310 is the most susceptible variety. The infected billets are usually shorter and of poorer quality than those planted with cutter-planters, and will generally have been cut by a chopper-harvester without special attention to billet length and quality. Many billets have only one eye, damaged ends, cracks and splits along their length or have a bruised rind to allow invasion by the soil-borne organism. Once infection begins, the internal tissue is progressively destroyed, starving the germinating cane shoot. Advice is given on how to ensure that the billets for planting are of satisfactory quality and of adequate length (which should be 300 mm).

Awareness of nematode problem increases. C. L. Toohey. *Cane Growers' Quarterly Bull.,* 1979, **43,** 48-49 While granular nematicides such as Temik and Mocap are a welcome alternative to the fumigant type (which require laborious injection into the soil with often uncertain results), it is pointed out that there may still be good reasons for not using a nematicide. Even if poor, retarded growth is caused by nematodes (there are numerous growth-limiting factors that could be responsible), decisive factors to be considered are: the amount of damage, soil type and irrigation availability. Correct application of a nematicide on a sand or fine sandy loam should give rapid improvement, whereas the chances of success become lower as the clay content increases (apparently because of inactivation of the chemical by the clay particles). Modern nematicides degrade quickly on contact with the soil, so that moisture is needed to dissolve the chemical; where irrigation is not used, the grower should seek further advice.

Influence of heat treatment on the germination of eight sugar cane varieties. R. Claus. *Agron. Trop.,* 1979, **34,** 122–126 *(French).* – Hot water treatment of eight varieties (four grown commercially in Ivory Coast and four in the last stages of selection) was carried out at 52°, 54°, 56° and 58° for 20 min or at 50°, 51°, 52° and 53°,C for 2½ hrs as a means of controlling ratoon stunting disease, smut and chlorotic streak. Tabulated and graphed results show that average % germination 37 days after planting of the treated setts was maximum after 20 min treatment at 54°C and after 2½hr at 50°C, although it was higher than for the control up to 56°C with 20 min exposure. Varietal differences were marked so that in some cases the shorter treatment could be conducted at 56°C and the longer treatment at 51°C for certain varieties.

The smut screening program in Belize. A. L. Fors. *Sugar J.,* 1979, **42,** (4), 27. – Brief mention is made of the screening program at the special station set up near Tower Hill sugar factory in Belize; over 300 varieties from Mexico, Belize and three other Central American countries are undergoing trials.

New hot water treatment facility at Mulgrave. Anon. *Cane Growers' Quarterly Bull.,* 1979, **43,** 52. Illustrations show the new cane treatment facility installed at the Mulgrave Cane Pest and Disease Control Board. Cane handling is facilitated by the use of special trailers, and the temperature of the electrically heated water is checked by means of a wall-mounted recorder. After treatment, the cane is lowered by chain sling into a cooling tank.

Progress in resistance breeding for red rot and smut. K. C. Alexander. *Maharashtra Sugar,* 1979, **4,** (10), 89, 91. – Varieties of value in breeding for resistance to the title diseases are listed and the methods used for evaluation are described. The most suitable breeding methods for the purpose are also indicated.

A brief note on red rot tolerance in sugar cane. B. K. Tripathi. *Maharashtra Sugar,* 1979, **4,** (10), 93–94. Evaluation of cane varieties for red hot resistance is described and results of screening tests conducted on selected germplasm are tabulated.

Studies in parental influence in resisting red rot and smut by sugar cane seedlings at the Sugarcane Research Station, Anakapelle. K. K. Prasadarao. *Maharashtra Sugar,* 1979, **4,** (10), 95–96, 98. – The significance of parental resistance or susceptibility to disease is demonstrated in a report on tests to evaluate the reactions of clones of different parental combinations to red rot and smut. In the case of red rot, 57% of the clones showed resistance where one of the parents was resistant, but only 20% where both parents were susceptible; with smut, the respective results were 52% and 13%.

Bio-assay of fungicide and antibiotics against *Colletotrichum falcatum* **Went causing red rot disease of sugar cane.** M. R. Gupta. *Maharashtra Sugar,* 1979, **4,** (10), 99–101. – Trials are reported in which four chemicals (Bavistin, Vitavax, Aurcofungin and Enosan) completely checked the growth of the fungus in Petri dishes, while another five reduced growth. Details are tabulated.

A note on the performance of mosaic virus-free Co 740 at Phaltan. A. D. Karve and A. R. Ghanekar. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), A.10–A.11. – Mosaic-free seedlings were obtained from the shoot tips of infected cane, and two successive generations of cane obtained from the seedlings. The 2nd generation cane was used in trials to compare the yield with that from infected cane. In small plots near to plots of diseased cane, the uninfected cane remained disease-free for only a relatively short time, so that the yield differences were small and statistically non-significant, whereas in large plots the yield from the uninfected cane was considerably greater than that from the diseased cane and reached a record level for the location.

Studies on *Paratheresia claripalpis* **Wulp (Diptera: Tachnidae), an exotic parasite against the sugar cane stalk borer,** *Chilo auricilius* **Ddgn.** A. N. Kalra, J. Chandra and N. K. Tiwari. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), A.17–A.22. – Studies were conducted on the behaviour and host preference of two strains of *P. claripalpis* (Colombian and Casa Grande). Mating in the laboratory was generally poor. The maize borer, *Chilo partellus,* proved the best host (61% and 75% parasitization), while *C. auricilius* was 33% and 63% parasitized. Neither strain parasitized the top borer, *Tryporyza nivella.* In a preliminary field test, recovery of puparia of the parasite from stalk borer tunnels in cane three weeks after release indicated that it holds promise for control of this particular borer.

Control of grassy shoot disease of sugar cane in Maharashtra. V. V. Shingte, D. G. Hapase, M. B. Bachhav, S. S. Lambhate and T. K. Ghure. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), A.23–A.26. – Experiments conducted on the highly susceptible variety, Co 419, showed that hot water treatment at 50°C for 2 hours eliminated grassy shoot, whereas dipping infected setts in 0.1% Benomyl for 20 minutes was ineffective.

Some aspects of losses due to the internode borer in sugar cane in Tamil Nadu. H. David, –. Sithanantham and B. Velayutham. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc (India),* 1979, (1), A.27–A.40. Investigations of losses due to *Chilo sacchariphagus* showed significant differences between the various growth phases of the crop at three sites and a greater loss on "garden" land than on "wet" land. In one particular harvest month, the average sugar loss per ha was calculated as 2.58 tonnes.

A comparative study of tissue culture and virus-infected setts and yield of sugar cane. M. B. Bachchhav, D. G. Hapase, T. K. Ghure, S. S. Lambhate and V. V. Shingte. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 2 pp. – Seed material from tissue culture initially free from mosaic was compared with 20% mosaic-infected setts of the same variety (Co 740). Results showed that, although % germination and average height were greater in the case of the diseased setts, cane and sugar yield and sugar content were much greater for the cane grown from the tissue culture material, which eventually showed some 18% mosaic intensity by comparison with nearly 25% for the cane grown from the diseased setts.

Sugar cane rust, caused by *Puccinia melanocephala,* **found in Australia.** B. T. Egan and C. C. Ryan. *Plant Disease Reporter,* 1979, **63,** 822–823. – The outbreak of rust in Australia and the Western Hemisphere, already widely reported, is briefly discussed.

SUGAR BEET AGRONOMY

A new sugar beet harvester from Denmark. D. Bakewell. *British Sugar Beet Rev.*, 1979, **47**, (3), 18-19. —Information is given on the TIM tractor-hauled, two-row beet harvester which can harvest beets from 4½-6 acres/day under average conditions.

Care of harvested beet. M. Atkinson. *British Sugar Beet Rev.*, 1979, **47**, (3), 22-24. —Guidance is given on correct clamping of beet and protection of the clamp against frost.

Latest developments in weed beet control. W. Hollowell. *British Sugar Beet Rev.*, 1979, **47**, (3), 48-49. —Descriptions are given of machines developed for elimination of bolted beet. One uses electrodes to pass a 8000-volt charge through the weed beets, another consists of a large number of flails to mince up the top of the beets, while a third is a home-made rotary cutter.

Anti-"blow" techniques work well. W. Hollowell. *British Sugar Beet Rev.*, 1979, **47**, (3), 52, 54. —The costs and effectiveness of four methods used to reduce wind erosion of soil are briefly discussed. The methods included inter-row planting of barley, straw "planting", application of carbonatation mud, and spraying of Vinamul copolymer.

Protection of pre-washed beet intended for storage. L. Fassatiova, J. Smolik and M. Stenglova. *Listy Cukr.*, 1979, **95**, 199-207 (*Czech*). — Raising the pH of flume water to 10 reduced the bacterial count and protected beets from infection during subsequent storage. Treatment of the beet with a 6% milk-of-lime solution reduced storage losses.

Nitrogen fertilization of sugar beet and current problems in Turkey. C. Nuh. *Seker*, 1979, **29**, (111), 23-35 (*Turkish*). — Since no significant responses were obtained to N applied to beet in field experiments, further investigations were conducted in which considerable quantities were found in lower soil layers; these were attributed to mineralization of soil organic matter and to residues from other crops grown in the rotation, while leaching did not occur on any appreciable scale. Hence, there is need to analyse soil samples for N so as to restrict the amount applied to an optimum.

Residual soil nitrogen and phosphorus in some sugar beet fields in Montana and Wyoming. D. G. Westfall, W. J. Eitzman, D. R. Rademacher and R. G. Vergara. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 217-232. Investigations showed that the residual nitrate N and P contents in Montana and Wyoming beet fields varied widely, so that no general fertilizer recommendation could be made; on the other hand, there was little fluctuation in the organic matter contents. The results indicate the importance of soil testing to determine the most economical fertilizer application.

For beet profitability, let us reduce harvest losses. A. Vigoureux. *Le Betteravier*, 1979, **13**, (135), 10-12 (*French*). — By means of photographs, the author describes how best to reduce beet losses during harvesting.

Effect of injury on respiration rates of sugar beet roots. R. E. Wyse and C. L. Peterson. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 269-280. — Investigations showed that injury to beet during harvesting and handling significantly affected the respiration rate during at least the first 10 days of storage. Injury as slight as that caused by dropping a 2-kg weight 60 cm onto beets previously injured in topping was readily detectable from changes in the respiration rate, which is therefore regarded as a useful technique for monitoring sources of injury. The respiration rate immediately after harvesting is very important both as regards sugar loss and heat generation in the pile. Topping by knife or tare machine caused an increase in the respiration rate during the first 5-10 days of storage, after which it was lower than in untopped beets, whereas use of a field topper caused a higher respiration rate throughout an entire 95-day period, probably because of the greater amount of damage it inflicted and the rougher cut. Earlier studies have shown that topped beet respire at a higher rate than do untopped beet during storage.

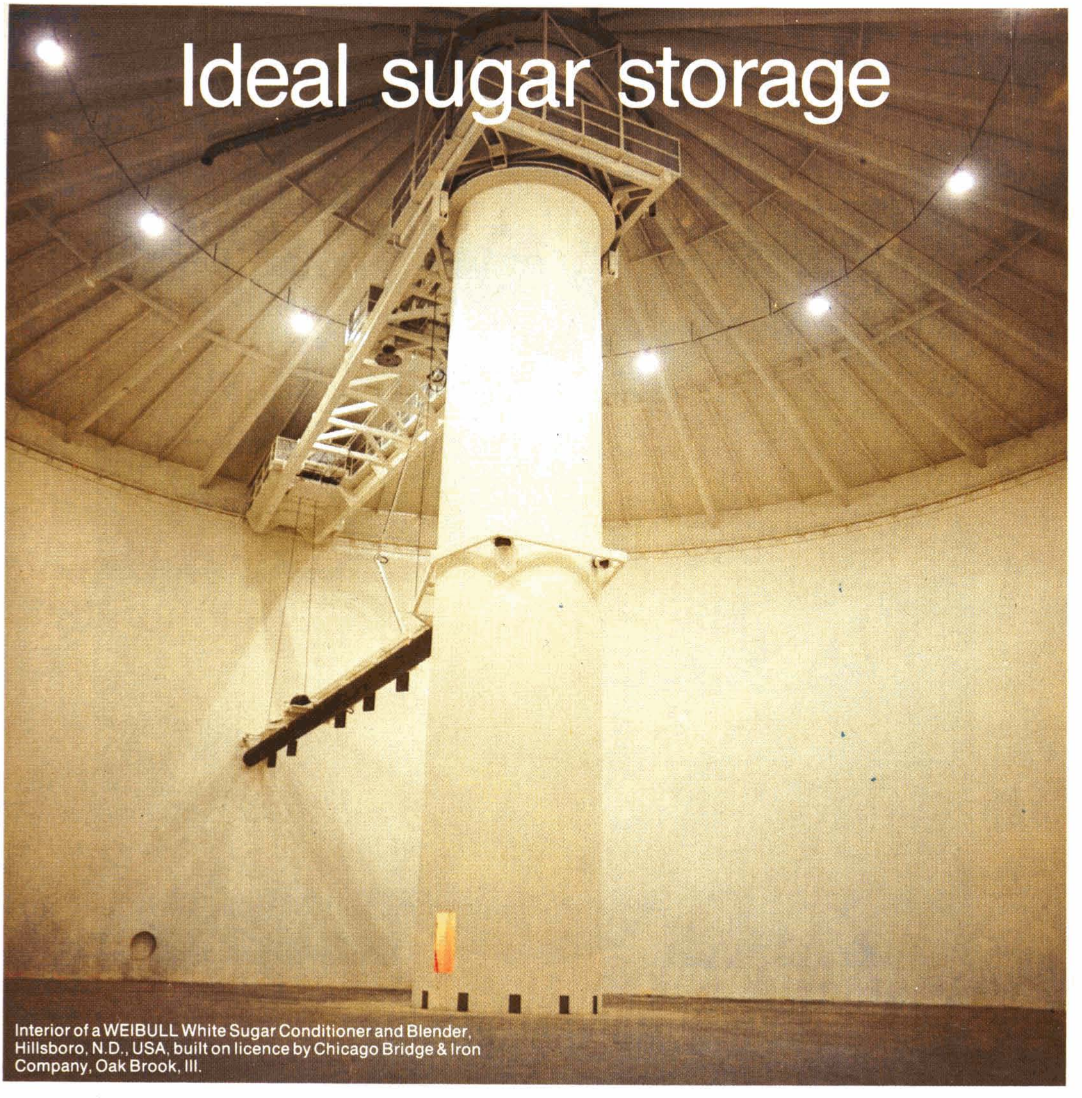
The effect of soil residues of Atrazine on sugar beets (*Beta vulgaris* **L.**). R. L. Zimdahl, S. M. Gwynn and K. Z. Haufler. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 297-306. — Greenhouse and field experiments were carried out to determine the amounts of residual Atrazine herbicide applied to corn that cause injury to a subsequent beet crop. Results indicated that beet growth in three soil types was seriously affected by 0.1 ppm Atrazine, while 0.2 ppm killed beets. Application to the corn crop of 0.125-0.5 lb Atrazine per acre caused slight beet damage, while 1-2 $lb.acre^{-1}$ a.i. caused extensive damage. Because of its sensitivity to low concentrations of Atrazine, the beet is considered a better analytical tool than gas-liquid chromatography using a microcoulometer as detector. Detection of even the smallest quantity of Atrazine by soil analysis should alert a grower to the possibility of beet injury.

Beet sampling in the field for purposes of premium payments. L. Schmidt and R. Bures. *Listy Cukr.*, 1979, **95**, 217-225 (*Czech*). -- The sampling method described earlier[1] was used to determine beet sugar content to give an accuracy of ± 0.2% in 98% of all cases. By comparison with the previous method used, the number of samples required was halved and the number of roots per sample reduced by approx. one-third.

Physiological aspects of nitrogen conversion in sugar beet. I. Relationships between nitrogen and carbon metabolism. K. Bürcky. *Zuckerind.*, 1979, **104**, 1039-1043 (*German*). — In a study of the relationships between the metabolic processes involving nitrogen on the one hand and carbon on the other, three dextrose-consuming processes were found to contribute to a fall in the sugar content of beet with increase in applied N: (1) the supply of energy for nitrate reduction, (2) the use of C skeletons for amino-acid synthesis, and (3) formation of cellulose necessary for leaf growth. It is shown how the concentration of nitrogenous melassigenic constituents increases with increasing N application and reduces the amount of recoverable sugar.

[1] Schmidt *et al.*: *I.S.J.*, 1978, **80**, 340.

Ideal sugar storage



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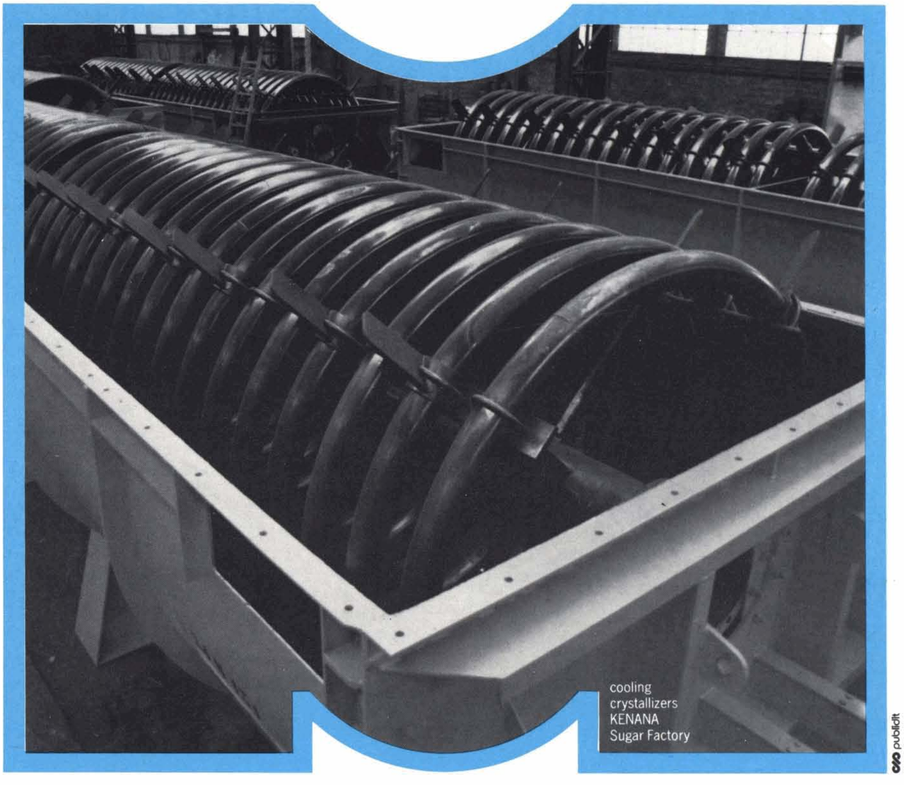
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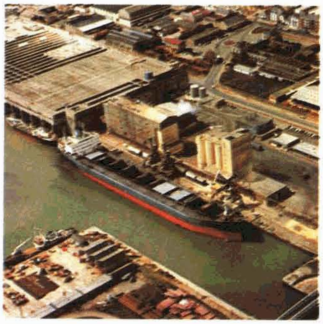

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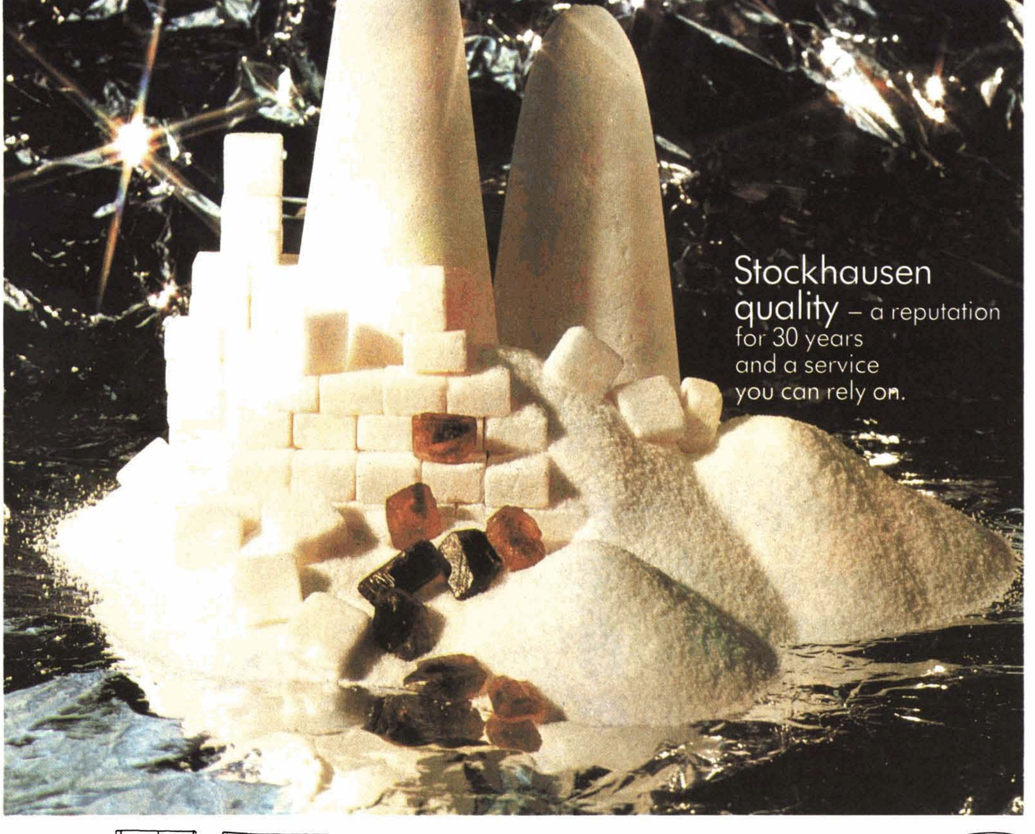

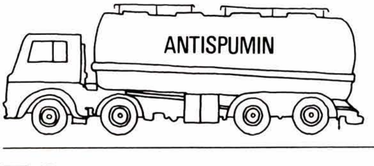

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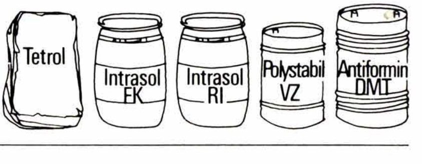

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CANE SUGAR MANUFACTURE

Aeration and the cane wash pond. D. F. Day. *Sugar Bull.*, 1979, **57**, (22), 8. – Aerobic treatment of cane wash table effluent is discussed. Types of aerator available are noted, and the question of economics of any given system is considered.

Surface treatment of sugar cane mill rolls. L. Laor. *Sugar y Azúcar*, 1979, **74**, (10), 28-29, 32. – Types of welding applicable for cane mill roller surface roughening or deposition of metallic globular protrusions to act as gripping points for the cane are described, with particular mention of the Azúcar 80 process. The costs of treatment are examined.

The factory performance index (FPI). R. Lokan and A. P. Chinnaswamy. *Maharashtra Sugar*, 1979, **4**, (9), 43-45. – For calculation of sugar factory performance, a formula has been developed which takes the form FPI = 40 (actual capacity/installed capacity) + 60 (actual ROE/ideal ROE), where ROE is the reduced overall extraction and is assumed to be ideally 85.54 and 86.45 for a 12- and 18-roller tandem, respectively. Worked examples are given.

Wash table corrosion (a survey). D. F. Day. *Sugar Bull.*, 1979, **57**, (23), 8. – A survey of Louisiana sugar factories has shown that at a third of them wash table carrier chains were severely corroded. The problem is attributed to a high rate of wash water recirculation, which does not allow sufficient time for degradation of the carbohydrates in a small settling pond. The water has a BOD_5 of 200-600 $mg.litre^{-1}$ and contains 1500-2000 ppm suspended solids. Remedial measures suggested include considerable increase in the size of the pond, a smaller increased coupled with means of aeration, or installation of an oxidation ditch where pond expansion is not possible.

Effect of mechanical factors on the extraction of cane juice and power consumption by a sugar cane crusher. II and III. A. J. Dangre. *J. Univ. Poona, Sci. Technol.*, 1977, **50**, 127-138; through *S.I.A.*, 1979, **41**, Abs.79-1335. – For three pilot-scale mills, data are tabulated on compression ratio, peripheral speed of the top roller, cane throughput, juice extraction % juice in cane and power consumption. The effects of the first three parameters on the last two are discussed. Increasing the diameter of the top roller led to a decrease in power consumption for a given throughput.

Survey of cane yard equipment and operation. M. R. Kedian. *S. African Sugar J.*, 1979, **63**, 408, 413, 415–416. – See *I.S.J.*, 1980, **82**, 181.

Large-capacity milling station for the Karun (Iran) sugar factory. S. Cecek. *Skoda Rev.*, 1979, (3), 50–53. – Details are given of the Skoda milling tandem, comprising six 3-roller mills having 42 x 84 in rollers, each mill being driven by a single-stage turbine. The factory capacity is 7000 t.c.d.

Brief history of the sugar industry of El Salvador. M. Henriquez L. and E. Castro M. *Sugar J.*, 1979, **42**, (4), 24. – The history of cane sugar production in El Salvador, where 14 factories operate, is very briefly outlined.

Working of a lime kiln at a glance. M. K. Suri. *Indian Sugar*, 1979, **29**, 203–212. – Factors of importance in the operation of a lime kiln are discussed and a number of recommendations made so as to optimize conditions. Introduction of the various measures at the author's factory has raised the output of high-quality lime in order to meet the requirements imposed by increased cane throughput and allowing supply of lime to a sister factory. Sugar quality has also been improved as a result.

Possibilities of reduction in power consumption of Indian sugar factory condensing systems – a typical case. J. P. Mukherji and S. B. Bhad. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, E.1–E.4. The authors calculate the reduction in power consumption and associated monetary savings obtainable by using barometric columns with individual water-jet air extractors and a cooling tower instead of multi-jet spray condensers with individual injection water pumps and a spray pond as used typically in Indian sugar factories.

Conversion of barometric condensers to multi-jet condensers. H. L. Verma and V. K. Rohtagi. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India.*, 1978, E.5–E.16. While multi-jet spray condensers are of advantage over barometric condensers in respect of vacuum conditions and absence of need of an air pump, they consume more power. A system is described in which barometric condensers can be converted to multi-jet condensers by addition of a separate multi-jet ejector but without an air pump.

A better condensing system. A. C. Chatterjee and G. Kashinathan. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, E.17–E.24. – A condensation system which permits a reduction in water and power consumption is outlined; it involves use of a counter-current condenser of the rain type coupled with a vacuum pump. Its advantages over the multi-jet condenser system are listed.

Introduction of cooling towers in sugar industries. K. K. Menon. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, E.25–E.31. – Comparison is made between the spray pond and cooling tower, and introduction of the latter advocated on economic grounds.

A new concept in regard to the manufacture of mill roller C.I. scrapers. V. S. Joneja. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, E.33–E.34. A scraper modification is described which has a number of advantages, as found in tests at the author's factory.

A study of headstock design. S. L. Kumar and S. Solaimuthu. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, E.35–E.39. – The advantages and disadvantages of vertical and inclined mill headstocks are discussed, and the former preferred from the point of view of mill performance and maintenance.

Balancing of the rotating machinery in the sugar industry. V. R. Rao. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, E.41–E.43. – A method of balancing cane levellers and knife sets is described and details given of a simple device for testing the balance of lighter units such as the impeller of a centrifugal pump.

Use of aluminium tubes in sugar industry raw juice heaters. M. K. Swarup and S. K. Sanghal. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, E.45–E.49. Six years' experience in the use of aluminium tubes instead of brass tubes in two juice heaters is reported. Advantages include negligible wear and lower capital costs. The tubes were unsuccessful in a pre-heater because of leaks and had to be replaced with brass tubes; it is suggested that the problems could be overcome with practice in installation.

Installation of a resistance heater. A. P. Chinnaswamy, R. Lokan and R. Venugopal. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, E.51–E.61. – Advantages of massecuite resistance heaters are listed, and details are given of various sugar factories where the model designed by Ramaiah & Gupta[1] has been or was to be installed; modifications to the crystallizer stations are also described.

The factory performance index (F.P.I.). R. Lokan and A. P. Chinnaswamy. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.1–M.7. – See *I.S.J.,* 1981, **83,** 117.

A study of drop in purity in the boiling house. N.R. Tagore. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.9–M.13. – Causes of drops in purity that may occur during clarification and in the vapour cell are discussed and means of avoiding them indicated.

Network analysis – an aid in planning sugar industry projects. M. C. Gupta. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.33–M.46. – Network analysis as an aid to project scheduling is explained and its usefulness demonstrated in the case of installation and commissioning of a juice weigher.

Mill performance – a comparative study for comparing the technical performance independent of sucrose content in cane. S. K. Gupta. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.83–M.88. – On the assumption that the relationship between cane sugar content and sugar extraction % cane is not linear but requires a correction factor, found by iteration to have a value of 0.91, the author presents a method of calculating the adjusted extraction of a mill (allowing for changes in fibre content) which is independent of the cane sugar content. Worked examples are given.

Prospects of reduction in cost of production of sugar in India – some practical aspects. S. K. Bajpai. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.89–M.102. – A number of agronomic and processing factors are discussed that have an influence on the costs of sugar production in India, which is behind a number of countries in terms of cane and sugar yield per ha and in respect of factory productivity.

Reduction of the water requirement in a cane sugar factory – a case study. M. Singh, V. M. Murugkar and S. J. Lagare. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.103–M.112. – Somaiya Sugar Works is located in an area known for its droughts, so that there was need to reduce the amount of water consumed in the processing of 2500 t.c.d. and to reduce the amount of effluent, disposal of which would present a serious problem. By re-using some 48% of the water introduced in the cane, recycling all the cooling water, and minimizing water consumption at specific points in the factory, the total hourly consumption was reduced to some 40 m^3 and the hourly quantity of effluent to about 15 m^3 by comparison with typical figures for a factory of the same size of 220 m^3 and 100–120 m^3 per hour. Details are given of the various measures adopted.

Use of a continuous centrifugal for curing low-grade massecuite. N. N. Joshi and R. Kumar. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.113–M.121. The performance of Walkonti 8/34° continuous centrifugals in low-grade massecuite curing at Daurala is reported. Aspects discussed include machine capacity, crystal damage, final molasses purity, C–sugar purity rise, effect of wash water application and screen life. Tabulated data indicate the advantages of the machines over batch centrifugals which have now been replaced.

Prevention of spontaneous combustion of molasses. A case study of the phenoma in two sugar factories in India. S. K. D. Agarwal, K. V. Gupta and J. K. Srivastava. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.145–M.165. – Two case histories are cited, in which stored molasses underwent spontaneous decomposition as exemplified by considerable frothing, temperature rise and fall in Brix and purity. The contribution made by caramel, formed by heating of the sugar in the molasses, and by amino-acids was established in the laboratory. Turkey red oil proved effective in reducing foaming and inhibiting the decomposition.

Efficient working of a lime kiln. Design, quality and operational aspects. S. K. Bajpai. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.231–M.243. Types of lime kiln are described, and the importance of limestone and coke quality discussed. Aspects of lime kiln operation are examined, and recommendations given on how to achieve a gas CO_2 content of 35-40%.

[1] *I.S.J.,* 1979, **81,** 120.

BEET SUGAR MANUFACTURE

Experiences from the 1978 campaign with the Hoesch automatic filter-press in the filtration of rotary filter cake and tests with the Andritz belt press. D. Wagner. *Zuckerind.*, 1979, **104**, 915 - 917 *(German)*. – Application of the Hoesch filter-press to treatment of cake from the rotary filters at Offenau factory is described, and areas of operation where problems arose are indicated. Particular mention is made of the O-rings used as seals at the slurry inlet, which had a very short life because of lime deposition; a modified design is expected to bring improvements. Mention is also made of the Andritz mud dewatering press tested at Rain factory (after earlier trials at Enns) which raised the dry solids content of rotary filter cake to 65-73%; it is only applicable for treatment of this material and not carbonatation slurry. Tests are to be conducted on another press developed by the same firm.

Contributions to a discussion on solids separation. *Zuckerind.*, 1979, **104**, 923-925 (*German*). – The views of a number of authors are given on aspects of filtration, particularly regarding the newly designed and tested filter-presses for carbonatation mud treatment.

Investigations on activated sludge degeneration in the treatment of sugar factory waste waters and on poorly degradable constituents. E. Reinefeld, H. P. Hoffmann-Walbeck, A. Pellegrini and J. Wittek. *Zuckerind.*, 1979, **104**, 931-939 (*German*). – See *I.S.J.*, 1980, **82**, 344.

Contribution of modern techniques to sugar factory automation. G. Windal. *Ind. Alim. Agric.*, 1979, **96**, 737-744 *(French)*. – See *I.S.J.*, 1980, **82**, 382.

An example of rational energy utilization: collaboration between a sugar factory and a malt factory at Arcis-sur-Aube for utilization of thermal wastes. P. Vautrin. *Ind. Alim. Agric.*, 1979, **96**, 749-752 (*French*). – The sugar factory operates about six months in each year, i.e. three months on beet processing and three on processing of stored thick juice. During the campaign 400 $m^3.hr^{-1}$ condensate from the last three evaporator effects had to be cooled from 95-98°C for re-use, while during thick juice processing 1200 $m^3.hr^{-1}$ condensate from the vacuum pans had to be cooled from 55°C. Under a scheme introduced in 1978, the condensate is fed along two 600-m pipelines to a neighbouring malt factory, where the condensate provides nearly all the heat required for two kilns during beet processing and almost half of the requirements during thick juice processing. However, it is stated that utilization of the condensate by the sugar factory itself could be of interest, despite the costly modifications to the existing heat scheme that would be entailed.

Treatment of muddy flume water and beet wash water by high-load bacterial filter. L. Audoin, –. Duquennoy and –. Depoisson. *Ind. Alim. Agric.*, 1979, **96**, 755-761 (French).–Details are given of a biological filter used to treat 140 $m^3.hr^{-1}$ waste water from a settling basin together with 130 $m^3.hr^{-1}$ water recycled from the filter. The filter is packed with Cloisonyle plastic tubing. After the campaign, it handles 52,000 m^3 of lagooned water. Its successful performance during its first year of use is reported, and the installation and operating costs are indicated.

Distribution of residence times. Practical use of a simplified flow model. P. Bonnenfant and J. M. Vicaigne. *Ind. Alim. Agric.*, 1979, **96**, 773-777 *(French)*. – Flow in chemical reactors is of two types: plug flow, where there is no dispersion and where the residence times of all the molecules are identical, and perfect-mix flow, where the residence times of the molecules vary considerably and where the composition at any given time is constant throughout the reactor. The reactor geometry also determines the residence time. Of two possible methods of determining the distribution of residence times, the one chosen involved the use of tracers; it allows both determination of the concentration of the reactor contents and establishment of a concentration-time curve. A simple mathematical model used to interpret such a curve is described. It was applied to a continuous vacuum pan, demonstrating the benefit of increasing the number of compartments from 5 to 12.

The continuous disc-type pressure filter in the sugar factory. M. Gaudfrin. *Ind. Alim. Agric.*, 1979, **96**, 779-781 *(French)*. – A description is given of the Gaudfrin rotary disc filter and of the means used to overcome the difficulty of cake withdrawal at a solids content of 52-56%. Mention is made of two units installed in French sugar factories, and their installation costs estimated. Advantages of the filter are listed.

Comparison of methods of demineralizing 2nd strike sugar syrups. H. Zaorska. *Ind. Alim. Agric.*, 1979, **96**, 783-788 *(French)*. – Three methods are compared: (1) anion and cation exchange with resins in H^+ and OH^- form, (2) electrodialysis, and (3) treatment with cation exchange resin in ammonium form and with anion exchanger in carbonate form. Application of the techniques to 60°Bx syrup of 97.6 purity showed that (3) was the best in terms of purity rise, pH of the treated syrup, sucrose inversion, lime salts and absorbancy.

Contribution to the study of the rheological properties of massecuites. J. Gebler and K. Ciz. *Ind. Alim. Agric.*, 1979, **96**, 799-805 *(French)*. – See I.S.J., 1976, **78**, **348**; 1977, **79**, 147; 1979, **81**, 251.

Development of the continuous centrifugal in the realm of high-purity sugars. P. Credoz, G. Journet and J. Ledoux. *Ind. Alim. Agric.*, 1979, **96**, 809-814 *(French)*. – The fundamentals of massecuite curing in centrifugals are explained, and factors of importance in influencing the residence time (basket geometry, speed of rotation, screen construction and wash water distribution) discussed. Crystal damage in centrifugals and how to minimize it are considered, and details given of the Fives-Cail Babcock FC 1000 SE 25° and FC 1000 GCV machines.

Controlled processing of low-grade product at Hatvan sugar factory. J. Lichtenstein. *Cukoripar,* 1979, **32,** 137-142 *(Hungarian).* – The fundamentals of low-grade massecuite treatment are discussed and details given of the system used at Hatvan for automatic control of cooling, dilution and re-heating as a function of viscosity and crystal content.

Recalcination of carbonatation mud in a high velocity reaction chamber. F. Schoppe, H. Schiweck and T. Cronewitz *Sucr. Belg,* 1979, **98,** 281-291 *(French).* See *I.S.J.,* 1980, **82,** 345.

Deammoniation of condensates from juice vapours by bubbling aeration in beet sugar manufacture. V. S. Samoilenko, A. I. Sorokin, N. A. Arkhipovich, L. P. Reva and E. A. Grivtseva. *Sakhar. Prom.,* 1979, (11), 26-28 *(Russian).* – Tests on bubbling of air into ammoniacal water held at constant temperature in a 300-mm flask are reported. Maximum ammonia removal (approx. 90%) was achieved at a flow rate of 0.010 $m^3.m^{-2}.sec^{-1}$, an air temperature of 80-82°C and a treatment time of 20 min after preliminary liming to adjust the pH to 11-11.5. The treated condensate can be used for diffusion.

Evaluation of crystal sugar screens. K. Ciz, J. Gebler and L. Masljanik. *Listy Cukr.,* 1979, **95,** 225-231 *(Czech).* The performances of three sugar screens used in Czechoslovakia have been evaluated, and results are tabulated. Descriptions are given of the screens, two of which (a gyratory model and a double-screen, spring-loaded vibratory model) are of Czechoslovakian manufacture, while the third is an East German electromagnetic, vibratory type. From the results it is concluded that the two domestic models are suitable but not the East German one.

Measurement of the temperature profile in a stream of low-grade massecuite. V. Jozefy and V. Hromek. *Listy Cukr.,* 1979, **95,** 231-233 *(Czech).* – The low-grade station at Hrochuv Tynec sugar factory was altered so as to permit longer boiling and cooling times and thus reduce the molasses losses. Among the changes was installation of a temperature control unit for the crystallizers. In order to establish the most suitable location of the thermometers, measurements were made of the temperature field in the massecuite flowing between two crystallizers. Results, illustrated by a contour diagram, showed that the variations were greater than the precision needed for accurate control of the temperature.

The use of disinfectants in diffusers and investigations of the microbial conversions. B. Winstrom-Olsen, R. F. Madsen and W. Kofod Nielsen. *Zuckerind.,* 1979, **104,** 1011-1018 *(German).* – Hydrogen peroxide was tested at Nakskov sugar factory as a disinfectant for diffusion in place of formalin, which may act as an irritant on the mucous membrane. While peroxide was found to give the same results as formalin (as measured in terms of pH and nitrite concentration) at the same dosage rate, it is at least twice as expensive as formalin. Investigations were carried out to establish to what extent disinfection was required, and showed that the criteria could be moderated. Acid-forming bacteria were found to use dextrose specifically as substrate, while the bacterial activity was accompanied by invertase activity only to a very small degree. Hence, acid formation and pH could not be regarded as indicators of sucrose loss. L- and D-lactic acid, pyruvic acid and acetic acid were also formed by microbial action. Because of acid absorption by cossettes, a drop in pH may occur at a point in the diffuser which is a long way from the source of infection. Since some of the formalin is absorbed by cossettes and is subsequently found in the pulp, a single "shock" dose will have a prolonged effect throughout the entire diffuser. The concentration of nitrite in molasses (one of the main reasons for disinfection in Danish factories because of its inhibiting effect on fermentation) from a large number of samples representing all five DDS sugar factories averaged less than 5 ppm, indicating that high disinfectant usage is not warranted. It is considered possible that further studies on microbial processes in diffusion will justify a reduction in disinfection consumption, so that the price difference between formalin and hydrogen peroxide will be of only marginal importance.

Micro-computer controlled thick juice filter station. K. A. Schultes. *Zuckerind.,* 1979, **104,** 1029-1031 *(German).* – Computerized control of the nine Hercules disc filters used for thick juice treatment at Enns sugar factory ensures an adequate supply of juice (by recycling feed syrup from the pan station to the filter feed tanks if necessary) and switches each filter to cleaning and precoating once the filtration of each batch of juice is completed. The filters are in two groups, and only one filter per group can be cleaned and precoated at a time; this guarantees that the muddy water tank and drain are not overloaded and that the requisite number of filters is handled. In the event of a number of filters needing cleaning, the computer establishes a priority list. The main program consists of eight sections, while the cleaning and precoat program comprises thirteen stages, each indicated visually as it is being carried out. After teething problems (not connected with the electronics) had been overcome, the system operated in its first campaign to fullest satisfaction.

Saving auxiliary agents with dosing equipment. E. Greulich. *Zuckerind.,* 1979, **104,** 1031-1033 *(German).* After the Quentin plant at the author's sugar factory had suffered a fall in performance after three weeks, it was decided to restrict injection of anti-foam agents in the sugar house to the falling-film evaporator used for *B*-molasses and to reduce the amount used throughout the factory by installing a mixer tank and replacing six metering pumps with ten of another type. The result was sufficient reduction in the amount used to pay for new equipment in one campaign – but there was no beneficial effect on the Quentin plant. The savings were found to be due to the dosing system as well as to the anti-foaming agent used (Glanapon DS 44) by comparison with previous anti-foam oils.

Remedying inadequate crystallizer capacity. R. A. McGinnis. *J. Amer. Soc. Sugar Beet Tech.,* 1979, **20,** 281-295. – Where factories have inadequate crystallizer capacity to permit the massecuite to cool for a sufficiently long period, exhaustion will be unsatisfactory unless modifications are made to the processes preceding crystallization. Of these, the one that is recommended is the use of as high a boiling temperature as possible without causing a fall in massecuite quality. Certain factors requiring consideration in the use of this technique are listed.

LABORATORY STUDIES

A study of sugar drying and conditioning. S. Farag. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 207-216. – In laboratory studies of sugar drying, 2-litre samples of wet sugar were dried at temperatures in the range 25-145°C in a small granulator, then cooled, accurately weighed and oven-dried under controlled conditions, cooled, reweighed and the moisture content calculated. After conditioning, the dried sugar was examined under the microscope and then tumbled in a bottle for 30 min before determination of the dust levels. Results indicated the considerable effect of drying temperature on the nature of the finished sugar. High-temperature drying (at 120-145°C) tended to encourage formation of small sugar particles loosely bound to the crystal surface, giving it a dull, opaque appearance and contributing to the dust problem by being easily rubbed off during handling; on the other hand, high-temperature drying caused less caking than did low-temperature drying. As a means of producing wet sugar of reduced but uniform moisture content, centrifugals have the advantage of a relatively low energy consumption, while granulators use much more energy because of the phase change or evaporation principle on which they operate.

Bibliography: Methods of sucrose analysis. D. W. Lowman. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 233-250. – A survey, with 61 references to the literature, is presented on methods and techniques used to determine sucrose (as well as sugar determination by polarimetry), and their accuracies and precisions discussed. Gas-liquid chromatography, nuclear magnetic resonance and isotope dilution are considered the most accurate, and the first two are considered to be possible routine methods of the future. However, polarimetry remains the most common method of analysis because of its ease and rapidity.

Thermo-physical properties of tablet refined sugar. Yu. P. Lutsik and A. F. Bulyandra. *Izv. Vuzov, Pishch. Tekh.*, 1979, (4), 117-119 (*Russian*). – Details are given of investigations to determine the heat diffusivity and thermal conductivity of tablet sugar as functions of moisture content and temperature. Graphed results show that the relationships were complex – with increase in temperature there was a fall in the two parameters studied, while they both increased as the moisture content rose.

The effect of calcium ions on renaturation of precipitated albumin. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Sakhar. Prom.*, 1979, (11), 20-22 *(Russian)*. – Studies are reported in which beet juice was treated with NaOH, with or without $CaCl_2$, at 20°C Earlier investigations had shown that Na^+ and Cl^- ions caused no albumin precipitation, and the present studies also confirmed that maximum precipitation occurred at pH 11.4 under the effect of Ca^{++} ions. However, with further increase in pH there was partial renaturation (re-dissolution) of the precipitated albumin in the presence of Ca; the amount precipitated by NaOH alone (i.e. the effect of OH^- ions) increased up to pH 12.5 but was always much lower than in the presence of $CaCl_2$. Increase in the Ca^{++} ion concentration beyond the equivalent of 0.3% CaO caused albumin dissolution, which at 0.5% CaO reached 10% of that precipitated.

Investigation of qualitative factors in diffusion on the basis of mathematical modelling. N. V. Kulinich, B. N. Valovoi, V. G. Yarmilko and V. V. Sposobnyi. *Sakhar. Prom.*, 1979, (11), 22-26 *(Russian)*. – A series of regression equations are given for rapid prediction of the potential pectin and reducing matter contents in raw juice as functions of their contents in pressed juice, diffusion temperature, juice draft, cossette length and ammonia content in the condensate used as diffusion water.

Determination of potassium and sodium with ion-selective electrodes and application of this method to beet evaluation. R. S. Sova, S. N. Kalina, I. V. Zakharova and G. G. Rusin. *Sakhar. Prom.*, 1979, (11), 43-45 *(Russian)*. – K and Na were determined in roots, beet brei, and pressed juice (before and after clarification) from five beet varieties, using ion-selective electrodes. The ionic strength of the clarified pressed juice was determined, from which it was concluded that the other ions present do not interfere in K and Na determination. Close correlation was found between the activities of the K^+ and Na^+ ions, respectively, in the various products, and regression equations are presented.

Determination of sulphur and chlorine in sugar beet plants and products of beet sugar manufacture. N. Kubadinow and J. Forsthuber. *Zuckerind.*, 1979, **104**, 1019 - 1021 *(German)*. –The significance of S and Cl in sugar beet and factory juices is discussed, and details given of a modification of the Lukassar *et al.* barium and mercury chloranilate method[1].

A comparative study on the chemical characteristics of BO 70 variety of sugar cane obtained from different regions of east Uttar Pradesh and Bihar and their influence on the colour formation and clarification difficulties. S. C. Sharma and P. C. Johary. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.19-M.32. After problems had been experienced at Marhowrah in the processing of juice from BO 70 cane (not found in other factories supplied with the same variety), laboratory studies were carried out. These revealed a high ash content in the crusher juice, with a considerable preponderance of silica and K_2O, a high reducing sugar content, low phosphate content and large quantities of colloidal matter and polyphenols. Addition of P_2O_5 to raw juice and preliming improved clarification and reduced sugar colour.

Studies on the use of flocculating agents during sugar cane juice clarification by the sulphitation process. K. H. Rao and K. P. Sinha. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.47-M.57.– Laboratory experiments are reported in which Califloc A (an anionic polymer) increased juice settling rate and reduced the mud volume by comparison with the control. At an optimum of 3 ppm it was almost as effective as Separan AP-30 at the same dosage rate.

[1] *Anal. Chim. Acta,* 1976, **87**, 247–250.

BY-PRODUCTS

Comparison of two fattening chicken hybrids in four feeding systems. L. M. Fraga and H. Thanh. *Cuban J. Agric. Sci.*, 1979, **13**, 47-55. – Results of experiments showed that, in terms of live weight, feed conversion and carcass weight, better results were obtained with maize-based rations containing soyabean and containing torula yeast than those containing either rice polishings or final molasses, although further economic studies are required to obtain final conclusions on the use of molasses and rice polishings in the initial stage, since diets used for feeding poultry in Cuba are primarily based on imported materials.

The nutritive value of single cell proteins (yeast and bacteria) in chickens. R. Romero, H. Meier and S. Poppe. *Cuban J. Agric. Sci.*, 1979, **13**, 63-68. – The true digestibility of yeast and biomeal developed on molasses was determined in tests with 2-week-old fattening chicks. While average true yeast digestibility was higher than for biomeal, the amino-acid contents of both products were identical. The digestibility was lower for yeast grown on molasses than yeast developed on a cane substrate containing a small amount of molasses. The true amino-acid digestibility for the products evaluated was high.

Effect of diet on *in vitro* metabolic activity of bovine rumen mucosa. R. Ruíz and M. Hernández. *Cuban J. Agric. Sci.*, 1979, **13**, 69-82. – The effect of high-energy diets and high-fibre diets on volatile fatty acid metabolism by rumen mucosa was studied with nine bulls. Results show that high molasses/urea feeding increases the utilization of butyrate by the rumen mucosa and its conversion to ketone bodies.

Soda-oxygen pulping of bagasse and rice straw. A. E. El-Ashmawy, M. H. Fadl, T. M. Saleh and S. A. El-Meadawy. *Tappi*, 1977, **60**, (6), 109-111; through *S.I.A.*, 1979, **41**, Abs.79-1201. – Laboratory tests to assess the suitability of a soda-oxygen process for pulping bagasse are described. Depithed bagasse was pulped at alkali charges of 8, 12 and 15%, a liquor: fibre ratio of 7:1 and oxygen pressures of 0, 5, 10 and 15 $kg.cm^{-2}$, with heating to 135°C in 90 min and maintenance at this temperature for 30 min. Pulp yields were maximum at an oxygen pressure of 10 $kg.cm^{-2}$, 6-10% relative higher than without oxygen. The lignin content of the pulp decreased with increasing oxygen pressure. Strength properties (burst factor, breaking length and tear factor) were maximum at an oxygen pressure of 5 $kg.cm^{-2}$.

Bleachability of rice straw and bagasse paper pulps and their mixture. M. H. Fadl, S. Hiekel and Y. Fahmy. *Indian Pulp and Paper*, 1977, **32**, (2), 7-9; through *S.I.A.*, 1979, **41**, Abs.79-1204. – Bagasse pulp was subjected to hypochlorite bleaching using 200% of the natural chlorine requirement, either in one stage or divided between two stages, and to three-stage bleaching with chlorine-soda-hypochlorite. Brightnesses after the processes were 75, 70 and 71%, respectively. Chemical and strength properties before and after the bleaching processes and yield losses on bleaching are tabulated for the bagasse pulp and for a 1:1 mixture of bagasse pulp and rice straw pulp.

Production and characterization of activated carbons from agricultural waste products and wood charcoals. A. J. Dandy. *N. Z. J. Sci.*, 1977, **20**, (3), 291-295; through *S.I.A.*, 1979, **41**, Abs.79-1206. – Activated carbons were produced from bagasse and other plant waste materials by treatment with H_2SO_4 followed by high-temperature activation; for bagasse, activation was carried out in the presence of steam at 780°C or of CO_2 at 825° or 880°C. The activity was measured by adsorption of N_2 at -197°C or of methylene blue; the former method gave respective surface areas of 820, 827 and 1000 $m^2.g^{-1}$ for the three bagasse carbons. These values were high, although lower than those of carbons derived from cottonseed husks.

"Fermentation flocculation" contamination of alcohol fermentation. G. E. Serra, M. P. Cereda, R. J. F. Feres, M. T. Bertozo and A. L. Vicente. *Brasil Açuc.*, 1979, **93**, 336-341 (*Portuguese*). – A micro-organisms survey was made on waste waters, cane wash water, condensate, juice, molasses, must, ferment (milk and yeast) and fermentate to try to find the cause of a contamination which resulted in the formation of small flocs of yeast and bacteria; a number of species of bacteria were identified and also a *Sporolactobacillus* which was not destroyed by adjustment to pH 1.9-2.0 with sulphuric acid and which seemed to be the causal agent. They form a gelatinous layer on the surface of the yeast and, since the active surface is thereby reduced, slow fermentation progressively. The extent of infection appears to be related to the quality and amount of recirculation of cane wash water and contamination of process liquors.

The situation in Campos in relation to vinasse. The utilization of this distillery effluent in obtaining methane gas. Impressions of a journey to Australia. M. Prates de Campos. *Brasil Açuc.*, 1979, **93**, 350-352 (*Portuguese*). A vinasse treatment module was constructed and tested at the Jaques Richer distillery belonging to Coperflu; it comprises a digester and gasometer and has a capacity of 400 m^3 of vinasse per day. The principal factors determining the function of the module have been identified and are listed. Steps are being taken to obtain a multiple-effect evaporator designed for the concentration of vinasse for pelletizing and incineration as a fertilizer, while literature on use of vinasse as animal fodder is briefly discussed and work at the University of Melbourne on the utilization of solar energy is quoted.

Treatment of vinasse, by-product of alcohol distillation. J. D. Camhi. *Brasil Açuc.*, 1979, **94**, 18-23 (*Portuguese*). Vinasse is produced at the rate of 12-14 volumes per volume of alcohol in distilleries and possesses a high BOD content, so that it is highly polluting as regards disposal in bodies of water. Methods currently known for treatment include direct irrigation of soil, concentration and combustion, and fermentation for methane production; these are discussed. All have anti-economic characteristics and the search continues for a technical and economical solution to the problem of vinasse disposal, a problem which will grow with the expansion of the fuel alcohol program in Brazil.

PATENTS

UNITED STATES

Separating device for cane buds to be heat treated as planting material. W. M. Da Silva, of Piracicaba, Brazil, *assr.* Cooperativa Central dos Produtores de Açúcar e do Alcool do Estado de São Paulo. (A) **4,085,545.** October 22, 1976; April 25, 1978. (B) **4,091,569.** October 12, 1976; May 30, 1978. – In (A) the machinery is described for cutting out buds from cane stalk sections while (B) describes the process of heat-treating them uniformly to kill disease organisms and planting out in beds of material (sand) poor in organic matter for germination.

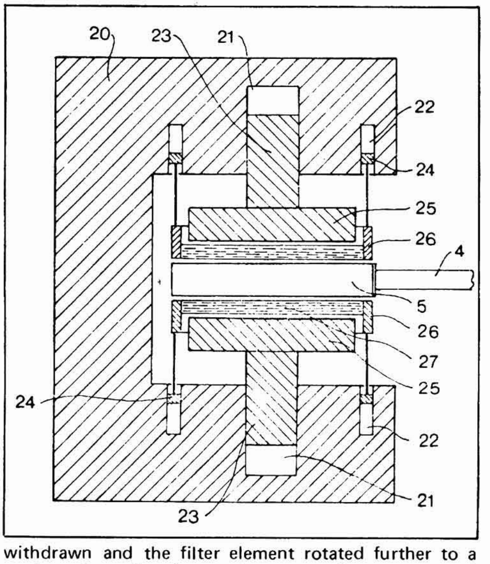
Process for producing dextrose isomerase. I. Kojima, H. Sato and Y. Fujiwara, *assrs.* Nippon Oil Co. Ltd. **4,086,138.** January 28, 1977; April 25, 1978.– See UK Patent 1,527,215[1].

Solidifying molasses (for use as animal fodder). J. Shimizu and T. Iwakura, of Yokohama, Japan, *assrs.* Mitsui Sugar Co. Ltd. **4,089,701.** February 7, 1977; May 16, 1978. – (Beet, cane or refinery) Molasses is mixed with oils, fats (beef tallow, fish oil, coconut oil, cotton seed oil, soya bean oil, tall oil or hardened or semi-hardened such oils) or esters of higher fatty acids [a methyl or ethyl ester of a saturated or unsaturated straight chain C_8 - C_{22} (C_{14} - C_{20}) fatty acid; a mono or diglyceride; monostearine or distearine] and concentrated (first at 80 - 130°C under reduced pressure and then) at 110 - 175°C (120 - 160°C) in the presence of sufficient alkali to regulate the pH between 8 and 12.

Dewatering thickened sludge. R. F. Madsen, of Nakskov, Denmark, *assr.* A/S De Danske Sukkerfabrikker. **4,092,247.** December 21, 1976; May 30, 1978.

A hollow shaft rotates about a horizontal axis and is surrounded by a manifold which supports eight hollow arms 4, each of which carries at its outer end a filter element 5. The manifold is so constructed that the arms 4 can be connected to vacuum and compressed air by way of the hollow shaft. Below the shaft is a container which holds a continuously circulating bath of thickened sludge, e.g. carbonatation sludge from a sugar factory, and the filter elements are immersed in this bath during rotation of the shaft, the vacuum connexion causing a cake to form on its filter surface. The element, after removal from the bath, enters a compression station where hydraulic cylinders 22 are activated to bring the annular frame members 26 into contact with the edges of the element 5.

The high pressure cylinders 21 are then activated to apply an increasing pressure to the cake and the expressed liquid is withdrawn through the vacuum connexion. The hydraulic pistons 23, 24 are then



withdrawn and the filter element rotated further to a station where the element is connected to compressed air and the cake removed from its surface to fall onto two discharge trays on either side of the element's path, after which the element can continue and again be immersed in the bath of sludge.

Batch-type centrifugal. H. Korsch, of Cremlingen-Weddel, Germany, *assr.* Braunschweigische Maschinenbauanstalt. **4,097,303.** December 29, 1976; June 27, 1978. – See U.K. Patent 1,524,174[2].

Enzymatic method of producing dextrose from ethylene treated cellulose. A. H. Freytag and J. C. Linden, *assrs.* The Great Western Sugar Co., of Denver, CO, USA. **4,097,333.** June 22, 1977; June 27, 1978. – Dextrose is produced by the enzymatic hydrolysis of cellulosic material (e.g. beet pulp) while bringing it into contact with ethylene and hydrolysing (later or at the same time) at least part of the cellulosic material. This may be achieved by dispersing the material in water and bubbling ethylene gas (at 1 cm^3.min^{-1} per 1000 cm^3 of dispersion) through the dispersion.

Cane harvesters. D. J. Quick, of Bundaberg, Queensland, Australia, *assr.* Massey-Ferguson Services N.V. **4,098,060.** October 26, 1976; July 4, 1978.

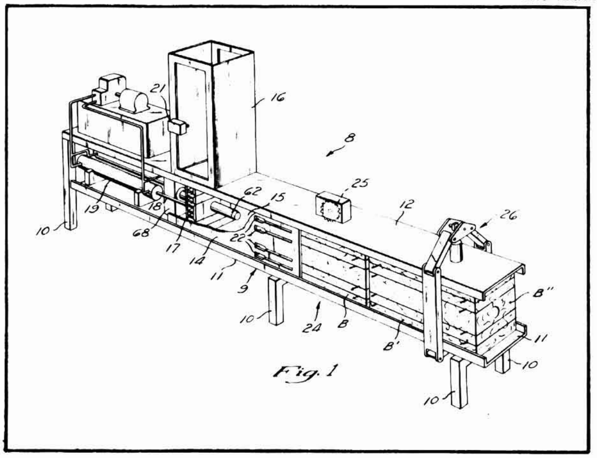
Bagasse baler. F. C. Tea and P. S. Hartman, of Bellevue, OH, USA, *assrs.* The American Baler Co. **4,098,180.** November 15, 1976; July 4, 1978.

The baling machine 8 is supported by a frame 9 with legs 10 and includes a floor 11 spaced apart from an upper side 12. Above an opening in side 12 is a feed hopper 16 and the sides of the machine are closed by walls 14 at this point to form a baling chamber 15. When the level of bagasse in the hopper reaches a predetermined height, as detected by photocell control unit 21, the charge of bagasse in chamber 15 is compressed by reciprocation of baling head 17 under

1 *I.S.J.*, 1981, **83**, 62.
2 *ibid*

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

the action of the hydraulic rams 18 driven by cylinders 19.



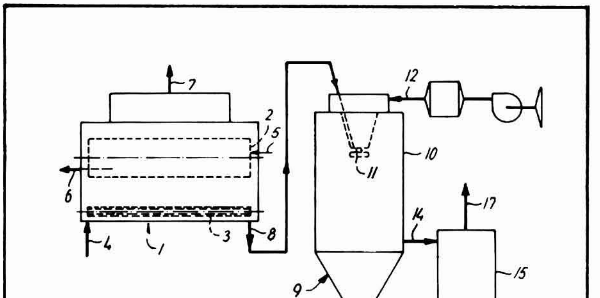
The bagasse forms a pad and, after a number of such pads have been compressed to form the desired length for a full bale, the baling head 17 is moved to its fully advanced position and a number of wires are inserted through openings 22 in sides 14. The end bale is held in position by the toggle mechanism 26 which presses floor 11 and upper side 12 together, gripping the bale and so providing a rigid end surface against which a new bale can be formed. After formation of a bale of the required length, as measured by conventional measuring wheel 25, the toggle mechanism is loosened and the end bale discharged.

Calcination of carbonatation mud. F. Schoppe, of Munich, Germany. **4,098,871.** June 3, 1974; July 4, 1978. An oxygen-containing gas (air, mixed with recycled waste gas) is introduced into the bottom of a rotationally symmetrical reaction zone so as to produce an upward flow in the centre. The gas is preheated (by exchange with reaction zone waste gases or by means of a combustion-type heater) and fuel introduced into the downward flow at its upper end whereby combustion occurs and the temperature of the reaction zone is raised. A lime-bearing raw material, e.g. lime sludge from a sugar factory carbonatation process, is preheated so that it is dry and may be conveyed pneumatically; it is introduced into the upper end of the central region of the reaction zone where it mixes with the downwardly flowing gases and is deflected outwardly at the bottom of the zone into the outer region where it is entrained by the rising gas flow. The temperature of the raw material is raised at a mean rate of $\nless$ 400°C per second in the reaction zone so as to disrupt the crystal structure and to give micro-crystalline primary particles which agglomerate on leaving the reaction zone in fractions of a second to give larger secondary particles. The residence time in the reaction zone and period of contact of raw material with the hot gases is $\ngtr$ 1 second. Particles too heavy to be entrained are removed from the bottom of the reaction zone. The agglomerated secondary particles are separated from the gas stream which is returned to the reaction zone while the particles are immediately surrounded by an inert gas (air at a temperature low enough to prevent carbonate formation). The air: fuel ratio is maintained at 1.4:1 - 2.5:1 (1.6:1 - 2.0:1) of the theoretical stoichiometric amount.

Cane harvesting. J. C. Hudson, of St Thomas, Barbados, *assr.* F. W. McConnel Ltd. **4,099365.** October 14, 1976; July 11, 1978. – A machine towed behind a tractor vehicle passes over a swath of cut green cane. This is lifted from the ground, the canes pulled top first from the swath with the stalk supported and then accelerated rearwardly, restraining the top of each cane while continuing to move the stalk rearwardly, to cause the top to break away from the stalk.

Ripening of sugar cane. L. G. Nickell, of Ellicott City, MD, USA, *assr.* W. R. Grace & Co. **4,099,957.** May 25, 1977; July 11, 1978. – The sugar content of cane is increased by applying an effective amount [1 – 80 (1 – 40) lb. acre^{-1}] of a ripening agent (iso-butanol, ethanol or *n*-propanol) between 2 and 10 weeks (3 – 8 weeks) before harvest.

Evaporating and spray drying of sugar solution. O. Hansen and S. Rasmussen, *assrs.* A/S Niro Atomizer, of Soborg, Denmark. **4,099,982.** October 31, 1977; July 11, 1978.

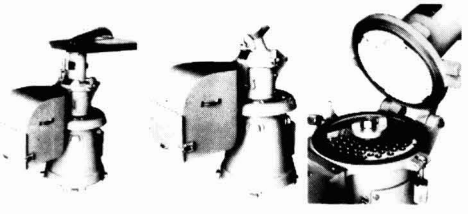


A sugar solution, e.g. deionized beet thick juice of 50% Brix, is fed through pipe 4 to a vacuum evaporator 1 where it is agitated by a rapidly turning rotor

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

Cutter-Grinder

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



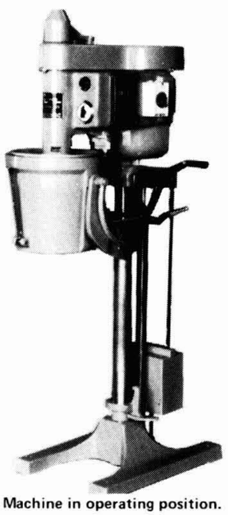
Above left: **Model 268B** will cut prepared cane or that which has come from a pre-breaker. It will also take full stalks including the tops and roots. The opening through which the cane is fed is 152mm. Power by 7.5kw motor.

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

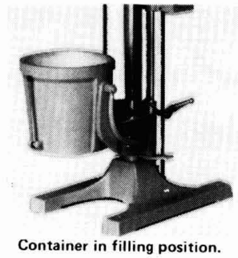
Above right: Illustration of internal cutting arrangement. The cutters which are mounted on a vertical spindle perform a scissors action with the four hardened inserts in the head of the machine. Screen plates with holes of various sizes are available.

DIMENSIONS - with receiving bin.
Unpacked - 155 x 115 x 74cm Packed - 150 x 126 x 92cm
Cubic - 1.74m3 Weight Packed - 547kg

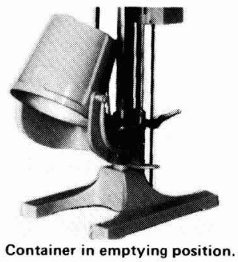
Wet Disintegrator



Machine in operating position.



Container in filling position.



Container in emptying position.

Above: **The Jeffco Wet Disintegrator Model 292** processes a measured quantity of cane and water resulting in the removal of sugar juice from fibre. It operates by a 2.2kw motor and is available in model numbers 291 - 9 litre and 292 - 14 litre capacity containers incorporating a water jacket for temperature control. Container tilts for easy emptying. Built in timer stops machine automatically at preselected time.

DIMENSIONS
Unpacked - 165 x 89 x 56cm Packed - 173 x 104 x 57cm
Cubic - 1.02m3 Weight Packed - 337kg

Approved by Leading Sugar Cane Research Centres.

JEFFRESS BROS. LTD. ENGINEERS
351 Melton Rd., Northgate, Brisbane. 4013
Phone: (07) 266 1677

To **JEFFRESS BROS. LTD.** 351 Melton Road, Northgate East, Brisbane, Qld. 4013 Australia.
Please forward full details on ☐ Wet Disintegrator ☐ Cutter/Grinder.
Name ....
Address ....
.... Post Code ....

How to teach an old centrifugal new tricks

48″ x 36″ basket

48″ x 30″ basket

Figure A

Figure B

Introducing PROJECT-UPDATE

If you own an older model Western States Automatic Batch or Continuous Centrifugal, we have some good news for you.

We call it "Project-Update."

You'll call it the best thing that's happened to your profit in a long time.

Because now you can upgrade your older Western States Centrifugals without the major capital investment of equipment replacement. Increased efficiency, additional capacity, lower maintenance costs, prolonged equipment life... they're all new tricks you can teach your older Western States Centrifugals now with "Project-Update."

For example, we can replace your existing batch type centrifugal's 48" x 30" basket with a 48" x 36" unit. The result? Increased capacity. (Figure A)

Productivity for older model Western States Continuous Centrifugals can be dramatically improved by a change-over to our new enclosed feed/massecuite pre-treatment system.(Figure B)

Replace existing relays in automatic centrifugals with solid state control. You'll gain improved system reliability and reduced maintenance. (Figure C)

Replace existing charging gates with our new Roller Wedge type combined with the Vertimatic cover... reduced maintenance. (Figure D)

Install quieter, cleaner, manifolded solenoid valves. (Figure E)

These are just a few of the ways Western States' new "Project-Update" can help you. There are many more. For more details, write us or contact your Western States representative. Be sure to include the serial number from the front nameplate of your existing Western States Centrifugal.

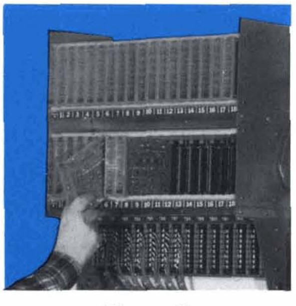


Figure C

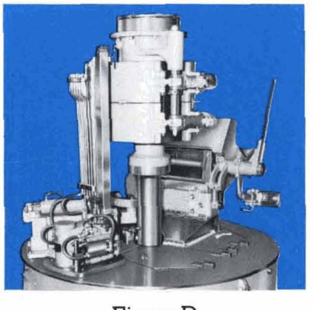


Figure D

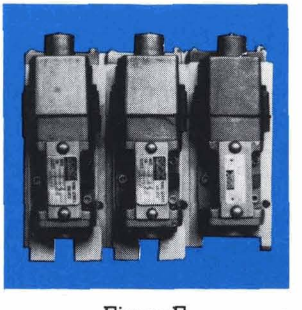


Figure E

Do it today. Put "Project-Update" to work for you... increasing productivity, capacity and efficiency.

THE WESTERN STATES MACHINE COMPANY

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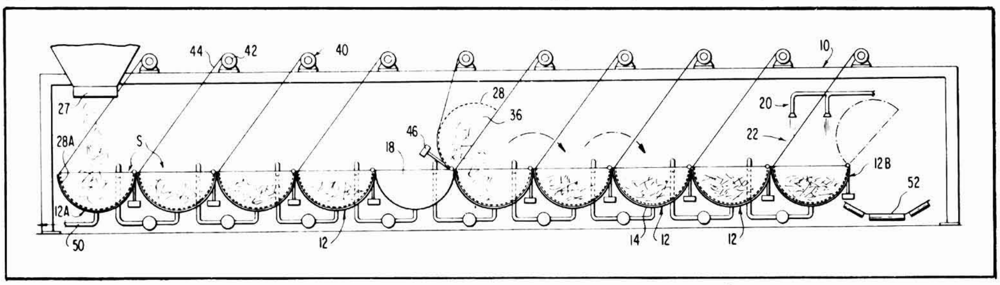
3 and thrown onto a slowly rotating cylinder 2 which has a corrugated surface and is internally heated by steam admitted through pipe 5, condensate being removed through pipe 6. The sugar solution is concentrated, vapour being withdrawn through line 7, and the concentrate (containing very small sugar crystals) is directed by line 8 to spray dryer 9.

Here it is distributed by atomizer wheel 11 within chamber 10 while filtered and heated drying gas is admitted through line 12. The product, resembling wet snow and containing 0.5 – 5% moisture, is removed through outlet 13 while any carried in the stream of exhausted drying gas leaving through line 14 is separated by cyclone 15 and discharged through line 16. The sugar from outlet 13 is delivered by conveyor 18 to a conditioning installation such as drum dryer 19, air at room temperature being supplied at 20 and removed through outlet 21. After passage through a "Vibro-fluidizer" 23 the sugar is removed at outlet 24 with a moisture content less than 0.1%. No molasses is produced and inversion, etc. which occurs in convential boiling is avoided.

Cane planter. S. E. Longman, of Franklin, LA, USA. **4,101,285.** September 27, 1976; July 18, 1978.

The diffuser 10 is depicted with a series of juice extraction stations S at each of which is a tank 12 having a curved bottom surface 14 and end walls to form a trough 18 arranged transversely to the length of the diffuser. A pipe from the bottom of each trough leads by way of a pump to an overflow above the adjacent trough so that water provided by pipes 20 above the end trough 12B can be conducted along the diffuser to the other end trough 12A from which it leaves through pipe **50**.



Within each trough is a perforated basket 28 formed from suitable screen material as sides and bottom. The baskets nest within the troughs but pivot about an axle at the edge of the trough so that they can deposit their contents into the next trough. The pivoting action is brought about by means of chains 44 which run under the baskets and are attached to near the pivoting axle; when the winches 42 are actuated the chains are drawn up and the baskets caused to pivot about their axle while, when the winch is deactivated, the basket is restored to its nesting position by the counterweights 46. In operation, a charge of juice-laden cane pith is introduced into trough 28A from hopper 27 where it soaks in juice delivered through the overflow pipe from the adjacent trough. After a suitable time it is transferred to the next trough, the transfer causing a tumbling of the pith to ensure that it is thoroughly mixed. A fresh charge is put into trough 28A and the pith continues along the diffuser to be discharged finally from trough 28B onto conveyor 52. Water entering the diffuser through pipes 20 becomes steadily richer in sugar before discharge through pipe 50.

Recovery of useful products from molasses. R. M. Rapaport, A. Monti, R. D. Moroz and C. B. Broeg, *assrs.* Sucrest Corporation, of New York, NY, USA. **4,101,338.** April 27, 1976; July 18, 1978. – Either a single molasses supply (of $\ngtr$ 60° Bx) or a first portion of (blackstrap) molasses (of 45 – 55° Bx) is brought into contact with an ion exclusion resin [a (4% cross-linked) sulphonated styrene-divinyl benzene copolymer in the Na form] and then a second portion at a lower density (10° – 25° Bx) and thereafter the resin eluted with a dilute aqueous medium (water) to give an eluate (in fractions, one of) which comprises predominantly a sugar solution (which is decolorized with carbon and a resin). The molasses is pre-treated by adding a polyelectrolyte and centrifuging [at >40° Bx (>70°Bx)] at an elevated temperature. A more diluted molasses may first be applied to the resin (in a column having a height: diameter ratio of <5:1). The temperature of the undiluted and 10 – 25°Bx portions is (20°F) lower than that of the 45 – 55°Bx portion. Alternatively, ferric ions [as $FeCl_3$, $Fe_2(SO_4)_3$ solution] may be added (at 60 – 120°F) to the molasses (at $\ngtr$30° Bx) (to bring it to pH 2 – 2.5), and the precipitated solids removed completely, (phosphate added to raise the pH to >7.0 and remove residual ferric ions) after which the treated molasses is passed through a (cellulose acetate) membrane filter.

Purification of sugar esters. K. James, of Reading, England, *assr.* Tate & Lyle Ltd. **4,104,464.** April 16, 1976; August 1, 1978. – Sucrose is trans-esterified with at least one triglyceride of a fatty acid (of at least C_8) (at 110° – 140°C in the presence of a catalyst) to give a solid material containing (i) fatty acid mono- and diesters of sucrose, (ii) fatty acid mono-, di- and tri-glycerides, and (iii) fatty acid soaps. This mixture is treated (at up to 70°C) with a solution of a metal salt [Mg, Ca, Ba, Zn or Al salt ($CaCl_2$, Ca acetate, $MgSO_4$, $ZnCl_2$, Zn acetate, $Al_2(SO_4)_3$, $AlNH^4(SO_4)_2$) in water or a C_1 – C_4 alkyl alcohol (ethanol, *iso*-propanol). This gives a second solid material containing insoluble fatty acid salts formed with the metal ions and the sucrose esters are then isolated by extraction with a C_1-C_4 alkyl alchohol, and evaporation of the extract to dryness. The glycerides may be extracted from the first or second solids with a solvent in which the sucrose esters are insoluble [ester, ketone or chlorohydrocarbon solvents (ethyl acetate, methyl ethyl ketone or 1,2-dichloroethane)].

Cane planter . S. E. Longman, of Franklin, LA, USA. **4,106,669.** March 8,1976; August 15, 1978.

Isomerizing dextrose to levulose. T. Kanno, H. Watanabe and S. Sano, *assrs.* Showa Sangyo Co. Ltd., of Tokyo, Japan. **4,106,987.** January 6, 1977; August 15, 1978. The dextrose is brought into contact with a hydrogel (agar agar, gelatine, collagen, pectin, locust bean gum, casein, wheat gluten, soy protein, egg white, tannin, persimmon tannin, wheat flour, starch or flour of *Amorphalus konjac* K. Koch) which contains dispersed cells of a dextrose isomerase active micro-organism (a *Lactobacillus, Pseudomonas, Leuconostoc, Streptomyces or Aerobacter* sp.) and with anion exchange resin.

Preservation of aqueous dextrose isomerase solution. T. Hirota, T. Hishida, A. Kamata, I. Nakazawa and H. Takamisawa, *assrs.* Mitsubishi Chemical Industries Ltd., of Tokyo, Japan. **4,106,993.** March 15, 1977; August 15, 1978. – The enzyme solution is preserved by adjusting its pH to 9 – 12 (10 – 11) [with $Mg(OH)_2$, NaOH, KOH and/or NH_4OH] when it may be stored for 3 days (≮7 days, ≮30 days).

Separation of saccharides by exclusion chromatography. I. F. Deaton, of LaGrange Park, IL, USA, *assr.* CPC International Inc. **4,109,075.** June 9, 1976; August 22, 1978. – A feed mixture (a starch conversion product), containing dextrose, levulose, disaccharides and higher saccharides, is supplied to the top of a molecular exclusion chromatography zone which is then eluted with water, collecting a first fraction containing the highest molecular weight substances (which is returned to the column), a second fraction rich in levulose and a third fraction rich in dextrose.

Increasing the sugar content of cane. J. E. Franz and R. M. Sacher, *assrs.* Monsanto Co., of St. Louis, MO, USA. **4,110,100.** August 12, 1977; August 29, 1978. The sucrose content of cane is increased by applying, 2 – 10 weeks before harvest, an effective amount of a (solution or suspension of a) compound of formula $MZO_2P{-}CH_2)_b{-}N(\rightarrow O)(-CH_2.COOM_a$, where M is H or a salt forming cation, a and b are integers and a + b = 3, and Z is H, lower alkyl, phenyl (when a = 1) or $-CH_2-N(\rightarrow O)(\rightarrow CH_2.COOM)_2$ (when a = 2) [N-phenylphosphinylmethyliminodiacetic acid N-oxide; N, N-bis (hydroxyphosphinylmethyl) glycine N-oxide trisodium salt; N-hydroxy phosphinylmethyliminodiacetic acid trisodium salt N-oxide; N,N'– hydroxphosphinylidenedimethylene)-bis-(iminodiacetic acid-N-N'dioxide].

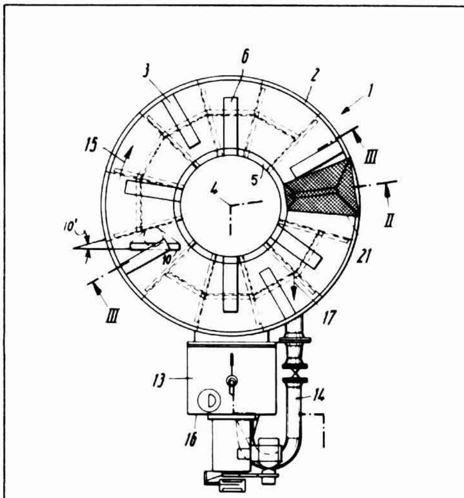
Production of a polysaccharide (from sugar) under carbon limiting conditions. R. C. Righelato and T. R. Jarman, of Reading, England, *assrs.* Tate & Lyle Ltd. **4,110,162.** May 20, 1977; August 29, 1978. – See UK Patent 1,513,061[1].

Process for obtaining amino-acids from raw beet juice. H. Hippchen, H. G. Schneider and R. Schwingeler *assrs.* Pfeifer & Langen, of Cologne, Germany, **4,111,714.** April 8, 1976; September 5, 1978. Impurities (other than amino-acids) in beet raw juice are coagulated (by adjustment to pH 2 – 5 or by liming to pH11 and carbonatation) and separated (by flotation) and the juice (treated with a pectin-cleaving enzyme and) passed (at<15°C) successively through one or more (strongly) acidic cation exchange resins to adsorb the dissolved amino-acids, which are then eluted with an ionic solution (in fractions rich in different amino-acids). When the cation exchange resin is in two columns flow may be switched from one to the other when betaine starts to appear in the effluent. The effluent from the cation exchange resin is passed through one or more (weakly) basic anion exchange resins, followed by elution with NH_4OH solution to give fractions containing different organic acids. The effluent from the anion exchange resin is processed to crystal sugar.

Converting liquefied starch to a mixture of dextrose and levulose utilizing a multi-component immobilized enzyme system. W Colilla and N. E. Lloyd, of Clinton, Iowa, USA, *assrs.* Standard Brands Inc. **4,111,750.** September 14, 1976; September 5, 1978. – Liquefied starch (prepared enzymatically and) having a dextrose equivalent greater than 25 is treated [at pH 4.5 – 8 (6 – 7) and 5° – 60°C (35° – 55°C)] with an enzyme system (in a mixed bed) (separately) comprising immobilized glucoamylase, immobilized dextrose isomerase and immobilized debranching enzyme, the last being either immobilized pullulanase or immobilized isoamylase or a mixture of these. All the starch is thereby converted to dextrose and levulose.

Beet diffuser. W. Dietzel and M. Athenstedt, *assrs.* Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **4,115,145.** July 5, 1977; September 19, 1978.

The diffusion tower 1 comprises a stationary housing 2 within which rotates a shaft 5 carrying conveyor wings 6 which are interrupted by radial baffles 3 located on the inside of the housing 2. The base of the tower may be in the form of a screen but as shown is closed with a screened outlet for separation of sand from juice in the tower. Feed of cossettes to the tower is through one (as shown) or a number of uniformly spaced slots 10, which may also be wedge-shaped, and are at an angle 10' to the radial direction. This ensures that the scraper/distributor blades on the bottom of shaft 5, which keep the bottom of the tower clear, only overlap a small part of the slot at any moment while the slot can also be longer than if it were radial, ensuring more even distribution of feed to the diffuser.



A screened feed screw 13 is provided which draws cossettes-juice mixture in the direction of arrow 17 from the bottom of the tower, separates juice and conveys a juice-cossettes mixture back into the tower.

[1] I.S.J., 1981, 83, 61.

International Society of Sugar Cane Technologists

The first Newsletter to be published in respect of the 18th Congress of the ISSCT has recently been published and distributed. It carries biographical notes on the General Chairman, Luís O. Gálvez, and the General Secretary-Treasurer, Oscar Almazán del Olmo, together with the Resolutions carried at the 17th Congress in Manila in 1980. Additionally, the rules for preparing manuscripts to be submitted by members are reprinted and enclosed, with a Membership Application Form. A copy of the Newsletter and its enclosures is obtainable from Mr. Almazán, c/o ATAC, P.O. Box 4063, Havana, Cuba (Telex No. 511667).

Trinidad sugar industry closure proposals [1]. — The government of Trinidad & Tobago has announced that it is considering plans to either shut down or drastically restructure the country's sugar industry. It has sent to Caroni and Orange Grove, the two state-owned sugar companies, proposals either to close down the companies, turning over the lands to farmers who could grow food, or to amend their structure. In 1980, Caroni lost US $72 million on the production and export of sugar. Production in Trinidad has declined steadily in recent years; in 1975/76 it amounted to more than 200,000 tonnes but in 1980 had fallen to 127,000 tonnes. The Opposition denounced the plans and its leader, who also heads the All-Trinidad Sugar and General Workers Union, called them "an attempt to keep sugar workers and their families in a state of semi-slavery".

Cuba sugar expansion [2]. — Some 700 million Cuban pesos (£420 million) is to be invested in sugar and its by-products over the next five years. Two new mills were completed recently, each with an output of 100,000 tonnes of raw sugar per season and eight similar mills are to be completed by 1985 with nine older mills to be extended and 14 modernized to raise the country's daily crushing capacity to 690,000 tonnes. The cane area is to increased by 268,000 hectares and 30% of the total to be provided with irrigation. Sugar refining capacity is to be increased from 900,000 tonnes to 1.5 million tonnes a year and, to achieve this target, the 16 existing refineries are to be modernized and two additional 560 tonnes/day refineries built. Alcohol distilleries are due for modernization to increase output and what is believed to be the largest rum production facility in the world, capable of producing 150 million litres a year, is under construction at Santa Cruz del Norte. By 1985 some 65% of cane harvesting will be mechanized, against 50% in 1980, while bulk storage capacities will be enlarged and transport and shipping facilities improved. Increased production is planned for furfural, fibre board, bagasse pulp and paper, torula yeast and sucrochemical products.

Sierra Leone sugar factory [3]. — The Magbass sugar factory, which was built by China, went into production at the beginning of 1981. The project, described as the most elaborate agro-based industry every undertaken in Sierra Leone, has a sugar cane plantation of 3350 acres attached to the factory, of which over 1000 acres has already been put into cultivation. When fully operational, the factory should have a capacity of 400 tonnes of sugar per day, sufficient to meet local needs, and export potential. The molasses produced will be used to make industrial alcohol.

Fuel alcohol plant in Louisiana . — A contract was awarded recently by the Independence Energy Co. Inc., of New York, to Tate and Lyle Technical Services of London, for design studies and definitive cost estimates for a 20 million gallon ethanol plant to be located at Thibodaux, Louisiana. The plant will be capable of accepting sugar cane products, sweet sorghum and corn. External energy will be supplied from Louisiana lignite. Tate and Lyle Enterprises Inc., of Coral Gables Florida, and Badger Energy Inc. are subcontractors to TLTS. This phase of the project is funded by a grant from the US Department of Energy. It will be the second fuel alcohol plant in Louisiana[4]

Sri Lanka sugar expansion.[5] — Booker Agriculture International Ltd. are negotiating a project at Pelwatte in Moneragala District, involving establishment of a 3000 t.c.d. sugar factory to crush cane from an area of 18,000 acres. Two other firms, HVA of Holland and the Mehta Group, have also expressed interest in starting cane sugar products in Sri Lanka . Sri Lanka consumes approximately 250,000 tonnes, raw value, of sugar per year while sugar production is not more than 25,000 tonnes, so that substantial quantities have to be imported to cover domestic requirements.

Mauritius sugar statistics[6]

	1980		1979	
	tonnes, tel quel			
Initial stocks		310,270		271,807
ISA Special stock		13,720		6,860
Production		475,494		688,383
		799,484		967,050
Exports				
Canada	0		13,750	
Comoro Islands	0		1,200	
France	54,363		39,900	
Germany, West	0		1,020	
Holland	504		0	
Sri Lanka	0		30	
UK	548,419		430,317	
USA	14,022		118,118	
		617,308		604,335
Consumption		36,657		38,549
Adjustment		4,336*		176
Closing ISA Special stock		0		13,720
Final stocks		141,183		310,270

*Loss in storage owing to cyclone damage

Guyana sugar production [7]. — Sugar production in Guyana in 1980 totalled 301,990 tonnes, well below the initial target of 375,000 tonnes but slightly above the previous year's output of 298,000 tonnes. The state-owned Guyana Sugar Corporation plans to raise output to 369,600 tonnes in 1981 and to 392,000 and 403,000 tonnes, respectively, in the following two years.

Denmark 1980/81 campaign results [8]. — The five Danish sugar factories worked an average of 91.8 days in the recent campaign and sliced 2,659,800 tonnes of beet to produce 371,300 tonnes of white sugar, which compares with 392,000 tonnes in the previous campaign.

Ivory Coast sugar expansion plans [9]. — The government hopes to see a rise in sugar cane output during the 1981-85 development plan from 1.4 to 2.6 million tonnes, an increase of 13.1% per year. It would mean a substantial increase in sugar production and with this a rising export surplus.

Soviet sugar plans [10]. — Among items contained in the USSR State Plan for economic development and the budget for 1981 (the first year of the Eleventh Five-Year plan) is a sugar beet purchase for the 1981/82 campaign of 91.16 million tonnes, 6 million tonnes more than the maximum in the Tenth Five-Year Plan. The target for total beet sugar production in 1981 is set at 9,050,000 tonnes, including 8,823,000 tonnes from the 1981/82 campaign. Planned refined sugar production in 1981 will be 2,703,000 tonnes, of which 770,000 tonnes will be packeted. The Plan also provides for a 6% increase in corn syrup production and a 9% rise in crystal dextrose output. A new dextrose plant of 31,000 tonnes/year capacity is to come on stream.

China sugar production, 1980 [11]. — Sugar production in calendar year 1980 reached 2.8 million tonnes, white value, against 2.5 million tonnes in 1979 and 2.3 million tonnes in 1978. The 1980 increase is reported to be mainly a result of a substantially higher beet sugar output.

1 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, 97.
2 *British Business*, 1981, **4**, 473.
3 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, 61.
4 See *I.S.J.*, 1981, **83**, 63.
5 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, 43.
6 *Mauritius Sugar Rpt., Bull.*, 1980, (12).
7 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, 84.
8 *Zuckerind.*, 1981, **106**, 99.
9 F.O. Licht *International Sugar Rpt.*, 1981, **113**, 100.
10 *Sakhar. Prom.*, 1981, (1), 2 - 6.
11 F.O. Licht, *International Suger Rpt.*, 1981, **113**, 41.

UK sugar imports, 1980[1]

	1980	1979
	tonnes, tel quel	
Barbados	21,348	27,519
Belgium/Luxembourg	637	1,170
Belize	35,666	35,027
Brazil	0	19,953
Congo	5,129	5,200
Cuba	11,890	0
Denmark	82,461	71,110
Fiji	137,298	172,351
France	36,470	13,308
Germany, West	1,056	831
Guadeloupe	11,078	0
Guyana	142,085	149,693
Holland	20,452	45,395
India	24,462	25,400
Ireland	28,128	40,604
Jamaica	88,305	85,078
Leeward Islands	13,548	15,225
Malawi	16,143	16,507
Mauritius	549,971	398,032
Poland	2,500	25,500
Réunion	0	30,518
Swaziland	110,334	137,844
Tanzania	10,124	0
Trinidad & Tobago	37,897	71,053
Other countries	638	1,438
	1,387,618	1,388,756

Indian sugar industry expansion[2]. – The current annual production capacity of the Indian sugar industry is about 6 million tonnes, tel quel, against the licensed capacity of 7.42 million tonnes. The gap is being filled by commissioning of 33 new factories in the next three years which will add 0.52 million tonnes capacity, and expansion work in 89 of the existing 307 factories which will add a further 0.92 million tonnes capacity. No major changes in milling and processing facilities are planned except for installation of some modern equipment such as bagasse dryers, waste heat recovery units and pre-heaters for improving thermal efficiency.

Cane sugar industry energy rationalization seminar[3]. — An international seminar was held in Havana, Cuba, during September 8-13, 1980, under the sponsorship of UNIDO, GEPLACEA and the Latin American Energy Organization, on the rationalization of energy in the cane sugar industry. Among the countries participating were Belize, Brazil, Colombia, the Dominican Republic, Honduras, Jamaica, Mexico, Nicaragua and Panama, as well as the host country, Cuba. Papers were presented by specialists from Brazil, Cuba, Ecuador, Hungary, the UK, USA (Hawaii) and West Germany.

Paris sugar market trading rise[4] — White sugar futures turnover on the Paris Commodities Bourse in 1980 rose 243% to 15.8 million tonnes from the 4.5 million tonnes of 1979. The number of contracts rose from 90,901 to 315,334. The sugar market dominated the Bourse, which also provides a futures market for coffee and cocoa, and contributed 48,000 million francs of the total turnover of over 50,000 million.

Fuel alcohol study in Australia[5]. — CSR Ltd. is carrying out a feasibility study into a $A 150,000,000 project to produce ethanol from sugar cane grown in the Ord River region of Western Australia. The study will be completed early this year and, if the scheme goes ahead, the ethanol would be used as a fuel extender in the Perth petrol market. Annual production of 120 million litres of ethanol is envisaged, although it would not be economically viable at present prices; government subsidies and a relaxation of excise duty will be required for the scheme to go into commercial operation.

Kenya alcohol plant. — The alcohol plant in Africa referred to earlier[6] is to be built at Kisumu, near Lake Victoria in Kenya. It will be owned by Kenya Chemical Food Corporation Ltd. and will utilize molasses from a number of Kenya sugar factories. The plant is a joint project by ABA International Inc. of Hawaii and Process Engineering Company of Switzerland.

Brazil sugar exports, 1980[7]

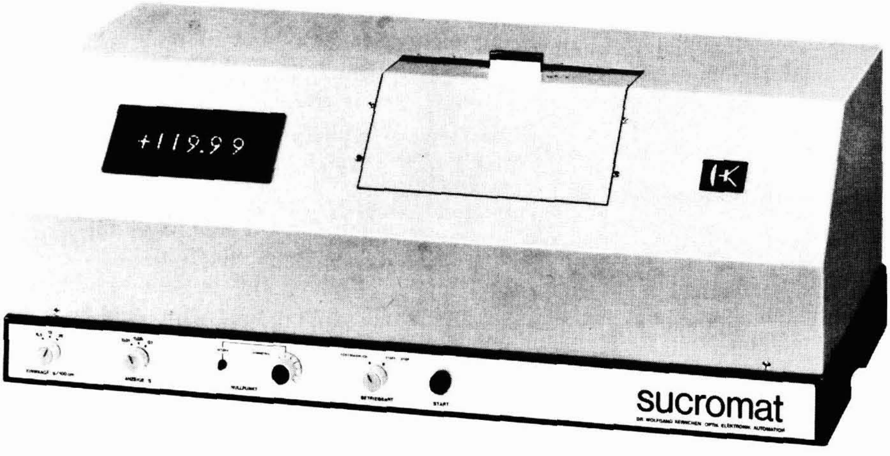
	1980	1979	1978
	tonnes, raw value		
Algeria	129,695	0	14,880
Angola	0	13,235	0
Canada	0	0	5,250
Chile	48,376	22,068	40,219
China	0	41,788	142,185
Ecuador	0	0	15,157
Egypt	146,521	84,949	146,268
Finland	0	0	27,250
France	0	34,500	90,575
Ghana	0	10,826	10,827
Haiti	5,311	0	0
India	194,432	0	0
Indonesia	0	23,601	88,586
Iran	104,364	132,576	170,104
Iraq	181,484	121,809	127,092
Japan	0	0	21,400
Jordan	19,153	0	19,920
Korea, South	0	0	15,320
Malaysia	10,160	0	11,192
Mexico	67,212	0	0
Morocco	116,000	21,909	0
Nigeria	27,639	35,726	45,240
Pakistan	72,839	13,641	0
Portugal	49,050	36,000	97,020
Senegal	0	41,475	24,375
Somalia	0	0	13,130
Sri Lanka	61,177	0	10,826
Sudan	43,290	35,130	11,344
Syria	13,598	0	9,743
Tanzania	0	0	24,413
Tunisia	24,292	12,500	0
Turkey	24,117	0	0
UK	0	21,652	0
USA	805,942	1,053,237	579,541
USSR	501,790	99,441	83,270
Venezuela	15,471	85,526	79,464
	2,661,913	1,941,589	1,924,591

Colombia bulk terminal expansion[8]. — With the technical assistance of a US consultant, Cia. Colombiana de Mieles y Terminal de Azúcar S.A. is to improve its facilities at the port of Buenaventura by increasing storage capacity from 18,000 to 42,000 tonnes and improving weighing and bulk loading facilities, at a cost of US $4,000,000.

Congo (Brazzaville) sugar scheme[9]. — Finance is being sought for a $39 million scheme to restore the Sucreries du Congo sugar mill as part of the 1982/86 Development Plan. The purpose is to generate export earnings and to supply the domestic market. In 1967/68 the Congo produced 98,730 tonnes of sugar, raw value, but this had declined to 4,400 tonnes by 1978/9. It rose to 12,000 tonnes in 1980/81 and is expected to reach 18,500 tonnes in 1981/2. The new project aims to increase production to 44,000 tonnes and eventually to 75,000 tonnes.

Brotherhood steam turbine for Australia. — Walkers Ltd., of Maryborough, Australia, ordered a 1400 b.h.p. steam turbine from Peter Brotherhood Ltd. to be used as a mill drive at the Haughton Sugar Co. plant and delivery was scheduled for March 1981.

1 C. Czarnikow Ltd., *Sugar Review*, 1981, (1531). 24.
2 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, 39 .
3 *Cuba Economic News*, 1980, **16**, (iii), 13-14.
4 *Financial Times*, January 9, 1981.
5 *Westway Newsletter*, 1981, (87), 11.
6 *I.S.J.*, 1981, **83**, 32.
7 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, S88.
8 *Westway Newsletter*, 1981, (87), 11.
9 *World Sugar J.*, 1981, **3**, (8), 19.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Steam Temperature	150/510°C (300-950°F)	
Steam Flow	2.5/115 x 10^3 kgs/hr (5-250 x 10^3 lbs/hr)	
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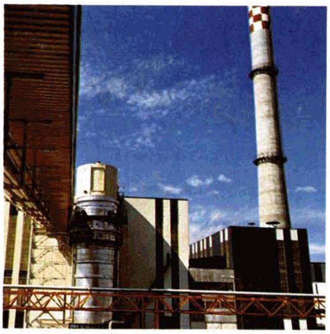

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