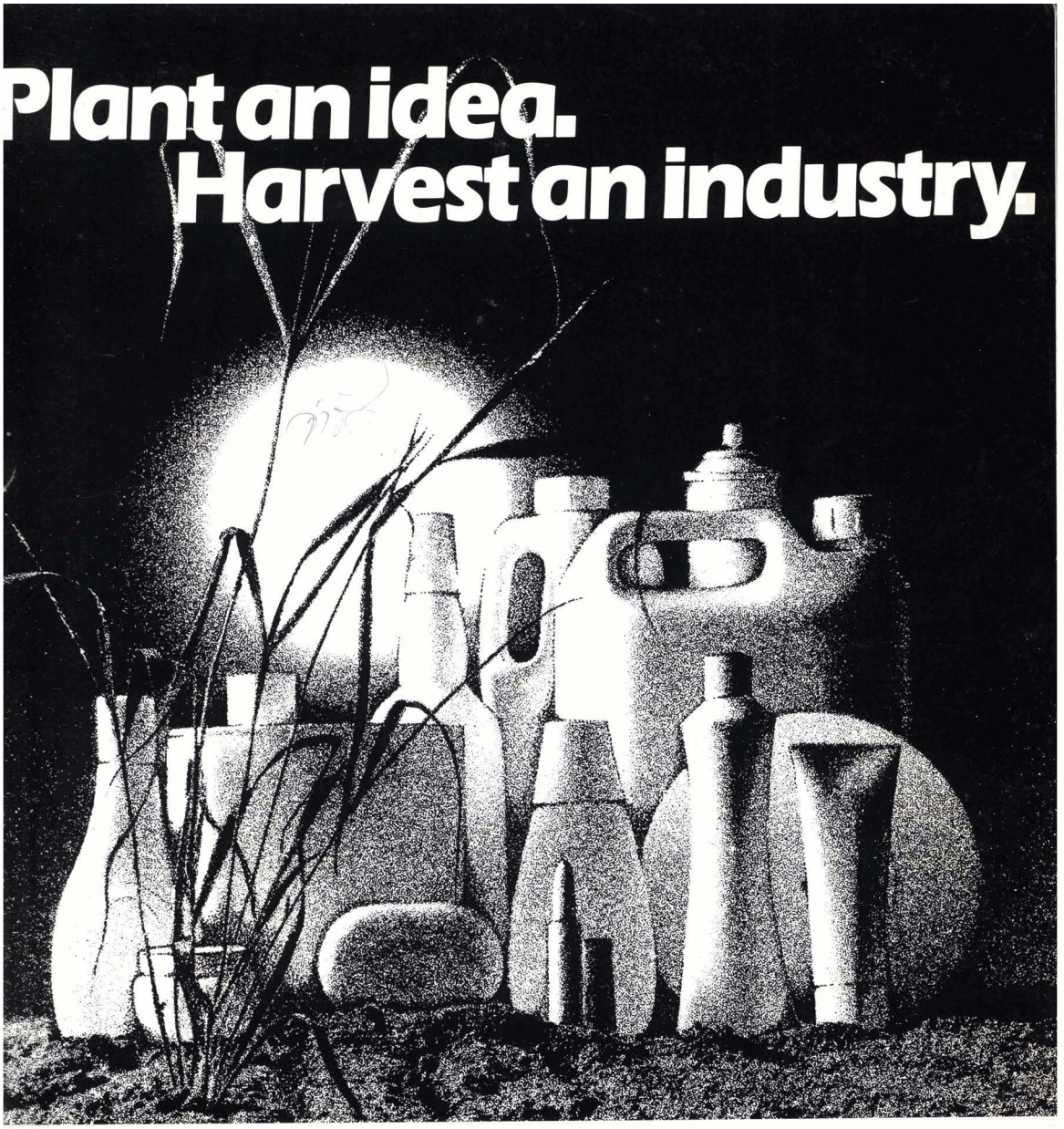
INTERNATIONAL SUGAR JOURNAL

VOLUME LXXXIII
ISSUE No. 973

JANUARY 1980

Printed by the Wrightsons Group of Companies, London; and published by the Proprietors, The International Sugar Journal Ltd., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.
PRINTED IN GREAT BRITAIN.



The usual effect of a crisis is to accelerate man's inventiveness. Today's major problems are high cost energy and low commodity prices. Tate and Lyle is the world's largest and most experienced independent sugar corporation and its research and development programmes concentrated on helping to solve these problems.

Power alcohol derived from sugar is one example of maximising the conversion of the sun's energy into liquid fuel at the same time as providing an alternative use for sugar cane. New chemicals made from sugar could soon replace many more oil-based products such as detergents, plastics and cosmetics.

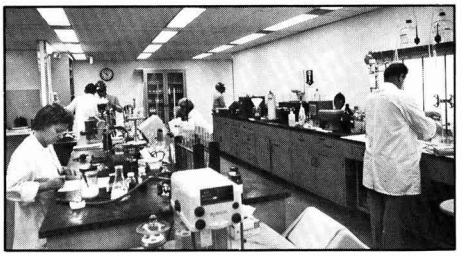
Tate and Lyle's scientists are working to make agricultural industry more efficient all over the world. Our aim is to add value to agricultural production and to make sure nothing is wasted – we even convert certain effluents into protein for animal foodstuffs.

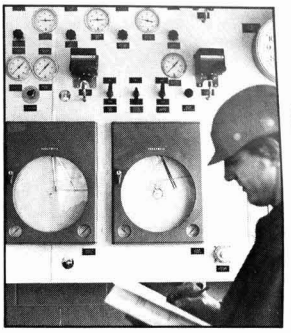
But adding value can also mean better yields, and that means better agriculture. Tate and Lyle provides expertise, not only in sugar, but in all fields of agriculture and is involved in management and training schemes in many countries. If you need help with your agro-industrial development programme, come and talk to us.

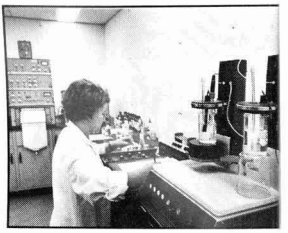
Adding value to agriculture

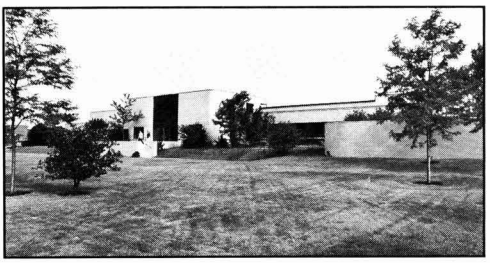
TATE + LYLE

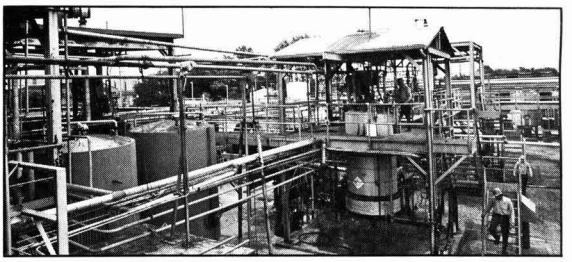
Tate and Lyle Agribusiness Ltd., Cosmos House, Bromley Common, Bromley, BR2 9NA, England. Tel: 01-464 6556.





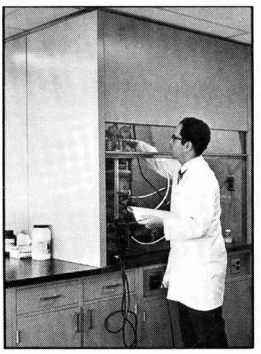






Hodag for Sugar Processing

Boost Sugar Production... Increase Efficiency... Reduce Operating Difficulties



With over 25 years of pioneering experience in the formulation and production of chemicals for the sugar industry, we can offer you proven, top-quality products, prompt service, and the technical know-how to meet your most demanding specifications.

Our modern technical facilities are equipped and staffed to produce the right product for your particular need. And, Hodag representatives are located in sugar producing countries around the world to provide any field support you may require.

Hodag Sugar Products can increase your sugar yield and solve your processing problems. Let us show you how.

Hodag products for the sugar industry include:

CB-6 Aids sugar crystallization and processing, improves quality, increases exhaustion of final molasses, and overcomes problems due to sticky, hard to handle massecuites.

VAP-99 Increases evaporator efficiency, saves energy, inhibits scale formation.

HCA-21 Inhibits scale in alcohol stills, evaporators, and heat exchangers.

FLOCS 411, 422, 433 Coagulants and flocculants for clarification of sugar juice.

RAPISOL Increases the penetration and cleaning efficiency of caustic soda.

PH-2 DESCALER Granulated acid cleaner for evaporators, pans, and heat exchangers.

FLO-1 Improves molasses fluidity for handling, storing, and clarification for fermentation.

SANITROL Reduces inversion losses, odors, and aids in overall mill sanitation.

ANTIFOAM BX-SERIES For beet sugar processing. Formulations for use with water or mineral oil.

Send the inquiry coupon below for samples, literature or to have one of our Technical Sales Representatives contact you.

Please send literature on the following Hodag products:

☐ Please send samples of the products indicated.
☐ Please have Hodag representative contact me.

Name _____ Title _____

Company _____

Address _____

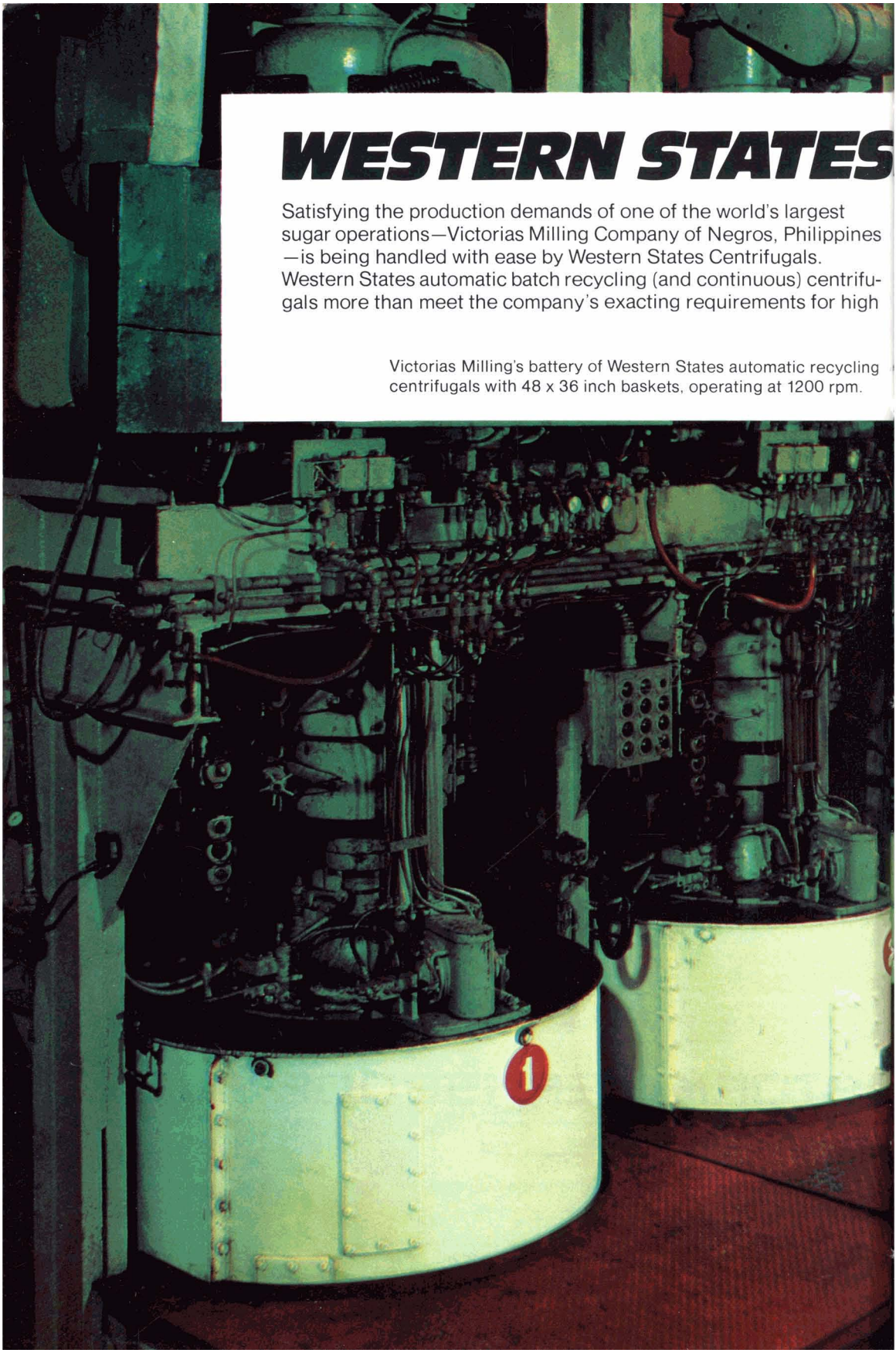
City _____ State _____ Zip _____

Country _____

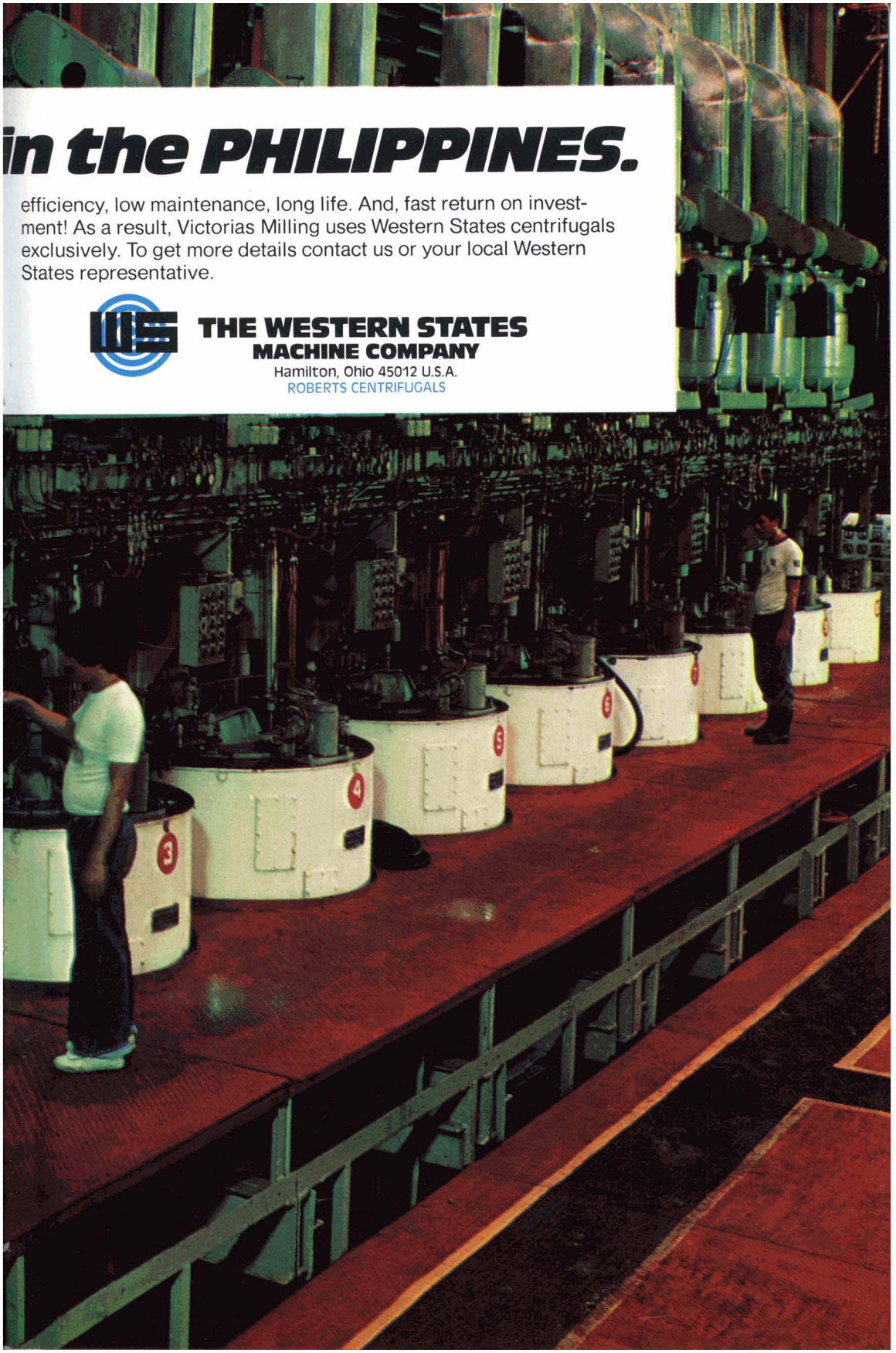
HODAG CHEMICAL CORPORATION
HODAG INTERNATIONAL S.A.
7247 North Central Park Ave., Skokie, Illinois 60076 U.S.A.
Telex: 72-4417 Telephone: 312-675-3950

WESTERN STATES

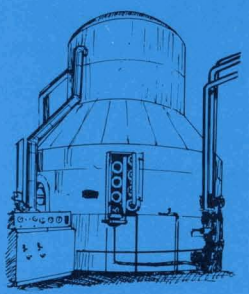
Satisfying the production demands of one of the world's largest sugar operations—Victorias Milling Company of Negros, Philippines—is being handled with ease by Western States Centrifugals. Western States automatic batch recycling (and continuous) centrifugals more than meet the company's exacting requirements for high



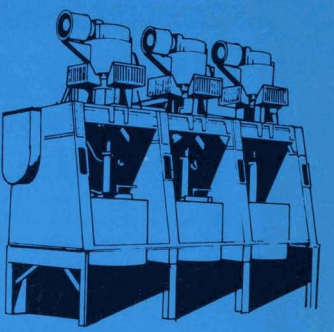
Victorias Milling's battery of Western States automatic recycling centrifugals with 48 x 36 inch baskets, operating at 1200 rpm.

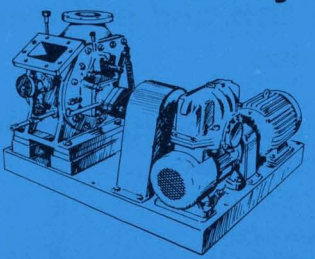

in the PHILIPPINES.
efficiency, low maintenance, long life. And, fast return on investment! As a result, Victorias Milling uses Western States centrifugals exclusively. To get more details contact us or your local Western States representative.
THE WESTERN STATES
MACHINE COMPANY
Hamilton, Ohio 45012 U.S.A.
ROBERTS CENTRIFUGALS

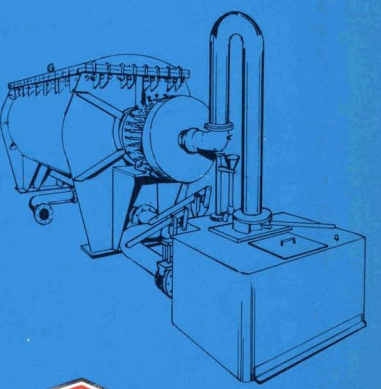
SMITH MIRRLEES

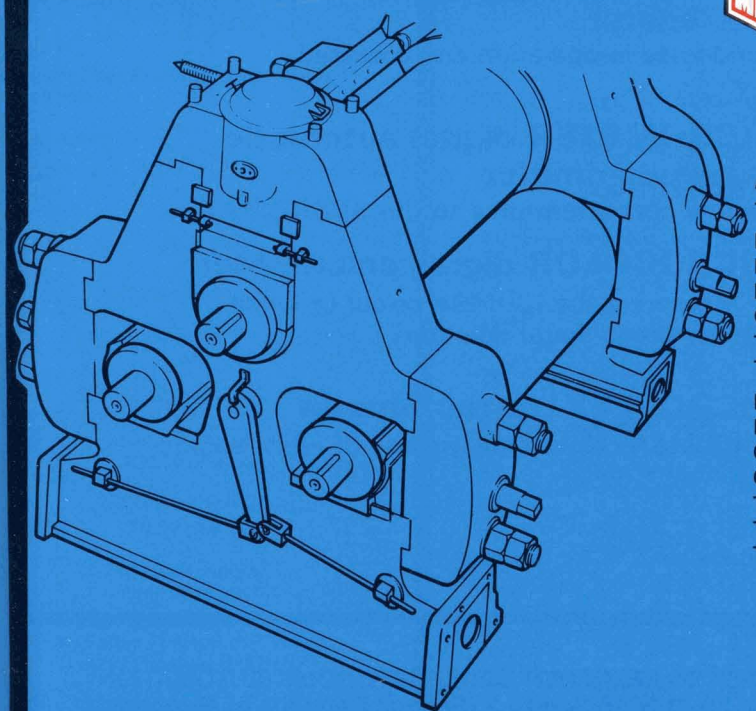


Offer you Over 140 Years' Experience in the Manufacture of Sugar Machinery









A. & W. SMITH & CO.
THE MIRRLEES WATSON CO.
No. 1 COSMOS HOUSE
BROMLEY COMMON
BROMLEY 3R2 9NA
GREAT BRITAIN
Telegrams Tecserve Bromley
Telephone 01-464 6556

Factory:
EGLINTON WORKS
COOK STREET
GLASGOW G5 8JW
Telegrams Engine Glasgow
Telephone 041-429 5441
Telex 77-137

PROGRESS THROUGH EXPERIENCE

A Division of Tate & Lyle Agribusiness Ltd.
A Member of the Tate & Lyle Group.

Editor and Manager:
D. LEIGHTON, B.Sc., F.R.I.C.

Assistant Editor:
M. G. COPE, M.I.L.

Advertising Sales Manager:
JOHN V. DANCE

UK ISSN 0020-8841

Annual Subscription:
$50.00 post free

Single Copies:
$5.00 post free

Airmail charges quoted on request to
The International Sugar Journal Ltd.,
23A Easton Street, High Wycombe,
Bucks., England HP11 1NX

INTERNATIONAL SUGAR JOURNAL

Volume 82
Issue No. 973

CONTENTS January 1980

Published by
The International Sugar Journal Ltd.
23A Easton Street,
High Wycombe, Bucks.,
England HP11 1NX.
Telephone: 0494-29408 *Cable:* Sugaphilos, High Wycombe
Telex: 21792 REF 869

Inquiries regarding advertising should be addressed to the above office or to the appropriate representative:

Australia: J. J. Hindmarsh,
24–26 Kent Street, Sydney 2000.
Tel.: 241-2471. *Cable:* Hindmarshad.

France: MaG-Watt International,
6 rue des Acacias, Vert-le-Grand, 91810 Essonne.
Tel.: 492-00-15.

Holland: G. Arnold Teesing B.V.,
Prof. Tulpstraat 17, 1018 GZ Amsterdam.
Tel.: 020-263615. *Telex:* 13133.

India and South-East Asia:
J.P. Mukherji & Associates Pvt. Ltd.,
P.O. Box 915, Poona, India 411 005.
Tel.: 52696/7 *Cable:* Preproject, Poona.
Telex: 0145-367 JRMASSO.

Japan: Douglas Kenrick (Far East) Ltd.,
Kowa Daisan Building, 11-45 1-chome Akasaka, Minato-ku, Tokyo.
Tel.: (582) 0951-5. *Cable:* Kenrick Tokyo.

U.S.A.—Florida and Latin America:
Mr. Mario A. Mascaró,
7321 S.W. 82nd Street, Miami, FL, U.S.A. 33143.
Tel.: (305) 667-1724.

U.S.A.—New England and mid-Atlantic states:
Mitchell Napier & Associates Inc.,
Suite 812, 342 Madison Ave., New York, NY 10017.
Tel.: (212) 986-0625.

U.S.A.—Southern states, except Florida:
Herbert Martin Company,
2325 Old Rocky Ridge Road, Birmingham, AL 35216.
Tel.: (205) 822-7371.

U.S.A.—Western States, incl. Hawaii:
Roy McDonald Associates Inc.,
Suite 265, Baybridge Office Plaza, 5801 Christie Avenue, Emeryville, CA 94608.
Tel.: (415) 653-2122.

NOTES AND COMMENTS

International Sugar Agreement

The Council of the International Sugar Organization met on November 19-20 following meetings of committees of the Organization during the previous week. The Council extended from December 1, 1979 to April 1, 1980 the date for implementation of the Stock Financing Fund and contributions to the Fund levied on sugar exports and imports under article 51 of the Agreement. In view of this postponement, there was no need to deal at this time with the question of the rate of contribution. There is no change in the time limit for ratification of the Agreement, which remains December 31, 1979.

The Council adopted an estimate by the Statistics Committee of net import requirements for the world free market for 1980 of 17,789,000 tonnes and, on the basis of this estimate, a 1980 global quota of 12,909,000 tonnes. This compares with the total quotas in effect for 1980 of 13,062,000 tonnes. The Council agreed that, in view of the renegotiation of basic export tonnages in the first quarter of 1980, Annex I exporting Members should not commit before April 1 more than 80% of their quotas in effect.

The Council agreed that the Executive Committee should resume consideration of the question of adjustment of the price referred to in the Agreement before the end of the first session of the Council in 1980. This review will relate to prices for 1980.

The Council noted that a GATT panel report concerning the sugar export subsidies policies of the European Economic Community had recently been adopted by the GATT Council and expressed deep concern that the Community's policies contribute to depress world sugar prices and disrupt world sugar markets. In view of the current review of the Community's Common Agricultural Policy for sugar, the Council resolved to request the Community, in its review of its sugar policies, to take due consideration of the effects of its policy on the world market and on the economies of sugar producing countries and to take account of the wish of the Council to work constructively towards terms of EEC accession to the International Sugar Agreement.

The Council established conditions for the accession to the Agreement of Ivory Coast, which has applied to accede as an Annex II exporting Member. Ivory Coast, which would be the 58th Member of the Organization, may now accede by depositing an instrument of accession with the Secretary-General of the United Nations. It also noted that Colombia and Poland have indicated interest in agreeing on conditions for their accession to the Agreement as exporting Members.

The Council agreed that the renegotiation of quotas provided for in article 34 will take place during March 13-31, 1980 and its first regular session of 1980 and related meetings will take place during the period May 19-June 6. It elected Mrs. Mette Colbjørnsen of Norway, Chairman for 1980, and Ambassador Alfredo Ricart of the Dominican Republic, Vice-Chairman. The member countries of the Executive Committee for 1980 will be Australia, Brazil, Cuba, the Dominican Republic, Fiji, India, Peru, Philippines, South Africa and Thailand on the exporter side, and Canada, Egypt, Finland, Iraq, Japan, the Republic of Korea, Norway, Sweden, the USSR and the United States for the importers.

The ISO Executive Committee at its meetings on November 16 and 19 agreed that the redistribution of export shortfalls of 126,671 tonnes should go forward pursuant to article 43. It acceded to a request by Nicaragua for relief from its obligation to hold special stocks in 1979 and to reschedule its stockholding obligations and deferred action until next year on pending export shortfall actions relating to Jamaica and Trinidad and Tobago.

EEC Commission proposals for the new sugar regime

Towards the end of November details were circulated[1] of the proposals of the EEC Commission for the new sugar regime to operate from July 1980 to June 1985. The proposals have to be considered by the Council of Agricultural Ministers at their meeting in the New Year. It is recommended that the current system of guaranteed quotas be continued but that the *A*- and *B*-quotas be reduced. The current and proposed *A*-quotas and proposed *B*-quotas are as follows (for 1979/80, the *B*-quota is set at 27.5% of the *A*-quota).

	tonnes, white value		
	Current	*1980/85*	
	A-quota	*A-quota*	*B-quota*
Belgium/ Luxembourg	680,000	612,000	112,000
Denmark	328,000	318,000	79,000
France	2,996,000	2,465,000	616,000
Germany, West	1,990,000	1,954,000	489,000
Holland	690,000	639,000	160,000
Ireland	182,000	164,000	10,000
Italy	1,230,000	1,179,000	242,000
UK	1,040,000	936,000	0
	9,136,000	8,686,000	1,708,000

In addition to the above supplies, the Community is committed under the Lomé Agreement to import 1.3 million tonnes, white value, in the form of raw sugar from the A.C.P. countries (this does not include the current 466,000 tonnes or proposed 419,000 tonnes of sugar forming part of the French *A*-quota but produced in the French West Indies, Réunion, etc., which while geographically A.C.P. countries are under French law "overseas departments" and as such part of France itself).

If all the Commission's proposed *B*-quota were filled this would provide a total supply of about 11.7 million tonnes whereas consumption requirements are estimated at about 9.5 million tonnes, leaving more than 2 million tonnes to be exported. Of course, it is not certain that all the *B*-quotas would be filled, especially since the Commission proposes that the levy imposed on *B*-quota sugar producers to contribute to the cost of its disposal should be raised from 30 to 40% of the intervention price. The Commission also proposes that, instead of the current *A*-quota and *B*-quota for high fructose corn syrup of 139,000 and 38,000 tonnes dry matter equivalent, a single quota of 168,976 tonnes should be established.

It is to be expected that each Farm Minister will endeavour to limit cuts in his own country's quotas, the UK Minister because, in order to raise production from the politically limited level of production before EEC membership, the British Sugar Corporation has just completed a costly expansion programme and after four years is now able to meet its target production of 1.25 million

[1] C.Czarnikow Ltd., *Sugar Review, 1979,* (1468), 235-236.

tonnes, about half of UK consumption. The Corporation and the UK farmers' organization are very much opposed to the UK losing its *B*-quota entitlement, resulting in a cut of almost 30% in *A*-plus *B*-quota whereas corresponding cuts for other members range from 3.71% for West Germany to 9.38% for Italy, with France, the biggest producer of *C*-quota (i.e. unsubsidized surplus) sugar suffering only a 8.38% cut.

In France the proposals to reduce production are seen as anachronistic in view of the way the world seems to be moving into a sugar deficit, and an EEC surplus, it is thought, could be a source of profit instead of the drain on the EEC taxpayer which such surpluses have been in recent years. Reactions from other member countries have been less vociferous but no doubt as strongly felt so that the Farm Ministers' meeting should be an interesting one.

World sugar prices

During November the London Daily Price for raw sugar rose from £154 to £169 in a number of surges with subsequent falls and recoveries. The decision by the International Sugar Council to reallocate quota shortfalls brought a sharp drop from £162 to £151 on November 16 because exporting countries would be keen to find customers to take delivery in the few weeks remaining to the end of the year, but the steady upward trend in prices made up the fall before the end of the month.

White sugar prices were less volatile so that the premium over raw sugar prices fluctuated considerably, starting the month at £18 per tonne and rising at one point to £30.50 before falling to £11 by the end of the month. The LDP(W) moved in a range from £172 at the beginning of November to reach a peak of £189.50 on November 13 after which it fell back to £176 on November 21 and fluctuated between this level and £182.50 during the remainder of the month, ending at £180.

World sugar production 1979/80

F.O.Licht GmbH produced their first estimate of world sugar production for the crop year September 1979/August 1980 in October[1] and these are reproduced elsewhere in this issue. It came as something of a surprise to the sugar market that Licht should anticipate a production as much as three million tonnes less than that of the previous year, although something of a fall was widely expected. Subsequently estimates have been released by C.Czarnikow Ltd., *World Sugar Journal* and the US Department of Agriculture, all indicating a fall in outturn but not quite as drastic as that forecast by Licht.

The level of sugar production in Europe is set as in Licht's previous estimate for the continent[2] but with continuing good weather Licht anticipates that the final figures could be higher, especially for France. Beet sugar production outside Europe is expected to fall by more than 6%, mainly owing to lower output in the USA, but also because of bad weather in Morocco. In the Western Hemisphere, the Cuban crop is set slightly lower; Cuba has reported crop losses due to rust but the disease has occurred in past years without serious damage. Mexico is also expected to produce a smaller crop and the Dominican Republic is expected to produce less than its target because of hurricane damage.

Brazil's production is expected to decline from 12.5 to 11.9 million tonnes partly by reason of export restrictions and partly by diversion of cane to alcohol manufacture. Production in Peru and Venezuela is expected to begin recovery from levels which had fallen in recent years. The rise in sugar output in Africa is expected to continue, the increase being particularly marked in the case of the Ivory Coast.

In Asia, the main reason for the fall in production is the considerable reduction – from 6.4 to 5.5 million tonnes – for India, resulting from drought and diversion of cane to gur and khandsari manufacture. Drought is also expected to bring a lower outturn in Thailand where the area planted was also lower. Slight increases are expected in the Philippines and Australia, while the considerable investments in the Fiji sugar industry are reflected in the anticipated rise from 359,000 to 474,000 tonnes output.

The total of world production is thus set at 88,004,000 tonnes against 91,026,000 tonnes, raw value, in 1978/79 which would considerably reduce the surplus sugar stocks in the current season in the face of steadily increasing consumption.

US membership of the ISA

Following the defeat of a Sugar Bill in the House of Representatives in October there has been further action to enable ratification of US membership of the International Sugar Agreement. The Senate Foreign Relations Committee voted unanimously to proceed with such measures and the full Senate voted in favour of ratification on November 30. The vote came after the US Department of Agriculture had made a commitment to support a minimum sugar price of 15.8 cents a lb. Both Houses of Congress have to pass legislation to implement the treaty and ensure that the US plays its full part as a member of the Agreement. It is understood that the Administration is confident that this would be achieved in time for the instruments of ratification to be deposited with the ISO before the time limit of December 31. It is interesting that the commitment to a 15.8 cents price support level, which brought about the co-operation of Senator Church and his committee, is already historical, raw sugar prices in the US already having surpassed 16 cents, c.i.f.

US sugar import fee

Following the higher prices for raw sugar on the world market, the US import fee was reduced by a further 1.00 cents to 0.76 cents/lb with effect from October 18, and then eliminated completely with effect from October 22. The refined sugar import fee was similarly reduced to 1.28 cents per pound and then to 0.52 cents from October 22.

Caribbean sugar output decline[3]

The Annual Conference of the Caribbean Sugar Association opened in Georgetown amid dire predictions as to the future of the sugar industry in the region. World prices below production costs, competition from artificial sweeteners, a brain drain and escalating costs of petroleum and other inputs, as well as attitudes to work and political agitation by opposition groups were listed as some of the factors responsible for the situation.

Statistics contained in a Conference brochure circulated at the start of the meeting pointed to a falling regional sugar output trend. The total cane area for the Caribbean Community, Caricom, rose to 462,552 acres in 1978 from 443,726 acres in 1974 while, for the same period, output dropped from 1,029,576 to 903,730 short tons of sugar.

Speakers underlined the need for improved technology, greater efficiency and higher output.

[1] *International Sugar Rpt.*, 1979, **111**, 573-577.
[2] *I.S.J.*, 1979, **81**, 321.
[3] *Reuters Sugar Rpt.*, September 25, 1979.

Current trends in chopper harvesting machinery

The development and release of the Massey-Ferguson Model 201 Cane Commander for the 1969 Australian harvest started a trend for mechanized harvesting standards now applied world-wide. There were many other types of harvester that preceded the MF 201, but it was the first self-propelled, over-the-row chopper-type machine to deliver a very high quality cane billet under almost all crop conditions with both capacity and economy.

The most popular commercially-built machines being marketed today are still the self-propelled, over-the-row chopper-type cane harvesters which, in common with other cane machinery, have not changed in principle but which have become more efficient in producing billet cane through design changes to various components in the machine.

Fig. 1.

The developments which may be considered significant are:

(1) increased machine output or capacity,
(2) improved billet quality and cleaning,
(3) ability to cut in all crop conditions, including wet, stony and rough conditions,
(4) greater reliability and serviceability, and
(5) enhanced operator comfort.

Increased capacity has been achieved in many ways, including the use of improved front gathering walls and crop dividers, more aggressive feed roller systems, more available engine power, combined with larger and greatly improved elevators to convey this higher machine output into the field transport. Manoeuvrability plays a major part in achieving high capacity, the machine needing to be able to operate quickly in relatively small plots and where headland space is minimal. This has made it necessary to design compactness into the current machines which are now very noticeably shorter than those of only a few years ago, as witness the photograph of the latest Model MF305 (Fig.1) compared with the Model 201 (Fig. 2) of ten years ago.

Naturally this trend to development of compact machines with greater capacity has given the design engineer many problems to overcome in maintaining access and serviceability in the unit.

The quality of the billet has been the subject of much investigation by various research organizations because of the requirements for higher quality sugar for the refineries. The first step towards achieving the highest quality is for the harvester to have the ability to provide clean-cut billets of uniform length, free of dirt, trash and dead cane, etc. The quality of the sample is related to the capacity of the machine and, as with most machines, increasing the capacity has a tendency to lower the quality of the cane billet for a given machine arrangement.

Increases in the capacity of current harvesting machines have therefore led to a number of developments to improve the cleaning ability of the units. The most significant area of development in improved cleaning has been in the air separation of trash in cleaning chambers. These chambers may be defined as the area through which the chopped billets pass in suspension and where a high-velocity air stream passes through the flow of billets approximately at right angles to the direction of billet travel.

Fig. 2.

To provide this high-velocity air over a large area, the simplest and most compact method is the use of the axial-flow fan, mounted above the billet trajectory, as may be seen in Fig.3. The diagram (Fig. 4) shows in more detail how, in the MF 305 harvester, the axial-flow fan draws in air through the inlets, A, B and C and pumps this and the extraneous matter out via a spiral discharge chute. The direction of the discharge chute is controlled by the operator so that all the separated trash may be directed away from the transport units receiving the cane billets.

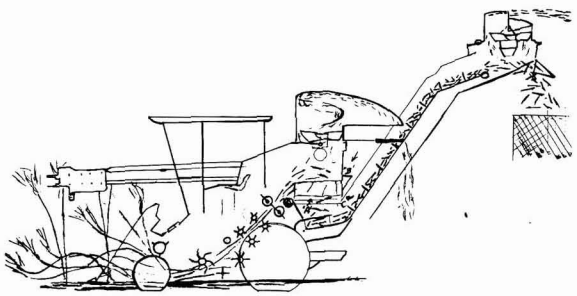


Fig. 3

The improvements in the cleaning capability of this machine, along with its feeding ability, have made it quite a good performer in the harvesting of green cane and it is being used for this purpose in a number of areas throughout the world. A particular application is in the cutting of seed cane for use with the billet-type planters that are appearing in the cane fields. It is worth noting that the aggressive feeding ability and conveyance of the cane through the machine is still comparatively gentle so that the seed billets suffer very little damage.

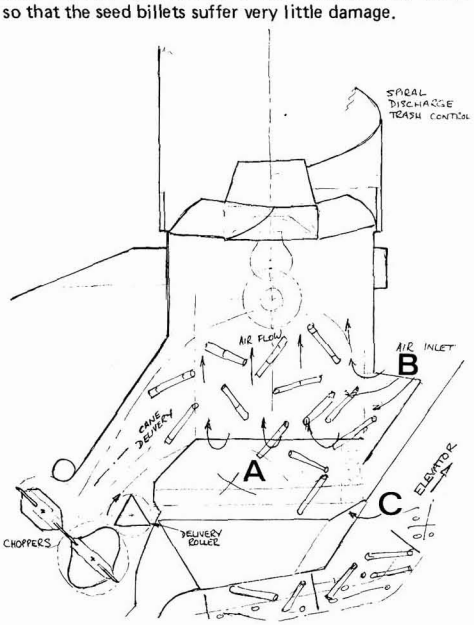


Fig. 4

Ability to cut in all crop conditions has generally been achieved by the use of design variations or optional attachments, available in kit form, which may be quickly fitted to the standard machine. For instance, for stony areas, the base cutter and first bottom feed roller may be modified to give the machine a very good operating capability. This modification is not provided as a kit to be taken on and off, but can be supplied as a design variant from the factory to be specified if the machine is to be used in stony areas. The operating ground speed of the machine is slightly lower in this form, as might be expected under such conditions, but, because it is only a slight reduction, it has no real effect on the output in stone-free or normal conditions.

Wet or poor-flotation ground conditions have been overcome by the availability of a half-track arrangement to replace the rear wheels of the machine; this has been highly successful and gives the unit very good flotation in the worst conditions. The design of this half-track arrangement allows for a change from wheels to rubber tracks and *vice-versa* in a matter of two hours, giving the unit great versatility while avoiding the very high costs associated with continual track usage as with a full-track design.

Reliability of the machine is a complex matter which is affected by many variables as well as the initial design, while good service and spare parts back-up, plus training of mechanics, operators, distributors and associated people all contribute to reliability. The trend in design is towards the use of more hydraulic drives, but this can be an unreliable and expensive feature if there are shortcomings in any of the variables mentioned above. For this reason MF design incorporates both hydraulic and mechanical drives in their machines in order to provide the most reliable and serviceable system possible.

Operator comfort is a factor which plays a big part in ensuring the success of harvester operation. Design in the positioning of the various control levers and, more recently, the adoption of air-conditioned cabins gives the operator the comfort he needs to remain alert for the required number of hours in his working day. Other factors such as noise level and clear vision have also been taken into consideration, resulting in a tremendous improvement to what was a rather arduous operation only a few years ago.

For the future trends in harvester design are toward further improvements in capacity, reliability and cleaning ability, the last being the area which will receive top priority in order to produce better quality billets without major increases in the capital or operating costs.

Summary

Progress in the design of chopper harvesters during the past ten years is reviewed and future trends noted.

Tendances actuelles en moissoneuses tronçonneuses

On décrit le progrès en dessein des moissoneuses de canne pendant les derniers dix années et remarque les tendances pour l'avenir.

Gegenwartstendenzen bei Häcksel-Vollerntern

In den letzten zehn Jahren ausgeführte Verbesserungen in der Konstruktion von Häcksel-Vollerntern werden diskutiert, zusammen mit einer Bemerkung betreffs Zukunftstendenzen.

Tendencias actuales en cosechadoras-picadoras

Se describen los mejoramientos en el diseño de cosechadoras-picadoras en las últimas diez años y se presenta una nota sobre tendencias para el futuro.

Mechanical harvesting of green cane

By K. RHADES and M. BAEDEKER
(Claas OHG, Harsewinkel, West Germany)

Development of today's modern sugar cane harvesters has made it possible to mechanize completely this rather demanding, unpleasant manual work. The following are the principal systems currently in use:

(1) *Cutting, cleaning and loading of cane by hand.* This method has the advantage that the cane delivered to the factory is absolutely clean. It requires a great deal of organization, however; disruption in production, due to labour shortages or strikes for higher wages, occurs usually when the cane is badly needed in the sugar factory, and the Unions are holding the stronger position. This has always to be considered, particularly when manual harvesting is employed.

(2) *Machine cutting, cleaning and stockpiling by hand, loading by grab.* With this method a smaller force will be required but it has the disadvantage that impurities are increased. Quite often, foreign matter such as stones, wood and scrap from implements are covered up by the cane piles and are loaded automatically by the grab loader. The presence of such material in the cane can result in considerable damage in the factory. Furthermore, additional labour has to be made available to "scrap", i.e. to collect the cane left behind by the loader.

(3) *Cutting and windrowing of sugar cane by a whole-stick harvester and loading by grab.* The whole-stick harvester only cuts standing cane satisfactorily. Lodged and tangled cane results in higher losses and also makes it necessary to collect the residual stalks by hand. The disadvantages of using grab loaders are the same as mentioned above.

Mostly, cane fields are burned before these three systems are put into operation. Approximately 30% of hand-cut cane is harvested green. The sugar content drops during the burning process, and the heat destroys the micro-organic structure on the surface and slows down ratooning. In addition to these disadvantages, humus and nutritious matter are destroyed and erosion of the soil is encouraged.

The disadvantages of the three harvesting systems and those resulting from the burning of cane are avoided by adoption of a fully-mechanized system of harvesting green cane. Mounting production costs for sugar extraction, and the lack of available manpower for manual harvesting are also factors encouraging the use of such a harvesting system.

The main requirement for a green cane harvester is a wide throat and a chopping system located immediately over the twin base cutters which obviate the need for any roller or special elevator system. With this arrangement, the cane is chopped as soon as the base cutters have severed the stalk and the billets produced are carried upwards on a primary elevator to be dropped onto a secondary elevator so that the trash may be separated by means of a blast of air directed through the falling cane.

Fig. 1. The intake system of the Claas CC 140Q green cane harvester is provided with rotating scrolls and shoes which can be moved to vary the throat between 1400 and 1950 mm, two rotating disc base cutters, a vertically rotating double knife (left) to cut off overhanging stalks, and the topper

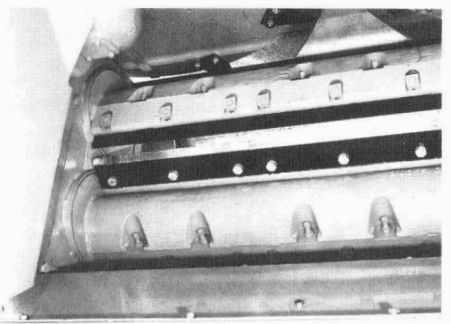


Fig. 2. Cane is chopped into 30-cm (12 inch) billets by the two horizontal chopping cylinders

Lodged cane encumbers the feed into the throat of harvesters in general, but a harvester designed with a wide throat for green cane is able to maintain higher cutting rates under lodged crop conditions while semi-lodged green cane may be harvested much more easily.

Green cane harvesting is of interest not only in areas where there is a high incidence of wet weather during harvest but also where the cane will not burn easily owing to other weather or culturally-related conditions, such as in Argentina where fields may be affected by frost during the first three months of the season so that the cane will not burn and must be harvested green.

Another factor to be considered is the better juice quality obtained from cane harvested green. In a number of countries cane burning is prohibited by legislation in order to prevent air pollution and growers have had to seek alternatives in harvesting their cane.

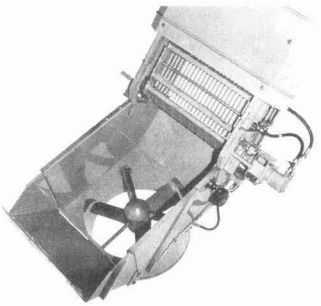


Fig. 3. The fan on the end of the discharge elevator removes the remaining leaves before the cane is loaded into the cart

Naturally, there is a considerable difference between the costs of harvesting green and burnt cane; a harvester will cut, clean and load approximately 25% less tonnage in green cane than in burnt cane, depending on field conditions. On the other hand, a harvester designed for operation in green cane can also be used with good performance in burnt cane, but not the other way round.

Trials have been carried out by various sugar cane research institutes and the main findings of one such study, a comprehensive investigation of billet cane harvester performance, were as follows:

(1) The main factor affecting extraneous matter level was the difference between cane varieties. The percentage of tops and, to a lesser extent, leaves was much higher in areas where varieties with a heavy top are grown.

(2) The total extraneous matter level increases with harvester speed.

(3) Green harvesting does not necessarily increase extraneous matter levels compared with burnt cane although large increases may occur with certain cane varieties in wet weather.

(4) Extraneous matter is often lower with green cane. In particular, Q 90 variety has a tendency to lodge after burning, which makes efficient topping much more difficult. As a result, the level of tops in burnt cane of this variety is in general higher than when it is harvested green. Tests have proved that there can be a slight increase in trash levels when operating in green cane but that the presence of fewer tops compensated for this, for example, 6.5% in green Q 90 cane as against 7.4% in the same variety harvested after burning, and 0.7% and 1.4% corresponding figures for N:Co 310 cane variety. This difference is thought to be due to the increase in sprawl of the cane which results from the burn, with a consequent reduction in the efficiency of the topping process.

(5) There is no significant difference between the amount of loose dirt in burnt and green cane.

The use of harvesters with capability for cutting green cane and poorly-burnt cane is a real advantage over other machines which, under certain conditions would either force cane growers to burn cane 4 or 5 days ahead of harvest or shut down the mill owing to no cane or a low cane supply.

Summary

Systems of mechanical cane harvesting are discussed and their disadvantages noted. Benefits of harvesting green cane are compared with burnt cane harvesting and the results of a comparative study of the two are quoted.

Récolte mécanique de canne verte

Les auteurs discutent des systèmes de récolte mécaniques et indiquent leurs désavantages. Les avantages de récolte de canne verte sont comparées avec la récolte de canne brûlée, et les résultats d'une étude comparative des deux systèmes sont cités.

Die mechanisierte Ernte von grünem Zuckerrohr

Mechanisierte Systeme von Zuckerrohrernte werden diskutiert und ihre Nachteile bemerkt. Die Vorteile, grünes Rohr zu ernten, werden mit der Ernte von abgebranntem Rohr verglichen, und die Ergebnisse einer Vergleichsstudie mit ben beiden werden berichtet.

La cosecha mecánica de caña verde

Se discuten sistemas de la cosecha mecánica de caña de azúcar y se notan sus desventajes. Los beneficios de la cosecha de caña verde se comparan con la cosecha de caña quemada, y se citan las resultas de un estudio comparativo de las dos sistemas.

Fig. 4. The Claas CC1400 harvester operating in green cane

Fig. 5. The same machine operating in burnt cane

The evolution of mechanized sugar cane harvesting in Brazil

By ODECIO ZANCA
(Santal Equipamentos S.A., Ribeirão Preto, SP, Brazil)

The very beginning of sugar cane harvest mechanization in Brazil was in 1956 when a few pioneers imported from the United States the first few machines to load and cut the cane. These machines did not perform as expected, however, owing to the lack of infrastructure and because the personnel in charge of them were not familiar with the handling of such equipment.

From that poor beginning in 1956 and almost no development through the late 1950's, the mechanization idea was reborn and became a reality in 1960, with Brazilian-made equipment, as a consequence of the lack of hand labour, mainly for sugar cane loading, a back-breaking job which nobody wanted to do. It was in the 1960's that mechanical loading was adopted in Brazil. Such a stage of mechanization not only served to create a new mentality amongst mill people but also to produce better-qualified labour and to awaken sugar cane technologists to the new methods and requirements imposed by mechanization.

In 1966, inspired by the fabulous outburst of growth in sugar production in Brazil (which also greatly contributed to aggravation of the lack of available labour), Santal Equipamentos S.A., a pioneer in the field of Brazilian sugar cane mechanization, designed, developed and put on the market the first local whole-stalk cane harvesters which, being mechanically simple, did not demand changes in the loading and transport procedures commonly practised by the sugar companies and private growers.

While these machines contributed decisively to reinforce acceptance of the new methods and procedures required by sugar cane mechanization, they were far from ideal, or the best solution of the Brazilian labour problem, as they were only able to cut standing cane of low density.

Fig. 1. The first whole-stalk cane harvester made in Brazil

In the early 1970's, therefore, Santal introduced the chopper-type cane harvester to Brazil. The first unit started operation at Usina Santa Lydia in Ribeirão Preto in the 1972 season, which saw the beginning of total mechanized harvesting in Brazil, with the introduction of modifications in traditional whole-stalk cane bins, field design and cane reception at the factory.

Fig. 2. The Santal CTE whole-stalk harvester of 1966

Today, seven years later, Brazil can lean on its own technology, which has progressed tremendously in all fields, enabling its use in other support equipment such as infield units, grabs, special bins, hydraulic unloading systems, etc., manufactured by Santal and other Brazilian companies such as Motocana, Hima, Painco, Egiarti, etc.

The 1979 season has also seen the beginning of a new era for mechanized sugar cane harvesting in Brazil; throughout past years and as shown by international experience, manufacturers and users have verified that around 60% of cane harvester stoppages (and operation costs) have been due to breakages or wear of chains, sprockets, bearing shafts and axles. This situation demanded a solution which could only come from a new sugar cane harvester with revolutionary features that would minimize the number and complexity of mechanical parts.

Such a machine has been developed by Santal after three years of research and intensive field testing. This new machine, the Santal-Rotor, is presently considered by unbiased engineers and users to be one of the most technologically advanced machines available for sugar cane growers throughout the world. Amonst the innovations introduced in the Santal-Rotor are the total elimination of chains, a significant reduction in the number of bearings, sprockets and moving shafts (from

Fig. 3. The Santal CMP-8 cane loader

44 in conventional machines to 11) and introduction of the Rotor system itself, which eliminates the three separate devices traditionally used for chopping, cleaning and elevation of the sugar cane, doing these three operations in a single step. The cane is cut by two chopping knives, enters the Rotor chamber and is thrown by the Rotor wings through a directional duct where powerful extractors separate the trash, feeding clean cane into the truck. Production of this machine is around 60 tonnes.hr^{-1} in green cane, owing to its high operational capacity in any type of cane and to the significant reduction in machine stoppages resulting from mechanical problems.

Recently Toft Bos. of Australia made an agreement with Dedini, the large sugar machinery group of Piracicaba, São Paulo, who have started production of the Toft 6000 harvester. It is clear that there are greatly improved facilities to encourage the use of mechanical harvesting in Brazil.

From the marketing point of view, however, the actual situation is different. Despite the tremendous growth of Brazil's sugar and alcohol production, the country's sugar industry has been strongly affected by the low world market sugar prices, coupled with the effects of crises in the coffee, orange and civil construction sectors which have released a large number of manual labourers. These have found employment in the sugar cane plantations, thus causing a temporary slowdown in mechanization, directly affecting the use of sugar cane harvesters.

Methods employed in sugar cane cultivation

Planting. Sugar cane planting in Brazil may be considered a semi-mechanized operation. After land preparation, a furrowing and fertilizing implement for 1, 2 or 3 rows is used, pulled by either crawler or rubber-tyred tractors. When the cane is to be harvested mechanically, the length of the rows varies between 400 and 1000 metres while the space between rows is 1.40 – 1.50 m. Where mechanical harvesting is not employed the rows are shorter, usually between 100 and 500 metres, in order to counter erosion.

The second step is the placement of the seed cane in the furrows. Usually bins hauled by trucks or tractors are used for such operations, the cane as whole stalks being thrown manually into the furrows. In the third step the cane lying in the furrows is cut manually into billets and the furrow finally covered, usually employing a small tractor. To a much more limited extent there is also some mechanical planting where all the operations are done at once. Such machines are normally used only by small independent growers because of the planter's low productivity.

Manual harvest. This is the classical method used all over the world. The cane is cut with a machete and the cutter piles five to seven rows in a single windrow in order to ease the mechanical loading.

Loading. Some 95% of hand-cut Brazilian sugar cane is loaded mechanically with simple sturdy hydraulic grab loaders, usually mounted on rubber-tyred conventional tractors. Average capacity is around 30 tonnes.hr^{-1}.

Mechanical harvesting. This is done with various makes of chopper-harvesters for the most part, although there are still a small number of whole-stalk machines operating in São Paulo state. It is important to stress that the introductory stage is already past. An ever-growing interest may be discerned on the part of executives, agronomists and mechanical engineers concerned with

Fig. 4. Santal S-115 chopper-harvester and VT-5 infield unit

the sugar industry regarding the study and development of infrastructure, the economical length of rows, cane varieties, better transport systems, roads, land levelling and mechanization management, with the aim of lowering operational costs.

Fig. 5. Santal 115 harvester delivering chopped cane to a VT-8 infield unit

Fig. 6. Unloading a VT-5 infield unit into a road truck

Fig. 7. The Santal TSM side-unloading system

Transportation. – For movement of cane to the mill, 10 – 17-tonne trucks have been used traditionally, independent of the distance involved. In the case of chopped cane, a special bin is fitted to the truck which allows side-tipping for unloading at the mill. Owing to the high cost of fuel, more and more mills and growers have adopted the use of infield transport units (also Brazilian-manufactured) in the last few years in order to cut such costs.

These infield units, of capacity ranging from 5 to 8 tonnes, travel alongside the harvester and, once loaded, are unloaded into higher-capacity semi-trailers (30 – 40 tonnes) waiting in a side road. This system, besides cutting transportation costs, eliminates the need for trucks to go into the fields, thus minimizing the effects of compaction caused by heavy units in the fields as the infield units are provided with low-pressure tyres and with high traction power, enabling them to work on wet soil without damaging the field; this also helps to maximize the use of the harvesters.

At present, operations in Brazil's sugar cane plantations are mechanized to different degrees, as indicated in Table I.

Table I

Land preparation	>95%
Cultivation	>95%
Planting	5%
Harvesting	12%
Loading	95%

As may be seen from this table, Brazil has a long way to go to full mechanization. The path is clear to modern methods of field management, while basic knowledge of the systems, good and adequate equipment and easy training and technical assistance are offered by the manufacturers. The low mechanization proportions for planting and harvesting result from:

(1) the current ready availability of labour,
(2) financing the purchase is rather difficult, and
(3) so far, manufacturers have not been able to make a low-priced planter.

Based upon such observations it is to be expected that total mechanization will reach a much higher percentage in coming years as it has already been proved that the cost of mechanical harvesting is lower than manual harvesting. At present 7000 sugar cane loaders are being used, compared with 412 harvesters. The numbers of harvesters and their makes appear in Table II.

The extent of mechanization in the principal cane growing regions of Brazil is indicated in Table III.

To consider the future, we have on the one hand, a series of crises in other sectors of the economy which have affected the development of cane mechanization in Brazil. On the other hand we have the ever-growing

Table II

Manufacturer	Number of harvesters	Proportion of market, %
Santal	270	65.53
Massey-Ferguson	89	21.60
Toft	35	8.50
Claas	18	4.37
	412	100.00

Table III

	% of Brazilian production	Mechanizable areas, %
São Paulo	55	75
Pernambuco	16	25
Alagoas	15	90
Campos	5	90
Others	9	57
	100	

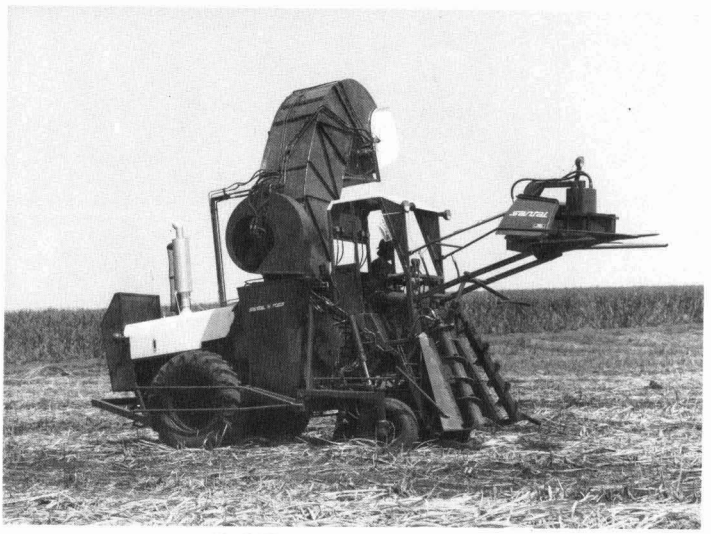


Fig. 8. The Santal-Rotor cane harvester

Fig. 9. The Santal-Rotor in operation

importance being given to sugar cane for fuel alcohol production which is to reach 11,000 million litres by 1985.

In order to attain this production new areas will have to be planted to cane and this will provide, in the mid-term, a perfect equilibrium between labour supply and demand, thus creating much more favourable conditions for the further development of sugar cane mechanization in Brazil.

Summary

The history, present status and future prospects for sugar cane mechanization in Brazil are reviewed.

L'évolution de la récolte mécanique de la canne à sucre au Brésil

On passe en revue l'histoire, la situation actuelle et les perspectives de l'avenir de la récolte mécanique de la canne à sucre au Brésil.

Die Entwicklung der mechanisierten Zuckerrohrernte in Brasilien

Man stellt eine Übersicht über die Geschichte, den Gegenwartsstand und die Zukunftsperspektiven der mechanisierten Zuckerrohrernte in Brasilien dar.

La evolución de la cosecha mecánica de la caña de azúcar en Brasil

Se presenta una revista de la historia, la situación actual y las perspectivas futuras de la cosecha mecánica de la caña de azúcar en Brasil.

Rumania campaign results, 1978/79[1]. — In the 1978/79 campaign, 5,845,000 tonnes were sliced against 6,246,000 tonnes in 1977/78. The beet yield per hectare was 23.3 tonnes against 24.5 tonnes in 1977/78 and white sugar production reached 555,000 tonnes (603,000 tonnes, raw value) in 1978/79 against 713,000 tonnes (775,000 tonnes, raw value) in the previous campaign.

Australia — South Korea sugar agreement.[2] — A new long-term sugar agreement has been reached between CSR Ltd. and representatives of Korea's sugar refining industry. The contract is for 1.5 million tonnes of raw sugar over a five-year period with deliveries starting early in 1980. The new contract succeeds the agreement for 1 million tonnes expiring at the end of 1979.

[1] F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 517.
[2] *Queensland Newsletter*, September 19, 1979.

Enzyme catalysed formation of colour in cane juice

Part III. Inactivation of *o*-diphenol oxidase by heating intact cane

By B.C. GOODACRE, J. HUTSON and J. COOMBS,
(Tate & Lyle Ltd., Group Research and Development, P.O.Box 68, Reading, Berks, England)

Introduction

It is generally accepted that in the sugar refinery much of the colour that is generated during processing of sugar is derived from non-enzymic browning reactions such as those between amino acids and sugars (to form melanoidins), or thermal and alkaline degradation of invert sugars to produce caramels. However, a number of recent publications[1-5] have established the importance of enzyme-catalysed reactions in relation to colour formation in the production of raw cane sugar. In particular, we have shown previously that over half of the initial colour formed in pressed juice may be derived from the interaction of amino acids with quinones generated by the enzyme *o*-diphenol oxidase and that it may be prevented by inhibition of the enzyme using chemical means[3,4]. The toxic nature of potential chemical inhibitors makes such a process unpractical for the production of raw sugar. Hence, alternative methods of inhibiting the enzyme have been investigated including measurement of the heat-inactivation of enzyme activity induced by steaming of intact pieces of sugar cane, as well as studies on the isolated enzyme, some aspects of which are discussed in the present paper.

During the course of this work results of a similar study[2] were published in which it was shown that steaming of cane would inhibit colour formation in cane juice resulting in an accumulation of phenolic compounds. Our conclusions in respect to the generation of colour in juice expressed from steamed cane are similar to those published, with the exception that we would consider that a major portion of the colour was derived from oxidation products of chlorogenic acid rather than from flavonoids as concluded in the previous study[2]. Our observations on the inhibition of colour formation *per se* are not included in the present report. However, we provide further information concerning the inhibition of the enzyme *o*-diphenol oxidase itself and treat in detail the various parameters which need to be considered in determining the period of heating necessary to obtain a significant reduction in enzyme-catalysed colour formation.

In particular, information is presented in relation to the following points:

(a) the kinetics of the enzyme catalysed reaction,
(b) the thermal inactivation of the enzyme present in raw expressed juice,
(c) the thermal characteristics of cane stalks, and
(d) the kinetics of inactivation of the enzyme in intact cane pieces.

Experimental

Plant material — Either soil-grown sugar cane of the variety B 51410, from a greenhouse maintained above 15°C, or cane of an unidentified variety obtained from Mauritius, was used. Although the imported cane had suffered some post-harvest deterioration, results were essentially the same irrespective of the source of the experimental material.

Juice extraction. — Juice was expressed from slices of cane stem using a small hand-powered stainless steel roller mill.

Enzyme studies. — Phenol oxidase (*o*-diphenol O_2: oxidoreductase) activity was determined polarographically using an oxygen electrode. Cane juice (0.02-0.1cm^3 μl) was injected into 3 cm^3 of a 1mM solution of chlorogenic acid in distilled water contained in a water-jacketed electrode chamber held at 30°C. The fall in concentration of oxygen within the chamber, due to the following reactions (equation 1), was monitored using a pen recorder calibrated so that full chart width was equivalent to 0.001cm^3 oxygen in the 3 cm^3 reaction volume. The tangent to the curve at t = O was taken as a measure of the enzyme activity (a). A correction was made for the low rate of oxygen consumption due to direct chemical oxidation of the chlorogenic acid. The reactions monitored were as follows:

$$\begin{aligned} E + S &\rightarrow ES \\ ES + O_2 &\rightarrow EO + H_2O + S' \\ EO + S &\rightarrow E + S' + H_2O \end{aligned} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$2\,S + O_2 \rightarrow 2\,S' + 2\,H_2O$$

where E = enzyme; S = chlorogenic acid; S' = *o*-diquinone of chlorogenic acid. In the overall reaction

[1] Carpenter *et al.: I.S.J.*, 1975, **77**, 9-12.
[2] Smith: *ibid.*, 1976, **8**, 259-263.
[3] Gross *et al.: ibid.*, 1976, **78**, 69-73, 106-109.
[4] Coombs *et al.: ibid.*, 1978, **80**, 291-294.
[5] Goodacre *et al.: ibid.*, 323-317.


B.C.Goodacre


J.Hutson


J.Coombs

two molecules of substrate plus one molecule of oxygen gives two molecules of quinone plus two molecules of water.

The effect of temperature on enzyme activity in expressed cane juice was determined as follows. Undiluted expressed juice was stored at 4°C. Samples 0.03cm^3 were taken at intervals and heated for varying periods at the required temperature in a 0.05cm^3 micro-syringe fitted with a temperature-controlled water jacket. Residual activity was determined polarographically at 30°C, as described above, after various times of heating. The effect of heat on enzyme activity in cane pieces was determined in a similar manner.

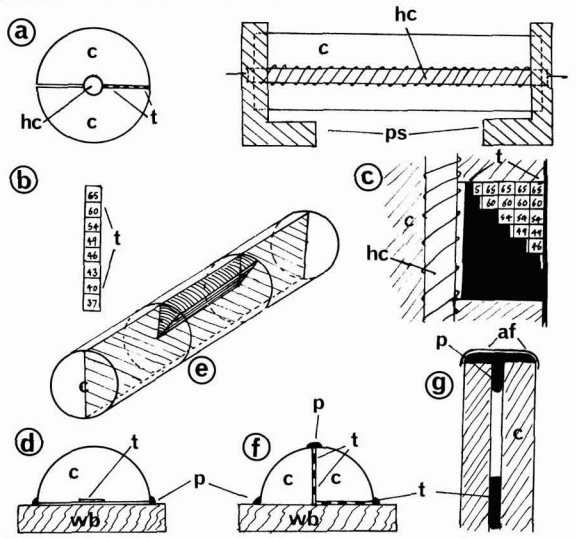


Fig. 1. Arrangements used in various experiments on heating of cane. (a) Heating to steady state by means of an electrically heated coil; (b) a thermometric strip used for temperature measurement; (c) the temperature profile detected using a number of thermometric strips in the electrical heating experiment; (d) and (f) various arrangements of thermometric strips used to determine centre temperature of steamed cane; (g) arrangement used to compare divided cane with intact cane during steaming experiments. Abbreviations: c=cane; af=aluminium foil; hc=heating coil; t=thermometric strip; wb=wooden block; pc=plasticine.

Thermal conductivity. – A 10.7 cm length of cane (diameter 5.5 cm) was split longitudinally and a heating coil (resistance approximately 12 ohms) wound on a glass rod inserted in a groove cut through the centre of the cane (Fig. 1a). Thermax thermometric strips (Fig. 1b) were placed on the cut surface to provide a record of the temperature profile, and the two halves of the cane placed together and held by a rubber band. The "reconstituted" cane, containing heating coil and thermometric strips, was mounted in an insulating support formed from two blocks of expanded polystyrene and heated by passing a current through the coil (P = 40.9 Wm^{-1}) until a constant external surface temperature was recorded. At this time it was assumed that steady state had been reached. The temperature was then obtained from the change in colour of the thermometric strips (Fig. 1c). The Thermax strips are very thin and have an adhesive backing so that there is good contact with the cane surface. When the temperature is equal to or higher than the number indicated on any particular square, the colour changes irreversibly from white to black. Three distinct sets of strips were used covering different temperature ranges and/or with different increments of response. The temperature profile was measured near the centre of the length of cane and end effects were neglected.

Heat inactivation of enzyme in cane pieces. – Lengths of sugar cane (20 to 25 cm), cut in such a way that they contained a node approximately in the middle, were split in two longitudinally. A shorter length was taken from one half of the cane, extending 3 to 4 cm either side of the central node. A segment from this half (Fig. 1e) was crushed and the juice extracted, centrifuged to remove particulate matter and the enzyme activity determined. The second half of the cane was mounted on a wooden block about 1 cm with a thermometric strip placed to record the maximum temperature reached at the centre of the cane (Fig. 1d). The cane was secured in place using rubber bands and the joints between the cane and the wooden block sealed with modelling clay (plasticine). The mounted cane was subjected to a gentle flow of steam at near atmospheric pressure inside a glass (QVF) apparatus. After the required time the cane was removed from the apparatus and trimmed to the same dimensions as for the unheated half, and the juice extracted from a segment cut from this section in an identical manner to that taken from the unheated half.

It is possible that the substitution of one half of the cane piece by a wooden block would lead to a distortion of the temperature profile in the heated cane. The magnitde of such distortion (if any) was investigated as follows. A length (22 cm) of cane (radius 1.6 cm) was divided longitudinally into four quadrants. Thermometric strips were attached to two quadrants which were then placed on the wooden block (Fig. 1f). This was then steamed for 7 min and the temperature profiles parallel to and at right angles to the block face compared. In order to check that the seal between the cane and the wooden block was steam-proof the temperature reached at the centre of the cut cane was compared with that reached at the centre of an intact length of cane. For this latter test a hole was drilled longitudinally into a length (20 cm) of cane (radius 16 mm) and a thermometric strip inserted into the hole in such a way that the end was about 5 cm from the cut end of the cane (Fig. 1g). The hole was filled with water to ensure good thermal contact between the cane and the thermometric strip, sealed with plasticine and covered with aluminium foil.

Results

Enzyme studies on expressed juice. – The *o*-diphenol oxidase of sugar cane, in common with that which occurs in most organisms, consists of four sub-units of molecular weight 32000 daltons[6]. Each sub-unit contains a copper atom which is involved in the catalytic action. Although the reaction mechanism is complex, both in terms of the sequence of reactions (as detailed in the methods section) and in respect of possible interactions between the sub-units under conditions where either of the substrates (oxygen or chlorogenic acid) is in a large excess, the kinetics of the reaction

[6] Coombs *et al.*: *Phytochemistry*, 1974, **13**, 2703-2708.

will approximate to those of the Michaelis-Menton equation (Fig. 2 inset) i.e. a biphasic curve will result if the observed rate is plotted as a function of the concentration of variable substrate.

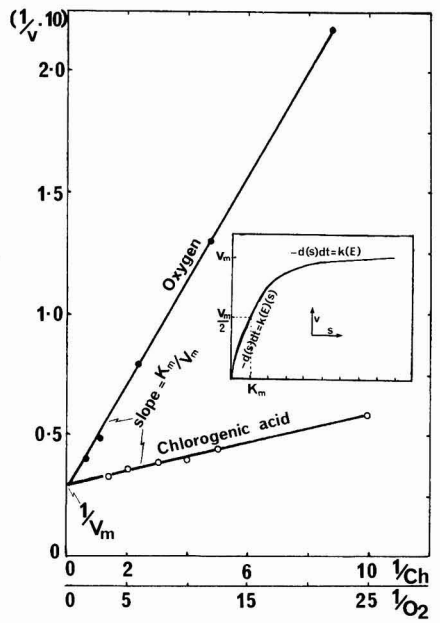


Fig. 2. Double reciprocal plot of reaction velocity as a function of substrate concentration for phenol oxidase activity in expressed cane juice at variable concentrations of oxygen or chlorogenic acid. *Inset:* Theoretical plot of enzyme velocity as a function of substrate concentration at fixed enzyme level

At low concentrations of the variable substrate (S) the reaction is first order and hence the rate of reaction depends on both the concentration of substrate (S) and the amount of enzyme (E) present in the reaction mixture. At higher concentrations of S the reaction becomes zero order (in respect to S) and hence the observed rate of reaction will depend only on the concentration of enzyme. In order to determine the relative activity of the enzyme present in juice obtained under the various conditions employed it is necessary to ensure that the concentrations of substrate used are constant and preferably saturating. The necessary concentrations of substrate can be determined in terms of the K_m (Michaelis constant) of the enzyme. The Michaelis constant is defined as the concentration of substrate necessary to produce a reaction of half the maximal velocity (V_m) at a given enzyme concentration. This empirical constant is numerically related to the rate constants of the reaction shown in equation 2; i.e. $K_m = (k_2 + k_3/k_1)$.

$$S + E \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_3} \text{product} \qquad \ldots\ldots\ldots (2)$$

The Michaelis-Menten equation can be rewritten in a reciprocal form (Lineweaver - Burk) which results in a linear relationship between the reciprocal of the observed rate of reaction and the reciprocal of the substrate concentration, equation 3.

$$1/v = 1/v_m + K_m/(v_m S) \qquad \ldots\ldots\ldots (3)$$

In the present experiments S is either the variable oxygen concentration at constant enzyme and chlorogenic acid concentration, or the variable chlorogenic acid concentration at constant enzyme and oxygen concentration. From the results of experiments carried out under both sets of conditions the K_m values were calculated as 0.1 mM for chlorogenic acid and about 0.06 mM for oxygen (Fig. 2). These results indicated that the 1mM solution of chlorogenic acid would provide an adequate excess of substrate, and furthermore that the concentration of oxygen in water equilibrated with air at the temperature used was equal to about four times the K_m for O_2. Under these conditions variations in rate obtained in the following studies can safely be ascribed to changes in the activity of the enzyme.

Decay of enzyme activity on the heating expressed juice

The rate of enzyme activity was measured in expressed juice after it had been heated for varying periods of time at temperatures ranging from ambient to 80°C. Results obtained at 25° and 70° are shown in Figs. 3a and b respectively. In both cases the decay in activity is first order in respect to enzyme, with the enzyme activity half life ($t_{½}$) decreasing rapidly as the temperature is increased (Fig. 3c). The first order rate constant is plotted as a function of the reciprocal of the absolute temperature in Fig. 3d. From the slope of this plot the heat of inactivation is calculated as 150 $kJ.mol^{-1}$

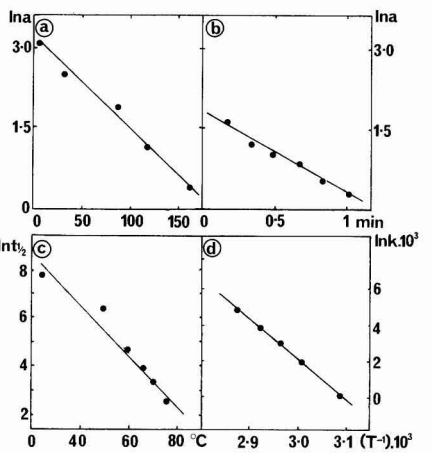


Fig. 3. (a) and (b) Decay of phenol oxidase activity with time of heating juice expressed from sugar cane at (a) room temperature and (b) 75°C; (c) Time for enzyme to lose 50% of its activity ($t_{½}$) as a functin of temperature (°C); (d) Apparent first order rate constants for inactivation of phenol oxidase in expressed cane juice as a function of temperature (absolute)

At 75°C the half-life of inactivation of enzyme activity was about 10 seconds. At higher temperatures the time taken to carry out the experiment became long compared to the half-life which precluded an accurate determination of the rate of inactivation at steam temperature (100°C approx.). However, owing to the linear relationship shown in Fig. 3c and 3d, values can be obtained by extrapolation. From these results it can

be shown that at 95° and 100°C the enzyme would lose half the activity in less than one second. Unfortunately the problem is not as simple as this if inactivation of the enzyme is considered in terms of an intact piece of cane being heated by external application of steam starting at ambient temperature. Under these conditions the limiting factor will be the rate at which the cane tissue heats up, which in the present discussion will be regarded as the rate at which the temperature at the centre of the cane increases. This in turn will depend on the thermal conductivity of the cane and the temperature gradient.

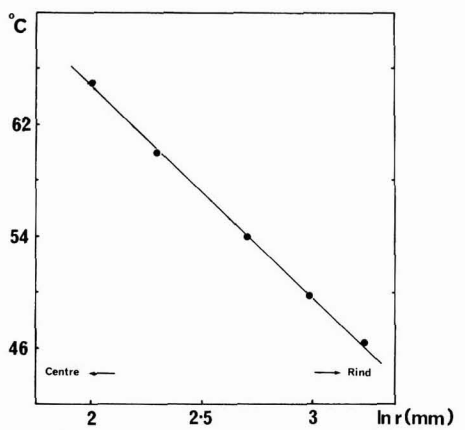


Fig. 4. Temperature profile through electrically heated cane at steady state; R = 5.5 cm; P = 40.9 Wm^{-1}

Thermal conductivity. – The thermal conductivity was determined at equilibrium as described in the methods section and is illustrated in Fig. 1a. The temperature profile at equilibrium is shown in Fig. 1c. The equilibrium temperatures were plotted as a function of the natural logarithm of the distance from the centre (in mm) as shown in Fig. 4.

For the steady-state heat conduction in an infinitely long cylinder of radius R and external temperature θ_s, of constant thermal conductivity throughout, heated by power P per unit length, the temperature profile is described[7] by equations 4 and 5.

$$\theta_c - \theta_s = (P/2\pi\lambda)\ \ln(R/r) \qquad \ldots\ldots\ldots (4)$$

$$d\theta/d(\ln r) = -P/2\pi\lambda \qquad \ldots\ldots\ldots (5)$$

As shown in Fig. 4 a plot of temperature *versus* radius gave the expected linear relationship. From the slope of this graph and the known consumption of power per unit length of cane the thermal conductivity was calculated as 0.42 $J.m^{-1}.s^{-1}.°C^{-1}$.

Temperature profiles in steamed cane. – The temperature profiles measured at right angles as shown in Fig. 1f showed a centre temperature in the range of 82 to 88°C at a radius of 11.5 mm after 7 minutes steaming. The two profiles, parallel with and at right angles to the wooden block, were identical within the accuracy of the thermometric strips. It may be concluded therefore that distortions due to substitution of half the cane length by the wooden block were not significant. The centre temperature recorded as shown in Fig. 1g was in the range 77 to 82°C, which was close enough to the value found with mounted cane to confirm that penetration of steam through the seal was insignificant.

The analytical form of the equation for non-steady-state heat conduction in a body of any particular shape is unmanageably complicated; hence, graphical forms of numerical solutions may be more convenient to use.

These graphs[8,9] relate the "dimensionless temperature" to the "dimensionless time" t/R^2 and the "dimensionless distance" from the centre r/R; where α = thermal diffusivity = $\lambda/\rho C_p$; λ = thermal conductivity; ρ = specific gravity; C_p = specific heat. Figure 5a shows the radial temperature distribution, each curve representing the profile at a different time, for a cylinder with an infinite ratio of length to diameter. Figure 5b shows the centre temperature reached after a given time for solids of various dimensions. On theoretical grounds the rate of increase in θ_c, and hence the rate of increase in loss of enzyme activity is a function of $\lambda t/\rho C_p R^2$.

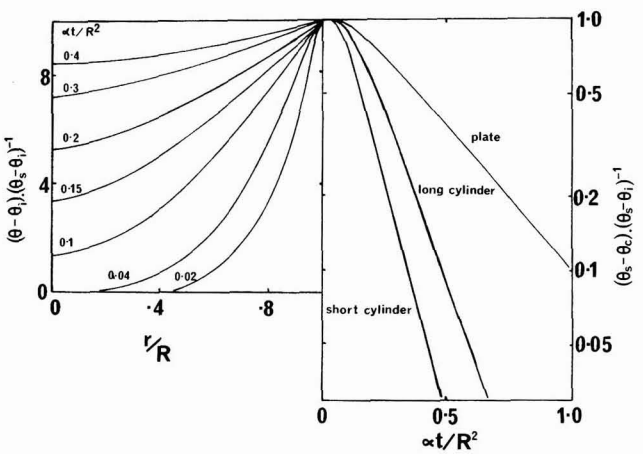


Fig. 5. Theoretical relationships between dimensionless temperatures, times and distance between centre and heated surface for various solids of homogeneous material

(To be continued)

New Polish sugar factory[10]. – A new sugar factory was planned to be put into operation at Ropczyce in Rzeszow province during October 1979. At full capacity it will process more than 6500 tonnes per day.

[7] Bird *et al.*, (Wiley, New York), 1960.
[8] Crank: "Mathematics of diffusion", (Oxford Univ. Press), 1970.
[9] Jacob: "Heat transfer. Vol 1", (Wiley, New York), 1949.
[10] F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 564.

SUGAR CANE AGRONOMY

A simple ready reckoner for estimating the area of intact sugar cane leaves. U. S. Singh and M. Singh. *Indian Sugar,* 1978, **28,** 31-36.—A table has been prepared of true areas corresponding to areas calculated by the method previously described[1]; the range covered is 1-500 cm^2.

Influence of "Cycocel" on waterlogged and lodged sugar cane. A comparative study of laboratory and big mill trials. S. C. Sharma, G. S. C. Rao and S. S. Sharma. *Indian Sugar,* 1978, **28,** 87-91.—Juice analyses revealed that preharvest foliar application of the chemical ripener "Cycocel" at 2500 ppm increased purity by 1·7-2·84 units 3-8 weeks after spraying, while sugar recovery was increased by 16·9% (1·52 units) in factory-scale experiments comparing treated with untreated cane.

Basic points on which factory participation in the research and development of sugar cane is contemplated. G. K. Patwardhan. *Maharashtra Sugar,* 1978, **3,** (10), 9-14.—It is stressed that, since cane agriculture is entirely in the hands of member growers where a cooperative sugar factory is concerned and that there is wide diversity in the practices used, it is incumbent on the factory to carry out research with the aim of solving major problems and introducing rationalization in the various schemes used. The author discusses the subject in relation to varietal selection, fertilization, soil analysis and distillery spent wash disposal, while greatest attention is paid to the problems associated with lifting of irrigation water.

Feasibility of autumn planting of sugar cane with companion cropping in Uttar Pradesh. M. L. Agarwal, A. Nath and K. M. Bhardwaj. *Indian Sugar Crops J.,* 1978, **5,** (1), 9-15.—Experiments conducted during 1955-75 at various research stations and cane field locations are reported. The effect of various companion crops on cane yield and the net income obtained from cane plus intercrop are indicated in a number of tables.

Measurement of leaf area in sugar cane (*Saccharum officinarum*). H. V. L. Bathla and H. L. Sharma. *Indian Sugar Crops J.,* 1978, **5,** (1), 16.—While a planimeter gives accurate measurement of cane leaf area, it is not easy to use; however, from planimeter measurements on leaves of six cane varieties, the authors have derived a factor of 0·6274 by which the apparent area (maximum length × maximum width) is multiplied to give a value which deviates from the true area by an error within the range from − 0.89 to + 3.78%.

An alternative of sugar cane survival. M. H. Ashraf, Y. Rai, B. K. Singh and S. Zaman. *Maharashtra Sugar,* 1978, **3,** (11), 39-40.—With a tendency among farmers in India to prefer a short-duration crop such as wheat to a long-duration cane crop, there has been a gradual fall in cane area. It is pointed out that the decline can be checked and the area under cane even increased by inducing farmers to adopt cane growing with an intercrop. Of the various intercrops examined in experiments at the Sugarcane Research Institute, Pusa, potato was found to give the highest net profit with cane. Information is given on the number of irrigations required with each of 10 intercropping systems as well as quantities of N, P and K, seed rate, inter-row spacing and numbers of intercrop rows between cane.

Nitrogen and sugar cane. XVI. Available soil nitrogen during different phases of crop growth. U. S. Singh. *Indian Sugar,* 1978, **28,** 121-124, 137.—Two-year investigations showed that the maximum quantity of available N in the top 15 cm of soil occurred during the tillering phase of cane growth, after which it fell with age of crop and was minimum at harvest time. The available N in the 15 cm of subsoil was lower than in the top soil, but it gradually increased until it was almost the same during the elongation growth phase, after which it declined during the sugar accumulation phase. The uptake of N ($kg.ha^{-1}$) from both layers was similar in magnitude. Examination of green matter production showed that the tillering phase was characterized by leaf growth while the other two phases were characterized by stem growth, most of the cane growth occurring during the elongation phase; there was relatively little increase in fresh cane weight during the sugar accumulation phase. When the available N content increased in both soil layers, more green matter was produced, the increase being greater during the tillering and elongation growth phases than during sugar accumulation, when green matter production was almost the same as with low N availability.

Effect of chemicals on ripening of sugar cane. P. C. Joshi, R. C. Agarwal and J. P. Shukla. *Indian Sugar,* 1978, **28,** 131-133.—Application of "Cycocel" at 2000 ppm or 2,4-D + "Ethrel" at 250 + 4000 ppm increased Brix, pol and purity of plant and ratoon cane 40 days later by comparison with untreated controls, and also improved primary and mixed juice quality. Variations occurred in the responses to the two treatments.

Nitrogen and sugar cane. XVII. Analysis of cane yield in relation to the availability of soil nitrogen. U. S. Singh. *Indian Sugar,* 1978, **28,** 181-184.—Investigations during two years showed that, although the available nitrogen in soil down to 60 cm was higher in all three cane growth phases in the second year than in the first, and fresh weight increased with N availability during the early growth phases, the final yield in the second year was only 1·3% higher than in the first.

Drip irrigation at Hawaiian Commercial & Sugar Co. R.J. Leffingwell. *Sugar y Azúcar,* 1978, **73,** (10), 42-43. The benefits of drip irrigation, used in cane fields of HC & S on the island of Maui, are briefly indicated. Savings in cane replanting, weed control, harvesting and irrigation water consumption by comparison with overhead and furrow irrigation have outweighed the costs of drip irrigation tubing (which has to be replaced every two years). The disadvantages of tube damage by rats and ants and some cane germination problems caused by poor lateral movement of water are more than balanced by the advantages of increased yields, reduction of drought problems and ease of conversion to flat land cultivation.

[1] Singh: *I.S.J.,* 1979, **81,** 239.

SUGAR CANE MECHANIZATION

Land use on steep slopes on an estate on the south coast of Natal. O. P. Landrey. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 125-128.—The Sezela estate of C. G. Smith Sugar Ltd. has 8420 ha of land under cane, of which 70% has a gradient greater than 15%, while 24% is steeper than the accepted limit of mechanization with conventional wheeled tractors. Runs often exceed 300 m from top to bottom. Details are given of the field layout, land preparation, planting, harvesting and transport techniques which have been adopted as components of a modified design on some 2260 ha.

The Edgecombe cane cutter. G. van der Merwe, J. R. Pilcher and E. Meyer. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 169-173.—Details are given of the harvester developed at Mount Edgecombe Experiment Station. It is a double-row, burnt cane cutter which tops and cuts the stalks at the base, leaving the cane in a single "sausage" windrow parallel to and between the two rows which have been cut. The machine can also cut green cane. In a trial period, during which it harvested nearly 5000 tonnes of cane, it averaged a rate of 15·6 tonnes per hr, with little time lost through breakdowns. Manoeuvrability and stability were good on slopes of up to 30%. An average of 3·6% of tops was sent to the factory (the cane being upright and straight). With use of a Bell loader, 9 tonnes of cane per ha was still left in the fields (requiring two workers to reduce it to 1.9 tonnes.ha^{-1}).

Machinery selection based on machine costs. T. J. Murray and A. G. de Beer. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 174-177.—Factors that affect machinery costs are discussed with the aim of optimizing selection. They include the protraction of farm operations on the one hand and under-utilization of power resources on the other. A computer programme devised to analyse the mechanization requirements of a farm and match tractor to implement is described.

Reducing extraneous matter in cane loaded mechanically. R. Gordon. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 178-179.—After problems concerning excessive quantities of sand and tops accompanying cane deliveries to the factory, the system of pushpile loading of cane from a single windrow (made up of cane from five rows) was replaced by the use of a Bell loader which picked up the cane after it had been stacked from three rows in bundles about 1 m apart. Each bundle was picked up until the grab was full (usually holding three bundles), after which the cane was loaded into a trailer. As a result of the change in the system, sucrose % cane rose to a level above that of the Empangeni grower group (it had previously been below it), fibre fell to below the factory average, and there was a marked improvement in purity as represented by non-pol % cane.

Sugar cane mechanization. L. V. Gentil and T. C. Ripolli. *Brasil Açuc.*, 1978, **91**, 175-191 (*Portuguese*).—Mechanization is applicable to much of the cultivation of cane, from soil preparation to harvesting and transport, and a table indicates the costs for Brazil in cruzeiros per hectare-year. Ideal conditions for the individual operations are set out as well as day-to-day problems which are encountered in reality where conditions are not ideal.

Trash in mechanical and manual harvesting of sugar cane. N. Tambosco, J. P. B. Teixeira, L. Geraldi, E. J. Ustulin, J. L. de P. Henrique, O. Alonso, W. J. Correa, L. R. Franceschi, R. N. Geraldi, J. C. Salata and G. E. Serra. *Sugar J.*, 1978, **41**, (1), 21-23.—See *I.S.J.*, 1979, **81**, 113.

Harvesting research in Hawaii. *Ann. Rpt. HSPA Expt. Sta.*, 1977, 40-41. — Modifications to Toft and Stubenberg S-75 cane harvesters were made to combine the best aspects of both in order to avoid the need to pass harvested cane through a wet cleaner and so save sugar losses. Problems of cane damage and field loss occurred and modifications were devised which were to be tested further. A further study has been partially carried out on the avoidance of a wet cleaner by use of a Toft harvester as against the use of a rake harvester followed by wet cleaning.

Six years of mechanization at Santa Lydia sugar mill in Brazil. F.O. Brieger. *Sugar y Azúcar*, 1978, **72**, (9), 83-90. — The cane mechanization system at Santa Lydia, started in 1972, includes six harvesters manufactured by the Brazilian firm, Santal Equipamentos S.A. The cane is harvested at the rate of 1500 tonnes per day and transported in chopped or whole-stalk form to the factory in 40 trucks of 15 tonnes capacity; tractors with mechanical loaders are also used in areas where mechanical harvesting is not possible. Over the 7-year period since introduction of cane mechanization, the factory has benefited from the reduction in time between cane burning and processing and from the absence of need for washing of the cane (resulting in more sugar and no wash water for disposal). Information is given on the field practices and on the varieties grown.

Sugar cane harvester performance. T.G. Fuelling, C.R. Henkel, K.C. Leverington and M.K. Wegener. *Producers' Rev.*, 1978, **68**, (7), 34-38. — See *I.S.J.*, 1979, **81**, 340.

Effects of mechanical cultivation on soil compaction, root development and sugar cane yield. P.C. Yang, S.J. Yang and F.W. Ho. *Taiwan Sugar*, 1978, **25**, 117-121. — Experiments are reported in which two varieties of cane were planted in (a) loamy soil with a high water table and (b) a silty, clay loam with a low water table, after which the cane was subjected to three different systems of treatment: (1) no mechanical cultivation but three applications of herbicide before closing-in between the rows, (2) two cultivations, plus one herbicide application immediately after planting, and (3) four cultivations plus one herbicide application immediately after planting. Results showed that the part of the root system near the surface was injured in plots subjected to four cultivations, but this did not affect subsequent cane growth and yield, which was 13% higher than without cultivation on soil (a). There was no significant difference in cane yield between treatments on soil (b). Cultivation using wheeled tractors did not cause severe soil compaction. Best weed control was obtained with four cultivations, and this method was cheaper than chemical treatment.

CANE PESTS AND DISEASES

Sugar cane smut. S. A. Alfieri. *Sugar y Azúcar,* 1978, **73,** (7), 41.—A brief history is given of smut occurrence in cane-growing countries, together with information on the method of spread, symptoms and control methods.

Increased survival of young seed cane after hot water treatment for RSD control. G. T. A. Benda. *Sugar Bull.,* 1978, **56,** (19), 7-14.—Experiments are reported in which cane stalks were pre-treated with hot water at 50°C for up to 30 minutes and then subjected to standard hot water treatment at 50°C for two hours on the next day. The pre-treatment increased the number of canes surviving the standard treatment, which considerably reduced the incidence of ratoon stunting disease by comparison with untreated cane. No substantial difference was found in the results between 10, 15 and 20 minutes' pre-treatment, while the effect of the 30-minute pre-treatment varied with cane variety.

Studies on sugar cane ratoon stunting disease in Taiwan. Phase-contrast and electron microscopy of the small coryneform bacteria in the diseased sugar cane. C. T. Chen, M. J. Chen and S. M. Lee. *Rpt. Taiwan Sugar Research Inst.,* 1978, (80), 13-20 (*Chinese*).—Phase-contrast and electron photomicrographs are reproduced, showing the coryneform bacterium associated with RSD. Coiled mesosomes, one of the distinctive characteristics of the bacterium, are clearly seen, as is a septum in some cases. A thin cell wall surrounding a cytoplasmic membrane and the coiled mesosomes was also revealed. The bacterium was not found in extracts from healthy cane.

Mass liberation of *Trichogramma australicum* Girault for the control of sugar cane moth borers in Taiwan. W. Y. Cheng *et al. Rpt. Taiwan Sugar Research Inst.,* 1978, (80), 21-36 (*Chinese*).—*T. australicum*, mass-produced on eggs of *Corcyra cephalonica,* was liberated in 18 autumn-planted cane fields of two sugar factory districts to evaluate its effectiveness in the control of *Argyroploce schistaceana*; non-release plots adjacent to the release plots were used as controls. Results showed considerable variation in the numbers of host eggs, whereas the difference between the control and release plots was not significant. However, egg parasitism ranged from 4·8 to 82·5% in the release plots, compared with 0–34·5% in the controls. Dead hearts in young cane in the release plots fell by 37–100% relative to the controls, while infestation of internodes in 250 millable canes taken from five points in each plot was 29·3–77·2% lower than in the controls. On the other hand, the reduction in borer damage was not related to the number of parasites released.

Estimation of the home range and movement of *Mus formosanus* Kuroda in sugar cane fields. P. Y. Wang and M. Seki. *Rpt. Taiwan Sugar Research Inst.,* 1978, (80), 27-48 (*Chinese*).—Studies in which marked rodents were recaptured showed that 58–75% belonged to the species *M. formosanus* on the farm in question. The number recaptured averaged 3·9 and was maximum at 23 during a 1-year period; the home range varied significantly with the growth stages of the cane and with locality, being greater in young than in mature cane. Variation was also found in the distance travelled, this again being greater in young than in mature cane and averaging about 15 m daily.

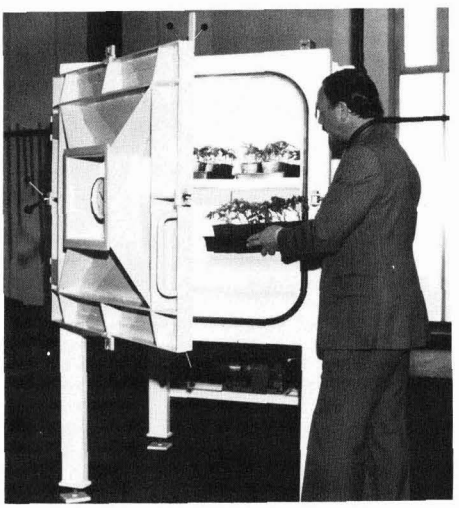
Sugar cane smut in Florida. E. H. Todd. *Sugar J.,* 1978, **41,** (3), 23.—Cane smut (*Ustilago scitaminea*) was discovered for the first time in mainland USA in late June, 1978, in an area of experimental cane varieties being grown by the US Sugar Corporation near Clewiston. A

Laboratory size fumigation chambers

Measuring 1.42 metres x 1.14 metres x 1.62 metres overall, the new GBEA fumigation unit has a chamber volume of one cubic metre. Apart from experimental and practical work in the laboratory, it is particularly suitable for fumigating trays of soil, seeds and seedlings. Operation is simple; the trays are loaded into the chamber which is hermetically sealed prior to activation of the process of fumigation by treatment with a methyl bromide gas formulation during a pre-set period normally between one and six hours.

The laboratory unit is constructed mainly of steel with an epoxy liming and features GBEA's unique metering system for accurate dosing of the fumigation gas. It operates from a 220/240 volt single-phase supply and can be supplied with castors where mobility is required. Other GBEA fumigation units are currently available in a variety of sizes up to 100 cubic metres.

Further information on them may be obtained from GBEA Ltd., Altham Industrial Estate, Accrington, Lancs., England.



large infected area of about 400 acres was discovered shortly afterwards about 4-5 miles from the site of the original discovery, and a number of other minor points of infection were subsequently confirmed in scattered areas up to 7 miles from the first site. The US Sugar Corporation, in collaboration with Canal Point Experiment Station, initiated replicated tests to screen 450 commercial and experimental varieties in the CL and CP series; inoculated seed cane was planted in a field adjacent to a site of confirmed heavy infection. The field was to be closely monitored and infected stools removed and destroyed as whips appeared; the information obtained from the tests was to be used as a guide in adjusting autumn and winter planting schedules for 1978 in Florida.

Efficacy of "Quinalphos" and "Chlorpyriphos" emulsions in controlling black bug of sugar cane. B. N. Pandey, B. P. Singh, R. Dayal and R. Sanehi. *Indian Sugar Crops J.*, 1977, **4**, 89-91.–Spraying with "Quinalphos" at 0·2 kg a.i. per ha reduced *Dimorphopterus gibbus* numbers by 93·7%, while "Chlorpyriphos" at the same application rate reduced the population by 93·6%, whereas in untreated plots the population increased by 6·8%.

Effect of fungicide spray in controlling the brown leaf spot disease of sugar cane in Karnataka. S. Kumaraswamy. *Indian Sugar Crops J.*, 1977, **4**, 92-93.–In trials, "Fytolon", containing 50% copper as oxychloride, proved by far the best of three fungicides in controlling *Cercospora longipes*. Sprayed at 0·2% concentration in three applications 30 days apart, starting when the cane was 5 months old, it increased the final cane yield of the 13-month crop by 14·45% and reduced disease intensity by 61·5% at the end of treatment and by 53·5% when the crop was 10 months old, compared with the control.

Survey of sugar cane pests in Orissa state. A. N. Kalra, K. Banerji and C. P. Dutta. *Indian Sugar Crops J.*, 1978, **5**, (1), 6-8.–Results of a survey conducted during 1961–67 are given. The shoot borer, *Chilo infuscatellus*, and top borer, *Tryporyza nivella*, were by far the most abundant pests found, after which came termites, the mealy bug (*Saccharicoccus sacchari*) and, at a very low rate of incidence, the leafhopper, *Pyrilla perpusilla*, and white fly, *Aleurolobus barodensis*.

Defoliating insect pests of sugar cane and their control. A. Singh, D. C. Singh and G. D. Pandey. *Indian Sugar Crops J.*, 1978, **5**, (1), 17-18.–The life history, form of attack and possible control measures are given for the army worm and grasshopper.

Current situation of disease problems of sugar cane in western U.P. M. R. Gupta and D. N. Gupta. *Indian Sugar*, 1978, **28**, 185-187.–Surveys were conducted in seven sugar factory zones of western Uttar Pradesh, and showed that brown leaf, grassy shoot and wilt were the commonest diseases, while red rot, top rot and smut occurred only to a much smaller extent. Details are given of the cane varieties most affected by the diseases.

Pest control research in Hawaii. *Ann. Rpt. HSPA Expt. Sta.*, 1977, 34-37.–Zinc phosphide may not be used as a rodenticide in a buffer zone between crops and streams, so that use of anticoagulant baits is recommended for these zones, as well as for non-crop waste areas from which the rats invade cane fields. Baits in plastic film bags and as pellets were comparable in cost and effectiveness. Two new anticoagulant rodenticides are under test: "Brodifacoum" from ICI America, and "Bromadiolone" from Chempar Co. Different tubing materials have been tested for resistance to attack by the ants which affect drip irrigation installations. Polybutylene, polypropylene and rubber blend tubing were all better than polyethylene. Certain insecticides and insect repellents kept tubing free from ant damage in the laboratory for 5-6 weeks but for less than 1 week under field conditions where they were rapidly broken down in the soil. Injection of "Lorsban" into the water protected tubing at one location but not at another; the species of ant present were different. Study has shown that feeding behaviour of the sugar cane leafhopper *Perkinsiella saccharicida* differed as to whether it was carrying the Fiji disease virus or not, and other work has confirmed that the virus can be passed from the virus-carrying leafhopper mother through eggs to the nymphs. A further 72 varieties (making a total of 314) were tested for resistance to the beetle borer; of the total, 15 varieties have been selected for possible inclusion in the breeding programme because of consistent resistance and good yields.

Cane disease research in Hawaii. *Ann. Rpt. HSPA Expt. Sta.*, 1977, 38-39. – Smut first appeared in Hawaii in 1971 but, by development of disease control measures and production of resistant varieties, the disease is no longer a threat to the sugar industry of the state, although screening of varieties to both A and B strains of the disease will continue. Routine programmes of screening for resistance to leaf scald and eye spot continue, as do evaluation of new pineapple disease fungicides, inspection of seed cane fields for disease and quarantining of newly introduced varieties.

Thermotherapy and aseptic bud culture of sugar cane to facilitate the exchange of germplasm and passage through quarantine. P. Waterworth and R.P. Kahn. *Plant Disease Reporter*, 1978, **62**, 772-776. – Cane cuttings about 5 cm long and carrying mature buds were obtained from mosaic-infected cane and subjected to one of three hot water treatments: (1) 20 minutes' exposure to 52°C, (2) 20 minutes at 52° followed, 24 hours later, by 20 minutes at 57°, and (3) 20 minutes at 52°, followed, 24 hours later, by 20 minutes at 57°, followed in turn, 24 hours later, by 20 minutes at 57°. In the first year, 1974, treated and untreated cuttings were planted in steam-pasteurized soil; in the second year, buds from the treated setts were established in agar culture and the resulting plantlets transplanted in soil. Results showed that 55% of the setts sprouted and developed into plants, but that only treatment (3) gave uninfected examples from all five varieties tested. In 1975, while only 42% of the buds grown under aseptic conditions developed into plants that were then successfully transplanted, all treatments provided uninfected representatives of the three varieties involved, method (3) giving complete freedom from mosaic in all cases of successful transplants. The better results with excised buds are attributed to the fact that, with larger pieces, some virus escapes the effect of heat and acts as an infection reservoir; buds cut from the piece are separated from the reservoir. Buds also have advantages over meristem or meristem tip cuttings in cultivation because of their reduced likelihood of generating callus (a source of mutations) and because bud excision does not require magnification nor special cutting instruments, so that the chances of survival are greater.

SUGAR BEET AGRONOMY

Single- or multi-row beet harvesting. K. Haase. *Die Zuckerrübe,* 1978, **27,** (5), 16–18 (*German*).–The title subject is discussed against the background of West German beet agriculture.

Agriculture and sugar beet in Holland. W. C. von Kessel. *Die Zuckerrübe,* 1978, **27,** (5), 22–25 (*German*).–A survey is presented of beet agriculture in Holland.

Wind erosion: three methods of lessening the damage caused by the big blow. I. Rye guard technique. J. Bastow, W. Peck and C. Astill. *British Sugar Beet Rev.,* 1978, **46,** (3), 14–15. **II. Factory waste lime.** D. Bakewell. *ibid.,* 15–16. **III. Straw planting.** D. Roebuck. *ibid.,* 16–17.

I. While little difficulty was experienced in drilling rye in firm, level seedbeds, problems did arise when the seedbeds were loose. Since the rye grows less vigorously on sandy soils, it should be sown before the end of September on such soils, while drilling by the middle of October is adequate on more fertile soils. Experience has shown that the most successful technique for burning off the rye in the following spring is application of "Gramoxone" at 4 litres.ha^{-1} in 450 litres of water about two days before beet drilling, followed by pre-emergence application of 1½ litres. ha^{-1} of "Gramoxone" if required. While adequate beet stands were obtained, frequent rain during the drilling period undoubtedly helped, particularly where seed cover was inadequate as a result of soil compaction.

II. Application of factory "waste lime" (carbonatation mud) has been found to reduce wind erosion, increasing the number of plants surviving by up to 50% by comparison with an untreated control and by 20% relative to a field in which the soil was treated with vinyl emulsion. Moreover, the carbonatation mud has value as a fertilizer because of its nitrogen, phosphorus and magnesium content.

III. On light peat soils, which are easy to work and highly productive but suffer from a high weed growth potential and susceptibility to wind erosion (a mean wind speed as low as 12 mph causing soil movement under certain conditions), one farmer has found that "planting" a row of straw (a technique he saw used in Holland some 20 years ago) after every five or six rows of beet gives satisfactory protection; the costs of the practice are considered worthwhile in the face of yield losses (up to 33%) which may result from wind blowing. The importance of the condition of the straw is stressed–it should be long and unbroken.

Harvesting. Maximizing the profits, minimizing the costs. W. Peck. *British Sugar Beet Rev.,* 1978, **46,** (3), 21. Advice is given on various aspects of beet harvesting whereby operational costs and beet losses can be minimized.

Beet losses–how they can be avoided. N. Lawrence. *British Sugar Beet Rev.,* 1978, **46,** (3), 41.–In a discussion on means of reducing harvesting losses, the author examines both below-ground losses (tap roots or beet pieces broken or cut by the lifting wheels or shares and left in the ground) and above-ground losses, most of which can be considerably reduced by paying attention to the various harvester settings. A chart accompanying the article indicates probable causes of specific faults and describes remedial measures.

How to set up the Armer-Salmon 3-row harvester and topper. Anon. *British Sugar Beet Rev.,* 1978, **46,** (3), 44–47.–Photographs are used to demonstrate how to set up the title machine; it is thought that the information may also be of value to users of other beet harvesters.

The 1978 harvest–some advice. A. Vigoureux. *Le Betteravier,* 1978, **12,** (123), 9, 12 (*French*).–Advice is given on topping, lifting and piling of beet in clamps as well as leaf ensilage. Photographs clearly demonstrate the various points made.

Pre-harvest desiccation of leaves with chemicals. G. Gólya. *Cukoripar,* 1978, **31,** 90–91 (*Hungarian*).–Results of tests demonstrated the effectiveness of defoliation of seed beet by spraying with "Reglone" at the rate of 3–3·5 litres in 400 litres of water per ha (or in 100 litres of water when applied aerially). The treatment was found to increase considerably the quantity of beet which could be mechanically harvested in a single pass. Spraying is best carried out 4–9 days before harvest.

Minimization of losses in beet storage. R. Vanstallen. *Le Betteravier,* 1978, **12,** (124), 10-11 *(French).* Factors contributing to increased sugar losses in beets stored in clamps are briefly examined, including: injury caused by poor topping, cleaning, loading and unloading; the presence of leaves and excessive temperature in the clamp; and freezing followed by thawing of the beets. Advice is given on means of avoiding these adverse conditions so as to minimize losses.

A three-row bullock-drawn drill for sugar beet. N. S. L. Srivastava and R. N. S. Yadav. *Indian Sugar Crops J.,* 1978, **5,** (1), 1–5.–A description is given of a three-row beet drill which, in tests at two locations, gave uniform sowing at intervals of 5 cm. At a speed of 2·5 kph and a field efficiency of 70%, 2 ha were drilled per 8-hour working day and the costs were only a fraction of those of manual sowing.

Development of sowing techniques in sugar beet agriculture in Western Europe during the last ten years. Z. Srzednicki, J. Kjellberg and G. Srzednicki. *Zuckerind.,* 1978, **103,** 850–854 (*German*).–Developments in beet sowing in Western European countries during the last 10 years are reviewed. Of the countries included, those of the EEC as well as Austria, Finland, Sweden and Switzerland have made considerable strides in mechanization of the various practices and in streamlining the system, particularly during the last 5 years, whereas in the other countries (Greece, Portugal, Spain, Turkey and Yugoslavia) development has been at a much slower pace. The rate of progress is demonstrated by tabulated data.

The effect of agrotechnical factors on the yield and quality of sugar beet. L. Lukács. *Cukoripar,* 1978, **31,** 121-127 *(Hungarian).* — The effect of fertilization rate x row spacing on yield, sugar content and ash content was investigated during 1973-75 as part of an investigation for the author's doctorate thesis. Results are shown in graph form. Also investigated was the comparison between laboratory and field germination and monogermity for a number of varieties in different seed forms. The study showed wide divergence between the germination rates for each variety, in all cases the field value being much lower than that in the laboratory, whereas monogermity was almost identical in each case, with one exception (where the field value was considerably higher than that obtained in the laboratory).

Some thoughts on beet growth. N. Roussel and W. Roelants. *Publ. Trimest. Inst. Belge Amél. Betterave,* 1978, **46,** 71-91 *(Dutch,French).* — The pattern of beet growth was examined in trial fields at one site in Belgium during 1971-77. The three phases are described (the period from germination to start of main root growth, the period of luxuriant leaf growth, rapid and considerable root growth and rapid increase in sugar, and the period of reduction in leaf weight and slow increase in root weight and sugar content). Curves show the changes in sugar content % and root and sugar yield per ha with time from the start of the second phase. Nitrogen application at 130 $kg.ha^{-1}$ was found to be better than 190 $kg.ha^{-1}$ in terms of sugar yield. While differences were found in the absolute sugar yields between two varieties under the effect of the two N rates, the general pattern was virtually the same with both rates, *viz.* the same variety yielding more sugar per ha on almost all sampling dates except in mid-to-late September and early October.

Modifications made to horizontal cylinder machines for chemical treatment of weed beet. A. Vigoureux and T. Vreven. *Publ, Trimest. Inst, Belge Amél. Betterave,* 1978, **46,** 93-105 *(Dutch,French).* — A machine devised by the Institut Technique de la Betterave in France in 1974 has been modified by the Belgian beet research institute (Institut Belge pour l'Amélioration de la Betterave) to increase its efficiency and safety in the control of bolted beet. Basically, the machine is a wheel-mounted cylinder with its axis at right angles to the beet row; as it is towed behind a tractor, it rotates in a direction opposite that of its forward path and simultaneously applies herbicide to the bolters (which, from the end of May, are much taller than the normal beets in the row). The modifications involve the use of a bottom, electrically driven cylinder which applies the herbicide; an intermediate plastic foam-covered roller, driven by friction from the bottom cylinder is used to ensure uniform distribution of the herbicide to the bottom cylinder from an independently driven top cylinder which acts as a feed tank. In one variant, the chemical is pre-mixed in a trough mounted above an upper and intermediate roller (both covered with foam plastic) which distribute the chemical to the bottom cylinder.

Organization of the sugar beet harvest. G. Cloţan, I. Cındea and N. Bria. *Prod. Veget., Cereale si Plante Tehn.,* 1978, **30,** (9), 14-19 *(Rumanian).* — Advice is given on mechanical harvesting and storage of beet in clamps, whereby losses can be minimized. Brief descriptions are given of the BM-6 topper and KS-6 harvester.

Short-term forecasting of beet yield and sugar content. V.B. Khikhlovskii, B.E. Grabovetskii and V.V. Dmitrash. *Sakhar.Prom.,* 1978, (11), 54-57 *(Russian).* — Methods of predicting beet yield and sugar content are described. One is based on comparison of analytical data for beet with mean absolute values obtained in the previous two 10-day periods, while the other, found to be more accurate, uses a computer to evaluate data from the previous single 10-day period.

Sugar beet production costs. F.L. Hoff. *Sugar J.,* 1978, **41,** (4), 11-13. — The costs of beet production in eight regions of the USA (of which only two are identified, *viz.* Minnesota-North Dakota and California-Arizona) in 1976/77 are discussed. The estimates are based on a survey involving 884 beet producers located in 17 states. The costs per acre ranged from $319.31 in Minnesota-North Dakota to $683.07 in California-Arizona, averaging $471.73. However, production costs per short ton of beet ranged from $21.02 to $26.92, averaging $24.33; in Minnesota-North Dakota, where beet yield per acre was the lowest of those recorded (12.5 tons) and sugar content was 16.673%, the costs were $25.62 per ton, while in California-Arizona, where the highest yield (29.6 tons per acre) but the second lowest sugar content (14.835%) were recorded, the costs were $23.11 per ton. (Average yield and sugar content were 19.4 $tons.acre^{-1}$ and 15.982%, respectively.)

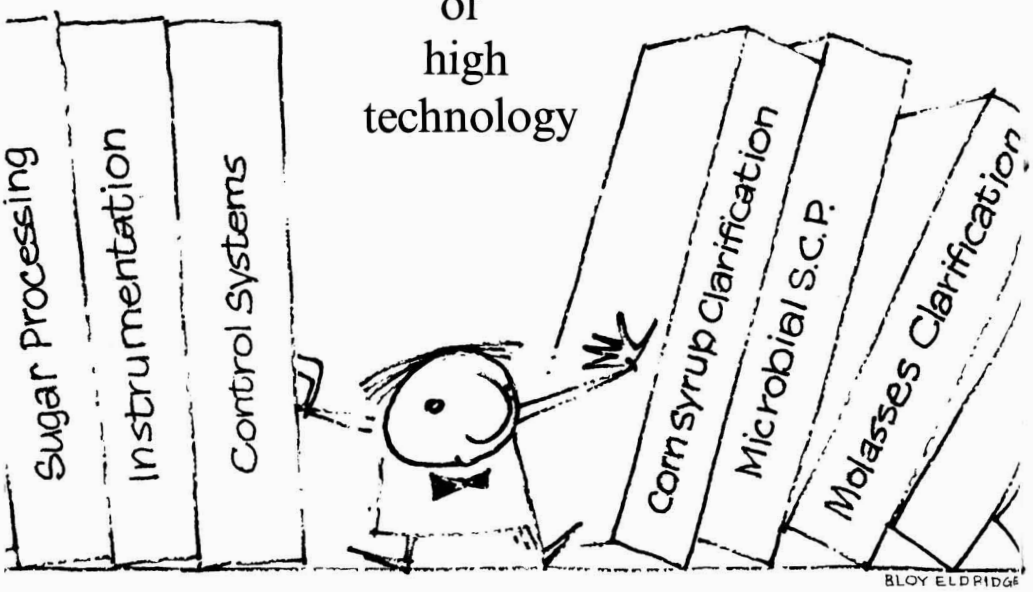
Effect of the number of single plants on technological quality with progressive beet cultivation methods. L. Schmidt, V. Kec and L. Jelínková. *Listy Cukr.,* 1978, **94,** 220-224 *(Czech).* — Since the introduction of planting of rubbed seed in 1962, with the concomitant reduction in manual work in beet fields, average plant populations in Czechoslovakia have tended to be below the 80,000 per ha at which white sugar yield is maximum, although in 1977 the plant population had risen to 73,700 per ha. The effect of populations on root yield, beet quality and white sugar yield are indicated for the overall range 50,000-85,000 (with intervals of 5000) for the period 1971-75.

Erection of and reclamation from beet clamps. M. Martens. *Le Betteravier,* 1978, **12,** (125), 9-10 *(French).* Advice is given on beet storage in clamps and loading of the beets into road transport. The clamp should not be erected on a damp or degraded soil, should be easily accessible to road trucks and loading equipment, should not contain untopped beets and weeds, and should be of such a shape that the external surface area is minimal (to reduce frost damage).

Research on chemical weed control in sugar beet agriculture. M. Erencin, B. Keskin and S. Kayimoğlu. *Seker,* 1978, **28,** (107), 13-20 *(Turkish).* — Trials are reported from four factory sites where individual plots were treated with Betanal, Betanal + Nata, Pyramin, Pyramin + Nata, Nata and hand hoeing. Details are given of the percentages of each weed species killed at each location, the percentages killed for which each chemical treatment was responsible, and the economics of treatment. It has been found that chemical weed control plus drilling to stand is of advantage, particularly where there is shortage of labour.

Results in development of sugar beet seed cultivation. G. Csapody. *Cukoripar,* 1978, **31,** 165-167 *(Hungarian).* An outline is given of developments in beet seed production in Hungary.

Pushing out the frontiers of high technology



Tate & Lyle Process Technology is a newly formed division in the Tate & Lyle group developing and promoting new technology for the sugar and allied industries.
The technology available covers the established range of products and processes from TALO including the well known TALOFLOC and TALODURA processes, the new batch TALOFLOC, TALO juice pH control and the TALO sulphitation systems.
In addition Tate & Lyle Process Technology now offer design, know-how and consultancy in the biological treatment of effluent waste, fermentation technology and molasses clarification.
In 1979 TALO Products and Processes gained the Queen's Award for Technological Achievement.

1979
THE QUEENS AWARD FOR TECHNOLOGICAL ACHIEVEMENT
TALO PRODUCTS & PROCESSES

TATE & LYLE PROCESS TECHNOLOGY, COSMOS HOUSE, BROMLEY COMMON, BROMLEY, KENT, BR2 9NA, ENGLAND. TELEPHONE: 01 460 9182 TELEX: 896253
CABLE: TECSERVE BROMLEY KENT
A DIVISION OF TATE & LYLE AGRIBUSINESS LTD.,
MEMBER OF THE TATE & LYLE GROUP

BEET PESTS AND DISEASES

Use of oospore inoculum of *Aphanomyces cochlioides* to initiate black root in sugar beet seedlings. C. L. Schneider. *J. Amer. Soc. Sugar Beet Tech.*, 1978, **20**, 55-62. – Methods for preparation and use of oospore inoculum of *A. cochlioides* to initiate black root in beet seedlings are described. Increase in inoculum density was accompanied by increase in the severity of the disease; application of the inoculum below the soil surface and near the seed level produced a more severe infection than did application at the soil surface, while application at planting gave a more severe disease than application 6 days after planting. Disease severity also increased when the ratio of mineral components to peat in potting mixtures was increased from 1:1 to 2:1 or more. The inoculum usually remained infective after storage for more than a year at 4°C or -9°C (but not at 23°C).

Comment on a paper on sugar beet yellow wilt by Urbina-Vidal and Hirumi. L. Hoefert. *J. Amer. Soc. Sugar Beet Tech.*, 1978, **20**, 63-64. – Information from the literature on beet yellow wilt and yellows is presented as an aid to interpretation of the elongated virus-like particles (VLP) to which reference is made in the article by Urbina-Vidal & Hirumi[1]. While the authors of the earlier article suggest that the presence of the VLP together with mycoplasma-like organisms is evidence of a complex disease etiology, the author of the present article states that the VLP could very easily be beet mosaic virus particles and inclusions, while the long filamentous particles also found could be normal structures known as P-protein bodies, which are found in developing sieve elements and phloem parenchyma cells. P-protein may be distinguished from virus particles at magnifications of about x 60,000.

The reaction of certain families of sugar beet to beet virus yellows. J. Polák, J. Chod and V.Rímsa. *Listy Cukr.*, 1978, **94**, 225-227 *(Czech)*. – Five families of high-yielding beets tolerant of beet virus yellows and five families of low-yielding, susceptible beets were mechanically infected from a highly necrotic infected stem in a glasshouse after prior inoculation with sap from leaves of an infected plant. The yield parameters and % infection after given numbers of days are tabulated for the ten families. In most cases, at least 50% of the plants were infected by mechanical transmission within 28-33 days, which was adequate for evaluation purposes.

The effect of *Cercospora beticola* (leaf spot) and disease control measures on sugar beet in Natal. N.G. Inman-Bamber. *Proc.52nd Congr.S.African Sugar Tech.Assoc.*, 1978, 214-218. – Investigations at two sites have shown that, while *C.beticola* is likely to be one of the most serious problems in beet growing in Natal, at the site of greater altitude (1450 m) satisfactory control was achieved by growing resistant varieties and applying fungicides. Of advantage is the longer beet-growing season in Natal than in many countries, since this allows resistant but less vigorous beets enough time to reach full root size. On the other hand, at the other site (950 m above sea level), where there are more frequent daily periods of high humidity and temperature, control depended on fungicide spraying, since even resistant varieties eventually became defoliated by the disease. Drilling as early as possible in spring helped by giving the crop the longest possible disease-free period.

Recent results of complex plant protection against sugar beet leaf diseases. I. Examination of the fungistatic effects and mode of action of contact and systemic fungicides against *Cercospora beticola* (Sacc.). T. Hetzer and E. Kiss. *Cukoripar,* 1978, **31**, 85-88 *(Hungarian)*. Systemic fungicides in a beet leaf migrate to the leaf edge and point but do not pass from one leaf to another. It is found that, 7-10 days after spraying, there is a gradual decrease in the action of the chemical in the lower section of the upper surface of the leaf, and within 14 days some surfaces are completely unprotected. *In vitro* and *in vivo* tests were conducted with a number of systemic and contact fungicides against beet leaf spot *(C. beticola)*; "Benlate" and "Fundazol 50 WP" proved most effective at 0.25 ppm, while 4 ppm of "Topsin", 8 ppm of "Brestan 60" or a 6-7% concentration of "Vitigran" were needed to give the same effect. To prolong the activity of a systemic fungicide, combination with a contact chemical was tested on two beet varieties. Results showed that the best in terms of sugar content and yield was 0.10% "Fundazol 50 WP" + 0.15% "Brestan 60" applied at the rate of 700 litres.ha^{-1}. It is stressed that the combinations do not have a synergistic effect.

Tests in 1977 on control of beet root rot. G. Kis. *Cukoripar,* 1978, **31**, 89-90 *(Hungarian)*. – The effectiveness of a number of non-mercurial fungicides against root rot was tested in 1977; both pelleted and unpelleted seeds were treated. Best results, in terms of plant population by comparison with the control, were given by "Tachigaren 70 WP" (manufactured by Sankyo Co. Ltd. of Japan) + "Dithane M-45" (a Rohm & Haas product) at 300 + 200 g/100 kg, followed by "Fundazol" ("Benomyl") + "Dithane M-45" at 200 + 300 mg/100 kg, "Tachigaren 70 WP" + "Thiuram" (from East Germany) at 300 + 118 g/100 kg, and "Tachigaren 70 WP" + "Dithane M-45" at 300 + 200 g/100 kg. A mixture containing phenyl mercuric chloride gave only slight improvement over the control.

A report of the results of a survey of phytosanitary products used in countries of the C.I.B.E. and their costs. J.M. Belien. *Publ. Trimest. Inst. Belge Amél. Betterave,* 1978, **46**, 121-154 *(Dutch, English, French)*. A summary is presented of a survey conducted on utilization of pesticides, herbicides and disease control chemicals in beet-growing countries that are members of the Confédération Internationale des Betteraviers Européens. The tables of data indicate the preferences shown for the individual chemicals in any one country, as well as the pests and moulds occurring. The prices of the individual pesticides in the member-countries are indicated (all values being converted to European Units of Account), and the amount spent as a percentage of the gross income and in terms of beet yield per ha.

[1] *I.S.J.*, 1976, **78**, 180.

CANE SUGAR MANUFACTURE

The control of steam turbines in the sugar industry with special reference to mill trains. H. M. K. Dickson and J. L. Keith. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 45–50.—Use of steam turbines as cane mill drives, particularly the Adaptable Electronic Controlled Turbines (AET) supplied by Weir Pumps Ltd. to Huletts Sugar Ltd., is discussed. Experience with the AET at Darnall factory is related, particular mention being made of speed control.

Heat transfer, mass transfer and scaling characteristics in a long-tube, climbing-film, pilot plant evaporator. D. R. James, G. A. Matthesius and P. F. Waldron. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 64–68.—See *I.S.J.*, 1979, **81**, 214.

The quantity and quality assurance of raw sugar throughput at South African Sugar Terminals, Durban. Z. J. Kimmerling. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 69–72.—Details are given of the procedures used at the Durban bulk sugar terminal in handling incoming raw sugar from the factories, checking its quantity and quality, safeguarding its quality during storage (possibly coating with invert syrup to adjust the pol just before loading into ships) and making a final check of weight of the outgoing sugar.

The crystallization of high-grade massecuite in crystallizers. E. E. A. Rouillard. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 73–79.—See *I.S.J.*, 1979, **81**, 214.

Experience with sodium hydrosulphite as an aid in sugar boiling. P. L. M. Vermeulen. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 93–95.—Trials at three factories over four years are reported in which "Blankite" (sodium hydrosulphite) was tested as a pan additive. It was found generally that addition at, typically, 1 kg per 25 m^3 of massecuite, increased Brix by an average of 0·3°, reduced boiling time by 0·4–0·5 hr, improved exhaustion and had a considerable positive effect on *C*-massecuite curing in the centrifugals. The use of "Blankite" permitted boiling of lower purity *C*-massecuite and produced a noticeable change in massecuite rheological properties.

Hyperthermophilic bacterial activity during clarification. L. M. Brookstein. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 113–117.—A number of bacterial strains were isolated from clarifier mud and clear juice and found to be hyperthermophilic, showing optimum growth at temperatures in the range 70°–85°C but not growing below 50°C. Most belong to the *Bacillus* genus, preliminary identification revealing strains of *B. coagulans, B. stearothermophilus* and *B. megaterium.* All are capable of metabolizing carbohydrates, although under normal conditions the retention time in clarification is sufficiently short to prevent serious losses. However, at Mount Edgecombe, a sucrose loss of some 0·05% (relative to mixed juice sucrose) was established by lactic acid determination; marked sucrose degradation occurred during a 16-hour shutdown (when the residence temperature fell to 80°–85°C) and, to a lesser degree, during short, unplanned stops such as when cane was lacking.

Reception and storage of cane. E. Marino. *Proc. Symp. Industrialization Sugar Cane* (STAB, Brazil), 1978, 11 pp (*Portuguese*).—The expansion of sugar and alcohol production from cane in Brazil has increased the importance of proper cane reception and storage at the country's sugar factories. It is important that the discharge system should be compatible with the types of vehicle used for cane transport and that the stock of cane should be minimal to reduce losses. The Hilo system of chain-net discharge of cane from trailers is described. A review is made of cane reception practice in Brazil, with descriptions of weighing, sampling and analysis, and discharge of cane to the feeder tables. The variety of discharge methods for whole-stalk and billet cane are listed and described individually, in some cases with a review of advantages and disadvantages.

Cane milling. A. Pavan. *Proc. Symp. Industrialization Sugar Cane* (STAB, Brazil), 1978, 25 pp *(Portuguese).* The expansion of milling capacity at Usina São Martinho between 1952 and 1978 is described with an account of the plant installed; from a single three-mill tandem the factory has expanded to two 6-mill tandems and a 4-mill tandem, using forced feeding for two tandems and a Donnelly chute for the other. Capacity had risen to 20,000 tcd and, on addition of a further two mills to the C-tandem, was expected to reach 24,000 tcd in 1979. The relationship between capacity and extraction is discussed, with reference to the work of Murry & Holt. The power available from the turbines driving the various sizes of mill is listed and varies between 2 and 3 hp per tch per mill; the importance of available torque is emphasized. Aspects of mill maintenance and operation are discussed and milling performance data from South Africa and Australia quoted. The integral imbibition system described by Hugot and its adoption in Brazil are discussed.

A new technology for small-scale sugar processing. E. W. Krause and G. B. Hagelberg. *Zuckerind.*, 1978, **103**, 757–761.—The problems associated with conventional sugar factory operation in developing countries are discussed and a survey presented of small-scale manufacture of non-centrifugal sugar from cane and palm, with particular reference to practices in India. Disadvantages of open-pan boiling are indicated, and details given of a system devised for cane sugar manufacture which is technically more efficient than present small-scale sugar manufacture but which is not considerably more expensive or complex. For production of a non-centrifugal block sugar from 20–300 tonnes of cane per day, the raw juice is limed and phosphated, scum being removed by flotation, followed by three-stage evaporation in which the juice is first concentrated from 18° to 35°Bx in a vertical, short tube calandria evaporator heated by bagasse furnace flue gases at 800°C; the juice is then taken to 80°Bx in a vapour-heated Robert-type open evaporator, and in a third stage is concentrated to 95°Bx in a thin-film evaporator. After crystallization in air-cooled crystallizers, the massecuite is poured into moulds. For manufacture of a direct consumption sugar, from 100–300 tonnes of cane per day, the limed juice is partly concentrated in a 1st evaporation stage, carbonatated with flue gas at 300°C and sent to a clarifier. The overflow is

filtered before proceeding to the next two evaporation stages. In the third evaporation stage the Brix is raised to 90°. After crystallization, the massecuite is cured in a centrifugal, with steam and hot water washing, before passing to a vapour-heated dryer. The first evaporator stage provides vapour for the 2nd and 3rd stages as well as for washing and drying of the crystals. Advantages of the schemes are discussed.

The "Lotus" roll—a new concept in milling. J. Bouvet. *Sugar J.*, 1978, **41**, (3), 29-31.—The "Lotus" roll has a cast steel shell with conventional (or almost conventional) circumferential grooving. The shell surface is perforated by holes arranged in axial rows, each row being connected to a collecting channel built into the shell, both ends of each channel being open to the atmosphere. Extracted juice which is normally trapped in the upper part of the cane blanket and creates a semi-liquid zone is forced through the perforations and is discharged at the ends of the channels where it does not cause contamination of the bearings. Inclusion of a "Lotus" roll in the 3-roller 1st mill at Jen Teh sugar factory in Taiwan considerably increased throughput (despite the fact that the roller had only half the number of teeth of a conventional roller as a result of a design misconception), eliminated juice flooding, reduced bagasse pol and slightly raised juice extraction. Other advantages claimed for the roller include greater reliability and life expectancy.

Studies on the design of resistance heaters for improving the fluidity of the polycomponent saccharine system in sugar factories. R. C. Sharma. *Sugar News* (India), 1978, **10**, (2), 7-10.—Possible means of increasing the fluidity of *C*-massecuite are discussed, and aspects of resistance heating examined.

Effect of sugar cane quality on its processing parameters. S. C. Sharma. *Sugar News* (India), 1978, **10**, (2), 16-21. The effects of cane quality on milling, clarification, evaporation and molasses exhaustibility are discussed, particular attention being given to the influence of juice Brix, reducing sugars, phosphate, colloids, wax, polyphenols, sulphate, silicic acid and colouring matter on clarification.

Origin and principles of diffusion. C. Ebeling. *Brasil Açuc.*, 1978, **91**, 305-313 (*Portuguese*).—The historical evolution of the cane diffuser is briefly discussed with an account of the principles of its operation. A series of electron micrographs are reproduced showing the cell structure of cane, and graphs are presented which indicate the reduction in the rate of extraction with time as a function of the increase in the degree of extraction, and also the change in the non-sugar : sugar ratio of the extract.

Control of milling. A. Lambert. *Brasil Açuc.*, 1978, **91**, 321-335 (*Portuguese*).—Given a basic theoretical mill of stated characteristics and dimensions, the various equations from the literature are used to calculate parameters related to milling capacity and efficiency.

Factory processing research in Hawaii. *Ann. Rpt. HSPA Expt. Sta.*, 1977, 42-46.—Improvement of raw sugar continued to be the principal objective of factory research in 1977. Factory-scale sulphitation tests were successfully completed, followed by commercial installation at the factory where the tests had been conducted. The economic feasibility of counter-current sugar boiling was also demonstrated at a second factory, with *C*-sugar remelted as *B*-pan feed, and *B*-sugar remelted for *A*-pan feed, only *A*-sugar being produced as commercial sugar. The system has been adopted at one factory and others are to introduce it. Colour of the raw sugar is reduced by 36-41% and filtrability increased by 25%, but small grain increased from 18 to 24%. A mixed juice analogue-digital flow controller, working on periodic rather than continuous tank level measurement to reduce flow fluctuations, was designed for a two-tandem, four-scale tank juice system and was successfully tested; it has entered regular use in the factory for which it was designed. The use of chloride ion factory material balances has been studied and a conductivity-titration procedure suitable for sugar factory streams developed. Because of analytical difficulties, it was not possible to compare chloride balances in a mill simulation with pol, fibre and refractometer solids balances.

Cleaning of heat exchangers. A. C. Chatterjee, C. B. Bogar and P. B. Londhe. *Maharashtra Sugar*, 1978, **3**, (9), 9-14.—Of factory down-time in Maharashtra, analysis shows that required for cleaning of heat exchangers—mainly the evaporators—to be 15-60%, indicating the importance of rapid and effective cleaning. Disadvantages of mechanical scale removal alone are discussed, and the use of pre-treatment with caustic soda and post-brushing treatment with dilute, inhibited acid is described. The cleaning of juice heaters and pans is briefly mentioned and attention given to the causes of deposits on the vapour side of evaporator tubes and measures to clean them.

Ingenio San Antonio. A progressive sugar factory in Nicaragua. C. F. Pellas. *Sugar y Azúcar*, 1978, **73**, (9), 38-41.—Details are given of the cane agriculture and factory processes and equipment at San Antonio sugar factory which has a daily crushing capacity of 8800 tonnes of cane. Of the 800 tonnes of sugar produced daily, half is raw sugar for export, while the other 400 tonnes is sold locally as bagged refined sugar. Mention is made of the computerized system of data logging and processing used to plan both factory and field activities and monitor equipment maintenance and repairs as well as accounting functions, etc.

Ingenio de Chiriqui, Panama. A. N. Hull. *Sugar y Azúcar*, 1978, **72**, (9), 55-59.—Details are given of Chiriqui sugar factory which started operations in 1977 at an initial capacity of 6670 tcd, with possibility of expansion to 10,000 tcd. The equipment is of the conventional type used in cane sugar factories, including six 3-roller mills supplied by Fulton Iron Works Co.

Los Caños of Puerto Rico is now Ingenio Tempisque in Costa Rica. J. H. Fàriñas. *Sugar y Azúcar*, 1978, **72**, (9), 69-71.—A summary is given of the equipment transferred from Los Caños factory in Puerto Rico to a newly designed factory in Costa Rica after the equipment had been renovated and repaired where necessary.

Chemical cleaning of external heating surfaces. D. S. Lande and N. C. Varma. *Maharashtra Sugar*, 1978, **3**, (10), 35-38.—The adverse effect of steam-side scaling of evaporators on heat transfer is discussed and chemical descaling procedures briefly described. It is the opinion of the author that oil separators are not sufficiently effective, so that there may be need for removal of oil deposit from evaporator tubes by flushing with kerosene.

BEET SUGAR MANUFACTURE

Rationalization of water circuits in a modern sugar factory. R. Michel and J. Vetter. *Ind. Alim. Agric.*, 1978, **95**, 805-809 (*French*).—When Cagny sugar factory in Normandy was expanded, in 1977, to a daily beet slice of 5000 tonnes (with possibility of even further expansion), it was necessary to make changes to the main water circuits. All the water is supplied from two boreholes; it has a temperature of 13°C, a very high lime content and an iron content which is not insignificant, so that special precautions have to be taken for certain processes. Details, with flow diagrams, are given of the water feed schemes and of the condensate and water recycle schemes (which have had to be adjusted, as have the steam schemes, to allow for the 30% of thick juice which is stored for post-campaign processing).

De Smet cold juice diffuser. P. de Bodard. *Ind. Alim. Agric.*, 1978, **95**, 823-825 (*French*).—Details are given of a De Smet Type 80-6-21 beet diffuser installed at Souppes-sur-Loing sugar factory in France, which is a cold juice system selected because of its lower capital costs and because of the opportunity presented to recover heat from condensate. The juice is discharged from tank 23, below the conveyor carrying the bed of cossettes, at a temperature of 30-35°C. Fresh water is fed to the diffuser at 43°C and recycled hot water at 72°C. Juice is discharged at 72°C to a circulation tank towards the tail of the diffuser; after heating to 80°C with vapour from the 4th evaporator effect, it is allowed to percolate through the bed of cossettes, after which it passes to tank 22 at about 45°C, from which it is sprayed over fresh cossettes and is recovered in tank 23. Performance during 1977-78 was up to the rated figures, including losses of 0·19% at a daily throughput of 3600 tonnes and a draft of 110%. Some slight difficulties were encountered in operation, but a fuel saving of 2 kg per tonne of beet has been achieved.

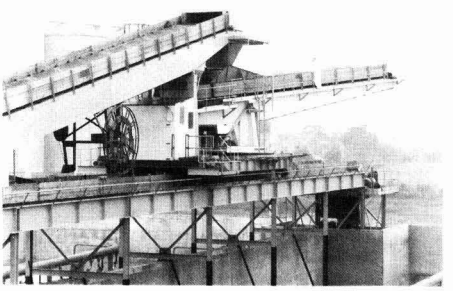
The 1977 campaign in A/S De Danske Sukkerfabrikker. R. F. Madsen and W. K. Nielsen. *Zuckerind.*, 1978, **103**, 831-840 (*German*).—Results of the 1977/78 campaign at the five sugar factories of the Danish Sugar Corporation are reported. Investigations on alternatives to formalin as diffuser disinfectant showed that, while iodoacetone gave good results, it is far more expensive than formalin and thus not economically viable despite the very small quantities required; moreover, it is not pleasant to handle. On the other hand, hydrogen peroxide at 20-25% of the normal quantities of formalin was found to be fully acceptable as an alternative, and does not have the disadvantages of formalin, *viz.* reaction with SO_2, and formation of colour and lime salts in the juice. The economics of formalin and H_2O_2 are about the same. Measurement of the redox potential by a platinum electrode, with a calomel type as reference electrode, proved to be completely satisfactory as a means of determining when to add disinfectant and gives an indication of both enzyme and micro-organism activity. Since addition of disinfectant caused the redox potential to rise, after which it fell stepwise, it is considered possible to apply the measurement to a fully automatic dosing system. Continuous measurement of juice Brix by an Anacon Model 47 refractometer installed in a diffuser was used to control the cossette:water ratio; after a number of problems, the system operated satisfactorily, a value fluctuating between 4 and 8°Bx being represented by a constant reading of about 6°Bx under stable operating conditions. The reading rose rapidly to 9-10° when any slight blockage occurred, so that the supervisor was able to prevent any increase in the problem; similarly, the system registered any dramatic fall in the diffuser feed volume. Investigations showed that addition of 4-14 g of beet pulp per litre to raw juice caused a marked increase in the colour of 2nd carbonatation filtrate but hardly affected purity. However, since the quantity of pulp removed from raw juice by sieving constituted only 0·2-0·6 g.litre^{-1}, it is considered that the colour increase to be expected is not sufficient to justify the costs and difficulties of pulp separation. Pilot plant experiments on continuous carbonatation revealed an approximate relationship between pH and juice colour, whereby an increase in pH to approx. 10·6 was accompanied by a fall in colour, after which the latter rose with further rise in pH. Maintenance of a pH of 10·6-10·7 during 1st carbonatation at Nakskov factory resulted in a very high juice and sugar quality. However, since the effective alkalinity falls with increasing pH as a result of dissolution of lime salts which are not readily

Beet reception at Cantley

A new travelling boom stacker system, part of the £14 million development programme for the factory, at the British Sugar Corporation's Cantley facility, achieves a beet handling rate of 1500 tonnes.hr^{-1}. The 2m wide main conveyor delivers beet to form a stockpile on either side, a method which ensures controlled placement and minimum damage to the crop. Travelling over a distance of 300ft (91.4m) at a speed up to 20ft.min^{-1} (6.1m.min^{-1}), the 45ft (13.7m) radius boom can slew through 270° and luff between 15° and 20° down.

Lorries discharge at ground level at five locations of which two are provided with hydraulic ramps from which lorries discharge beet into hoppers and three are fitted with hinged loading gates for self-discharge. Beneath each hopper, designed to receive loads of up to 20 tonnes, there is an apron plate feeder 5ft (1.52m) wide with a capacity up to 500 tonnes.hr^{-1}. The five feeders discharge on to a 2m wide troughed belt conveyor with inclined centres of about 85m running at 375ft.min^{-1} (144.3m.min^{-1}), which feeds at right angles to the main conveyor.

The plant was designed and fabricated by W.W.Brown & Partners Ltd. of Dartford.



soluble at lower pH values, maintenance of pH 10·5-10·6 also involves a slight rise in sodium carbonate consumption to combat the rise in lime salts. DDS factories normally use filtrate from the rotary filters for milk-of-lime preparation, but foaming requires the addition of water, which thereby increases the volume of thin juice; however, application of Diversay-PL antifoaming agent gave positive results and permitted a reduction in the quantity of added water. Tests on two turbidity meters used for 1st and 2nd carbonatation filtrate measurements showed that both operated satisfactorily in indicating defects in filter bags and checking the performance of newly installed bags; however, the Drott instrument, which measures diffused light at right angles to the main beam, requires cleaning at least once a week, whereas the Monitek instrument, which measures diffused light at an angle of 5-7° to the main beam, is stable in operation for an entire week without such treatment. Both are sensitive to air bubbles. Experience has shown that addition of SO_2 to thick juice, primarily with the aim of preventing colour formation, is not recommended (unless there is an abnormal pH rise in evaporation), since SO_2 is better utilized at the front end of the factory, *e.g.* in diffusion and 2nd carbonatation filtrate; even when added to diffusion water, it is effective in preventing colour formation during subsequent juice processing, particularly in blocking colour reactions in which polyphenols and invert sugar participate. Since thin juice softening by ion exchange does not increase the buffering capacity of the juice, while some sodium carbonate may have to be added to juice having a low effective alkalinity in order to allow adequate sulphitation, it is considered preferable to replace the ion exchange with sodium carbonate addition. The amount of SO_2 to use in sulphitation should be such that the normal maximum SO_2 content in white sugar is 15 ppm; also governing the SO_2 consumption is the maximum permissible content (0·5%) in molasses used as substrate for fermentation processes. The normal total energy consumption in Danish factories producing white sugar (without pulp drying) is 2·6-3·0% on beet, probably the lowest in the sugar industry, although still above the calculated minimum of 2·3%; Assens has achieved 2·57%. All the factories operate quintuple-effect evaporators with the heating surfaces and steam pressures so arranged that vapour from the 3rd and 4th effects is used exclusively for heating purposes in the factory. Before the vapour from the 5th effect goes to the condenser, it is used, together with pan vapours, for limed juice heating. LiCl addition to preliming and its determination by atomic absorption spectrometry has proved of value in determining the residence time throughout juice purification up to thin juice production and indicates *e.g.* when the capacity of a tank has been reduced by deposition. The method is also used to determine residence time in evaporators and low-grade systems. Lower values than calculated from evaporator vessel geometry are attributed to foam formation below the calandria and the resultant reduction in volume. For automatic boiling control, a measuring system has been developed based on the use of high-frequency sound waves. At >1 MHz, the electrical resistance of massecuite is only a small fraction of the total impedance, which is almost only governed by the dielectric constants and hence water content. An aerial installed in the bottom of the pan in the form of an electrode receives signals from a generator; any change in the vicinity of the aerial, *e.g.* the condition of the massecuite, causes a change in the impedance, and this is indicated as a change in the reflection. The impedance is matched to the signal source so as to minimize the reflection from the aerial to the signal detector (to which the signals pass via a transformer and filter). The measuring system is linked to a controller and has led to development of a fully automatic system for boiling control based on level, vacuum and steam pressure regulation which is designated the Model 78-II system. It is recommended for massecuite purities above 93; for lower purities, a system based on conductivity measurement is more suitable. Use of an analogue computer circuit permits selection of different impedance curves for syrup and crystal content as well as control of vacuum and steam pressure independent of massecuite level. Experiments were conducted on a new automatic seed sugar injector which consists of a mixer tank with a funnel below. Immediately before injection, a preset quantity of the suspension (40% icing sugar in 60% polyethyleneglycol) is measured out. Because of its high viscosity (225 cp at 25°C) it remains stable in the funnel, although the viscosity is not so high that the fine crystals are prevented from almost instant dispersion in the vacuum pan. The percentage of single crystals was higher and that of conglomerates lower than with normal dry injection of icing sugar, while mean crystal size was the same in both cases. Using milled white sugar in the automatic system gave poorer results than did icing sugar.

Advances in the treatment of sugar factory waste waters. H. P. Hoffmann-Walbeck and A. Pellegrini. *Zuckerind.*, 1978, **103**, 841-847 (*German*).—A survey is presented of systems for treatment of sugar factory waste water, covering both aerobic and anaerobic, slow and rapid, high- and low-load processes.

Mechanical damage to sugar beet. K. Vukov and G. Pátkai. *Zuckerind.*, 1978, **103**, 848-850 *(German)*. — The damage caused to beet by impact after falling during loading and unloading is studied mathematically, and decisive parameters shown to be height, beet weight and modulus of elasticity. Experiments, in which beets of known weight and elasticity modulus were dropped from a height of 1.9 m, gave values of the product of the three parameters which were greater than the calculated critical product value when surface breakage occurred, but were lower when there was no breakage; the divergences were attributed to differences in outer form of the beet or to its reduced compressive strength. The critical height of fall for beet of varying weight and elasticity modulus was also calculated, and the values recommended for use by designers and technologists.

The heats of combustion and calorific values of solid products in the food industry and their importance for evaluation of a dust explosion risk. R. Wasmund, V. Sprung and H. Bultmann. *Zuckerind.*, 1978, **103**, 856-860 (*German*).—The importance of knowledge of the heat of combustion and calorific value of a number of food products in powdered form with regard to dust explosion risks is discussed, and tables presented of experimental values and of values calculated from analytical data. White sugar and icing sugar are among the products listed.

A system of two-position control of affination massecuite Brix. J. Koj and W. Luczyński. *Gaz. Cukr.*, 1978, **86**, 228-229 (*Polish*).—Details are given of an automatic Brix control system applied to low-grade massecuite mingling with run-off, whereby the resultant magma is fed at 89-91°Bx to centrifugals for a second spinning.

NEW BOOKS

Sugar year book 1978. 365 pp; 10 x 14 cm. (International Sugar Organization, 28 Haymarket, London SW1Y 4SP.) 1979. Price: £7.00.

The 32nd edition of this pocket book of sugar statistics contains data relating to centrifugal sugar for 124 countries plus the EEC and French Overseas Territories. The data have been submitted by member-countries of the International Sugar Agreement under the ISA rules and, in the case of non-members, have been supplied by the individual governments, extracted from statistical publications or have been merely estimated. The figures relate to the calendar year and are expressed in tonnes; wherever possible, they are given in terms of 96 pol raw sugar, although (where the information is available) trade figures are broken down into raw and refined (or plantation white or factory white) sugar as well as the raw sugar equivalent totals. (If the quality of the sugar is unknown, the term "tel quel" is used.) In most cases, the data concern production, imports, exports and consumption in the period 1972-78, but in some cases the range is from 1971. World tables are also given, including refined sugar retail prices in selected countries as well as the London Daily price of raw sugar. Reference to the tables is easy because of the compact layout and clear print on matt paper.

Sugar analysis — ICUMSA methods. Ed. F. Schneider. xiv + 266 pp; 15 x 23 cm. (International Commission for Uniform Methods of Sugar Analysis, P.O. Box 35, Wharf Road, Peterborough, England.) 1979. Price: £12.00.

The first edition of "ICUMSA methods of sugar analysis", edited by the late H.C.S. de Whalley, was published in 1964 and achieved deserved success in its aim of gathering within a single cover all the methods employed for analysis covered by the various Subjects of the Commission. It has been out of print for some years, however, and five Sessions of ICUMSA have taken place in the interim.

It is consequently with great eagerness that the world of sugar analysis has awaited this second, revised and updated edition, ably prepared by nine contributors and edited by Professor Schneider, Life Honorary Vice-President of ICUMSA and former Director of the Institut für landwirtschaftliche Technologie und Zuckerindustrie, Braunschweig. Unfortunately, printing difficulties delayed publication until after the 1978 Session but postscripts have been added to the method descriptions to take account of changes adopted by ICUMSA in Montreal.

The book includes three main parts, *viz.* General methods, Special methods, and Tables. The former includes the major characteristics and parameters determined in sugar laboratories — sucrose and polarization, reducing sugars, ash, etc. and in each case there is provided a discussion of the scope and field of application of the analysis and details of the various methods, including the principle involved, apparatus and reagents used, procedure, and literature references, including an indication of its status (official or tentative).

The Special methods are those for assessing the characteristics of white sugar, the refining qualities of raw sugar and the evaluation of bone char and of powdered and granular carbons. A similar pattern is employed as for the General methods. Five tables appear in Part III of the book, *viz.* the International refractive index scale for pure sucrose solutions at 20°C and 589 nm, temperature corrections for refractive index values (reference temperature 20°C), International refractive index scale for pure sucrose solutions at 27°C and 589 nm, temperature corrections for refractive index values (reference temperature 27°C) and density values of pure sucrose solutions at 20°C. Author and Subject indexes complete what must be an essential part of the equipment for every sugar laboratory.

The Australian sugar year book 1979. Ed. W. Kerr. 320pp; 18 x 24.3 cm. (Strand Publishing Pty. Ltd., Box 11850, G.P.O., Brisbane, Queensland, Australia 4001.) 1979. Price: $Aust. 15.00.

The latest edition of this yearbook is, like its predecessors, packed with information on the Australian sugar industry, with a map, directory of personnel, statistics of production, a list of approved cane varieties for 1978, highlights of the annual reports of the Bureau of Sugar Experiment Stations and Sugar Research Institute, and accounts of major news stories of the year, including the purchase by cane growers of the three New South Wales factories, application of the Matthews Committee findings, etc. Reports are presented of the annual conferences of the Proprietory Sugar Millers Association, the Queensland Society of Sugar Cane Technologists, Queensland Cane Growers' Association and Australian Sugar Producers' Association, while speeches and articles are given, many reprinted from the *Producers' Review*, published also by the Strand company. The last section is, as before, the very detailed index to Australian sugar factories which provides brief histories, personnel records, and details of the plant and production figures from 1964 or 1965 until 1977 with estimates for 1978. The year book remains the most useful and complete source of information on the Australian sugar industry.

Gur and indigenous sugar industry of south Asia: an annotated bibliography. A.R. Ghani. 370 pp; 16 x 24 cm. (Shahtaj Sugar Mills Ltd., Mandi Bahauddin, Dist.Gujrat, Pakistan; Appropriate Technology Development Organization, Islamabad, Pakistan.) 1979.

In the course of setting up a small sugar factory library of works on sugar technology, the author found that there was no bibliography of literature on gur and indigenous sugars in southern Asia. It was decided to compile a bibliography which would not merely be a simple listing of titles, but would provide notes on the various works. The result is a compilation of 810 references to articles and books on the subject, set out in alphabetical order of their authors and covering economic, socio-cultural, historical and technical aspects. A glossary of selected terms generally used in north India and parts of Pakistan is appended, as is a list of journals, a name and subject index and a list of abbreviations used. For those people interested in gur and other non-centrifugal sugars, this is a useful work which is well set out and clearly printed.

LABORATORY STUDIES

Formation of lactic acid and colouring matter as a result of alkaline hexose degradation. H. Andres, B. Pichler and V. Prey. *Zuckerind.*, 1978, **103**, 753-756 *(German)*. – In investigations of hexose decomposition in an alkaline medium, 0·3M dextrose solution was mixed with (i) 0·1N NaOH and (ii) milk-of-lime (containing 88 g CaO per litre) in a 1:2 ratio (v/v) and heated in a water bath at 35°C. After a given time, a sample of the dextrose-NaOH mixture was neutralized with 0·1N HCl and made up to volume with water; similarly, a dextrose-lime sample was neutralized with 0·1N H_2SO_4 and the precipitate filtered off. U.V. absorption curves between 190 and 390 nm were plotted as an indication of the degradation time pattern, extinction in the range 420–560 nm was used to describe colouring matter formation, the bromine number of Knopp was used as an indication of browning polymer formation (in terms of conjugated double bonds), Tillmann's reagent was used in a semi-quantitative method for determination of endiolcarbonyl groups, while lactic acid was determined enzymatically. The curves show that absorption in both U.V. and visible light starts within the first 3 min of heating, U.V.-active compounds probably being formed before visible-spectrum colouring matter. It was not possible to confirm the existence of an equilibrium between colouring matter and lactic acid, since extinction is only an approximate measure of colour, although long-term experiments with lime suggest such a balance. Application of oxygen in the form of compressed air to the dextrose-lime mixture caused a fall in the extinction values as well as a reduction in the amount of lactic acid formed.

Sucrose degradation under alkaline conditions—an isotopic method for the estimation of "sugar loss" in refining processes. B. C. Goodacre, G. L. Martin and J. Coombs. *Sucr. Belge*, 1978, **97**, 305-315.—A method, devised for determination of small quantities of sucrose degraded under alkaline conditions approximating to those in a refinery, is described; it is based on addition of ^{14}C-sucrose to the sample before it is subjected to the same conditions as in the process. The sucrose degradation products are then separated from the residual, unchanged sucrose by column chromatography, and the extent of degradation then expressed by the ratio of the radioactivity of the non-sucrose fractions to that of the sucrose fraction. Details are given of the ^{14}C-sucrose purification, products separation and radioactivity measurement procedures. Elution profiles were obtained for a number of model compounds applied to the column of "Dowex AGW 50 x 4" resin and eluted with EDTA; in all cases, the degradation products were eluted well in front of the sucrose peak. Radioactive sucrose, dextrose and levulose were used in various combinations to confirm the position of various fractions. Application of the method to determination of sucrose degradation under conditions similar to those in refinery processes showed that it apparently gave an accurate measurement to within ± 0·01%, with a degradation magnitude varying from about 0·004% per hr to more than 0·04% per hr according to conditions. Because of the much lower sensitivity of other methods, direct comparison between them and the new one is difficult. While the method has the disadvantages of smallness of scale (with only a few cm^3 of degradation reaction mixtures being involved), complexity of separation and a lengthy ^{14}C-sucrose purification procedure, it does respond to a low degradation rate, unlike previous methods, and is applicable over a wide range of pH and temperature.

Problem of the hydrolysis of sugars and glucose syrup with hydrochloric acid (sucrose inversion). K. Zürcher and H. Hadorn. *Mitt. Geb. Lebensmittelunters. Hyg.*, 1977, **68**, (2), 200-212; through *S.I.A.*, 1978, **40**, Abs. 78-1059.—Pure solutions of sucrose, maltose and lactose and samples of glucose syrup and its dextrin fraction were hydrolysed (a) by Schoch & Alschwang's method, using dilute HCl at pH 1-2 on a boiling water bath for 15 min, and (b) by the German customs method, using more concentrated HCl at 68-70°C for 5 min. Sugars in the resulting solutions were determined by reductometric, enzymic and gas-liquid chromatographic methods. The sucrose was practically all hydrolysed to glucose and fructose, with no significant quantities of other products. The reducing powers of the lactose and maltose solutions increased only slightly, although GLC showed that there was considerable hydrolysis and conversion to other compounds. Acid hydrolysis, especially by method (b), partially degraded the oligosaccharides and dextrins present in glucose syrup.

Development of a new short-cut method for the determination of the sucrose content of sugar beets in sugar beet receiving stations in Japan. I. Contrivance of new brei samplers. H. Tanabe, T. Masuda, K. Kagawa *et al. Proc. Sugar Beet Research Assoc.*, 1975, (17), 1-10; through *S.I.A.*, 1978, **40**, Abs. 78-1070. **II. An improved brei sampler, a new digital refractometer, and the relationship between Brix and the percentage of sucrose in sugar beet.** *Idem ibid.*, 1976, (18), 1-14; through *S.I.A.*, 1978, **40**, Abs. 78-1071.

I. Two kinds of brei sampler, a borer and a small sawing machine, which have been designed for use in beet receiving stations in Japan, are described with diagrams. The Brix of juice obtained by squeezing the brei is measured by an automatic refractometer. Since there is a high correlation between the Brix and the sucrose content, the latter can be found by means of a regression equation.

II. An improved sawing machine for obtaining samples of brei has been designed; it is compact, portable and simple to operate. A refractometer has been designed by Atago Co. specially for use with beet juice. The Brix x of the juice sample is measured automatically and is converted to % sucrose y by means of a built-in mechanism; this % is indicated digitally on a panel. The conversion is based on a linear regression equation $y = ax - b$. Tests on commercial samples of beet gave the relation $y = 0{\cdot}93x - 1{\cdot}98$, with a correlation coefficient of + 0·979.

Changes in the chemical composition of sugar beet roots during prolonged storage. J. Zahradníček, M. Ondráček and P. Vrátný. *Listy Cukr.*, 1978, **94**, 193-199 *(Czech)*. Beets stored for 167 days were sampled at 14-day intervals for analysis. Results showed that the sugar content of undamaged beets fell from 17·65 to 12·50% over the entire period, while the invert sugar content rose from 0·028% to 0·138%. There was no essential change in the α-amino-N and ash contents. However, in the case of beets undergoing any degree of putrefaction or bacterial

infection, the sugar loss and final invert sugar contents were much greater, while differences were found in the contents of 18 free amino-acids determined by ion exchange chromatography. The pattern of change is shown by time curves for each amino-acid over a $3\frac{1}{2}$-month period. Glutamine was easily the most dominant.

Application of a HP 97 programmable computer in a sugar factory laboratory. J. Gerse and I. Pócsi. *Cukoripar,* 1978, **31**, 100-105 (*Hungarian*).—The application of a Hewlett-Packard HP 97 computer for sugar factory laboratory data processing is described; its potential is demonstrated by programmes applicable to a number of specific parameters.

New methods of invert sugar determination. J. Dobrzycki and M. Ludwicki. *Ind. Alim. Agric.,* 1978, **95**, 715-719 (*French*).—Two methods for continuous determination of reducing sugars are outlined. The first is based on use of Müller's reagent, diluted 1:1 with water, which is metered at the rate of 1·6 $cm^3.min^{-1}$ to a mixer where it is mixed with the test solution (metered at the same rate as the reagent) and allowed to react with it for 6 minutes at 95°C; after cooling to 25°C, the contents are mixed with 2·5N acetic acid and transferred to a measuring cell comprising a copper electrode and a calomel reference electrode connected to a KCl feed. The copper ion reaction with the reducing sugars is measured as e.m.f. on a millivoltmeter connected to a recorder. Of 24 organic acids, alcohols, ketones, invert sugar decomposition products and aldehydes, only the last had any noticeable effect on the measuring electrode potential, but even this was negligible under test conditions, not exceeding 7% of the reducing capacity of the reagent at identical molar concentrations of invert sugar and aldehyde. Sucrose had no effect on measurement up to a concentration of 30°Bx. Tests on invert sugar determination in raw, thin and thick juices showed relative errors of ± 17% in the range 0·02-0·18 g/100 cm^3, ± 12% in the range 0·012-0·10 g/100 cm^3 and ± 7% in the range 0·16-0·40 g/100 cm^3, respectively. While approximate linearity was established for the relationship between the electrode potential and invert sugar concentration as expressed by semi-log graphs, at equimolar concentrations of levulose and dextrose the straight line exhibited a marked deflection at approx. 0.2 g/100 cm^3, and the slopes of the lines on each side of this deflection were decidedly different. The second method described measures the time required for methylene blue decolorization by the reducing sugars; the reaction takes place in a vertical calibrated glass column maintained at 90°C by a water jacket, and the invert sugar concentration is represented by the height of the column of coloured solution. Approximate linearity was established between extent of decolorization and invert sugar concentration in 50°Bx white sugar solutions to which known quantities of invert sugar had been added.

The electrical conductivity of sugar products. J. Ponant. *Ind. Alim. Agric.,* 1978, **95**, 725-737 (*French*).—Studies carried out during six campaigns on molasses from ten factories have confirmed the validity of the equation $Y = A\ (100-P)\ xe^{-cx^n}$, where y = conductivity (mS), P = purity, $x = B/(100-B)$, where B = Brix, e is the natural logarithm base, n is a constant having a value of 0·8, and c is a coefficient (found to be inversely proportional to the absolute temperature) determined by measuring the conductivity at constant purity and temperature but two different Brix values and deducting the lower from the higher value. Applicability of the equation to *e.g.* purity determination, automatic control of ion exchange and automatic control of alcoholic fermentation of sucrose is demonstrated.

Application of micro-waves. Moisture determination in sugar factory products. P. Devillers, R. Detavernier and M. Groult. *Ind. Alim. Agric.,* 1978, **95**, 739-745 (*French*).—After investigations of the dielectric properties of beet molasses had shown that the moisture content could be determined by micro-waves of a frequency greater than 10^9Hz, tests were conducted with a microwave oven of US origin having an output frequency of 2450×10^6 Hz. Comparison was made between the values obtained for five samples and results given by gas-liquid chromatography, the Karl-Fischer method and oven drying at 105°C. This showed that the micro-wave oven gave the highest values, but also the highest C.V., indicating changes in the molasses during drying. Subsequent tests were carried out with an I.M.I. oven of French manufacture which has two heating rates and a rotary plate for uniform distribution of the micro-waves. Values obtained with this oven were in close agreement with those given by oven drying at 105°C, while oven drying at 65°C gave systematically lower values. The micro-wave procedure has the advantage of a much lower time requirement for drying. No trace of overheating was found, as was also the case with a 20% white sugar solution which did not undergo caramelization. The moisture content of beet pulp was determined within 30 minutes and of pellets within 12 minutes by the micro-wave method, compared with 14 hours needed for both products with oven drying at 105°C.

Expression of the viscosity of sugar solutions. J. Genotelle. *Ind. Alim. Agric.,* 1978, **95**, 747-755 (*French*).—By analysing the viscosity tables compiled by the National Bureau of Standards[1] and Schneider *et al.*[2], covering a Brix range of 20-86° at 0-80°C, the author shows that the equations derived by Kaganov, Pidoux and Wagnerowski for pure sucrose solution viscosity are only approximate, since the relationships between log viscosity and (i) molar concentration and (ii) ϕt (a function of temperature) are not strictly linear. A new formula has been derived which is of general application to intermediate factory products as well as molasses and pure sucrose solution; it incorporates a factor k which is a function of Brix, purity and viscosity and which can be found by means of a separate equation. Comparison with values obtained by other authors for molasses and for sugar solutions show close agreement.

Analysis of sugar cane quality in different sugar zones. R. de Ulivarri. *La Ind. Azuc.,* 1979, **85**, 203-205 *(Spanish).* Although Tucumán is the state in Argentina with the largest cane area, the other states to the north (Salta and Jujuy) produce more sugar in proportion to their area because of an average temperature of 22·2° *vs.* 19·0°C, the difference rising to 4·7°C in the summer, which allows a longer growing season and higher sugar content and cane yields. Cane quality is measured in terms of primary juice Brix, pol, and purity, and cane pol and fibre contents. Averages for the Argentine states for the period 1968-72 are tabulated with comparative figures from thirteen other cane-growing countries.

---

[1] "Polarimetry and saccharimetry of the sugars". *N.B.S. Circ.,* 198. (440).

[2] *Zucker,* 1963, **16**, 465-473

BY-PRODUCTS

Study of waste from the beet sugar factory which is turned into fertilizer. I. The kinds of waste and their present state. II. Granular fertilizer manufacture from lime cake. Z. Tanaka, M. Chigira, R. Wakui *et al. Proc. Sugar Beet Research Assoc.,* 1976, (18), 251-259, 261-268; through *S.I.A.,* 1978, **40**, Abs. 78-1044.—The main waste materials from beet factories are: Steffen waste, effluent from ion-exchange columns, filter cake, flume water and settled mud from it, and free soil. Steffen waste, which was formerly difficult to dispose of, can now be converted to concentrated Steffen filtrate and used in the production of fertilizer. Methods for granulation of the filter cake, to convert it to a convenient form for use in agriculture, were tested. Addition of lignosulphonates and the use of a two-stage drying process gave granules of the desired hardness; these granules contained not only lime but organic and other inorganic compounds absorbed from the beet juice during its purification.

Effect of addition of H_3PO_4 in mixed cultivation of yeast on vinasse. S. M. Tauk and V. Gambale. *Brasil Açuc.,* 1978, **91**, 239-244 (*Portuguese*).—Studies were made on the yields of protein by cultivation of *Candida* species, alone and in pairs, and on the effect of addition of 0·05% H_3PO_4 to the mixed cultivations. *C. utilis* gave the highest protein content (45·75%) and *C. javanica* the highest dry solids yield (5·04%) of the pure cultures, while mixed cultures gave lower protein contents and lower dry solids yields. Addition of H_3PO_4, however, raised both yields and protein contents of the mixed cultures, the highest dry solids yield being given by a culture of *C. solani* and *C. tropicalis* (4·89 mg. cm^{-3}) and the highest protein content (49·00%) being given by *C. brumpti* + *C. utilis.*

Evaporation in the storage of alcohol: causes and solutions. R. Clay. *Brasil Açuc.,* 1978, **91**, 245-248 (*Portuguese*). —The quantity of alcohol lost by evaporation from storage in a tank, where the vapour space temperature can vary between 15 and 55°C, is calculated and can amount to 3·16% of production for a distillery producing 90 m^3 per day and using three tanks of 4000 m^3 storage capacity. Losses also arise during filling of a tank and correspond to the alcohol content of the air displaced. This is calculated as a further 0·14% of production. Factors which affect these losses are listed and methods of reducing them discussed, including the use of valves to close off the vapour space from the atmosphere, floating aluminium seals, and a patented "Tisserand" steel floating seal. Other advantages of such floating seals (which are widely used in petroleum storage) in respect of safety, durability, etc., are mentioned.

Poultry production based on various feed products and by-products available in tropical climate countries. M. Valdivié. *Cuban J. Agric. Sci.,* 1978, **12**, 1-16.—A survey is presented of the literature on poultry feeds in tropical countries, including a short section devoted to the subject of using final and high-test molasses, raw sugar and filter cake oil.

Rearing dairy calves by restricted suckling. XI. Performance of calves reared by restricted suckling or with nurse cows supplemented with molasses/urea or concentrates from 1 week of age to 150 kg weight. J. Ugarte. *Cuban J. Agric. Sci.,* 1978, **12**, 17-23.—Calves reared on a system of restricted suckling twice a day after milking showed a daily weight gain which, from birth to weaning and from birth to a target weight of 150 kg, was greater than of those reared by nurse cows, although the latter system gave higher daily gains over the period from weaning to the target weight. In all cases, the daily weight gains were lower when the calves were fed on a diet comprising a molasses-urea mixture plus fish meal than when fed on a grain concentrate.

Effect of concentrate supplementation before and after calving on milk production of grazing cows. R. O. Martínez, A. Venereo and E. Gómez. *Cuban J. Agric. Sci.,* 1978, **12**, 33-42.—In experiments to study the effect of concentrate supplementation before and after calving, the live weight gain of cows was greater before calving when fed on the concentrate (containing 10·6% final molasses on dry matter) than when fed on pasture. However, the loss in weight after calving was greater when the cows were fed on concentrate than on pasture. In one experiment, there was no effect of feed on milk production after calving, whereas in the other there was a marked increase as a result of concentrate feeding. It is suggested, however, that feeding of concentrate is of benefit only when high-quality pasture is not available for the weight gains necessary for calving.

The use of fibrous sugar cane by-products by the ruminant. IV. NPN/TP ratio and true protein source in treated bagasse pith diets for fattening steers. P. C. Martín and A. Elías. *Cuban J. Agric. Sci.,* 1978, **12**, 43-49.—In investigations on the effect of the non-protein nitrogen: true protein (NPN:TP) ratio and on the influence of true protein source on the feed value of treated bagasse pith-based diets, a 60:40 ratio was better than a 80:20 ratio in respect of daily weight gain of steers weighing some 250 kg initially. The 60:40 ratio was responsible for a higher daily consumption and a better conversion rate (kg/kg), both factors being expressed as dry matter and metabolizable energy. None of the factors studied was significantly affected by differences in protein source. (Fish meal and soybean meal were the other protein sources involved, all supplements being offered with final molasses.)

Effect of restricted molasses-urea supplementation on bulls grazing pangola grass (*Digitaria decumbens* Stent). P. C. Martín and F. Alfonso. *Cuban J. Agric. Sci.,* 1978, **12**, 51-58.—Calves grazing continuously on a grass sward were also fed a supplement containing 1·5 or 2·5 kg of molasses plus 7% urea per day. While the daily weight gain increased, in both the wet and dry seasons, as a result of the supplement and was maximum with 2·5 kg of molasses per day, it was considered economically disadvantageous to exceed 1·5 kg of molasses per day.

Effect of the inclusion of zeolite in final molasses-based diets on the performance of growing-fattening pigs. M. Castro and A. Elías. *Cuban J. Agric. Sci.,* 1978, **12**, 69-75.—While final molasses has been widely used as pig feed, it has been found that a molasses level above 30%

has adverse effects, and studies have been made on the use of additives to improve the performances of the diets. Investigations on pigs of 35 kg live weight showed that the inclusion of at least 5% zeolite to the ration significantly improved feed conversion up to a live weight of 65 kg; in both this and the subsequent fattening stage to 100 kg live weight, 7·5% zeolite gave the best results as regards conversion and daily weight gain.

The use of high-test molasses for weaning piglets. I. Sucrase and maltase activity. J. Ly, M. Peraza and J. Díaz. *Cuban J. Agric. Sci.*, 1978, **12**, 77-82.– The specific activity of sucrase and maltase in piglets fed on rations containing ground maize and fish meal was not impaired by the addition of high-test molasses to the diets, and sucrose and maltose hydrolysis was unaffected. It is suggested that the activity of sucrase and maltase remains high in the presence of a high proportion of molasses in the diet and does not limit carbohydrate utilization.

Silage of manure and final molasses. III. Effect of different proportions of manure and final molasses on nitrogenous compounds. C. Hardy and A. Elías. *Cuban J. Agric. Sci.*, 1978, **12**, 83-87.–Investigations on the effect of the manure: molasses ratio in silage on the nitrogenous compounds are reported. In all cases the total N (% dry matter) was greater after 30 days than at the start of ensilage, and was higher with increase in the manure proportion. Conversion of soluble to insoluble N was also greatest with the maximum manure:molasses ratio (70:30). Hence, the possibility is suggested of making fodder of higher protein content by replacing a substantial proportion of the molasses with manure; the N content could also be increased by addition of urea.

The field of recovery of useful materials from pollutants and industrial wastes and their re-use in production. A.C. Chatterjee. *Maharashtra Sugar*, 1978, **3**, (9), 41-42. By means of a patented process, details of which are not given, Walchandnagar Industries Ltd. are able to obtain a potassium fertilizer from vinasse while eliminating the problems of disposal and environmental pollution. Methane gas is produced in anaerobic fermentation and can be recovered to provide heat which aids the steam balance.

Beet pulp drying and pelleting. S. Varotti. *Ind. Sacc. Ital.*, 1978, **71**, 100-103 (*Italian*).–Four different hypothetical cases are cited, in which pressed pulp from 5000 tonnes of beet per day at a marc content of 4% is dried to a given moisture content. Comparison is made between pressing to 18% dry solids before drying to 92% dry solids or to 88%, where pelleting is to be carried out and thus the dry solids content requirement of the pulp leaving the dryer is reduced. This is shown to increase the dried pulp yield at the same evaporation rate and pulp loss. Increasing the pressed pulp dry solids content and drying to 88% dry solids reduces fuel consumption in drying but reduces dried pulp hourly output. In the fourth case cited, pressed and dried pulp dry solids contents are respectively 18 and 92%, but the pulp losses are higher. The hourly output is the lowest of all four cases. It is concluded that drying plus pelleting has the advantages over straight drying of fuel saving, increased pulp production and reduced fire risk. Of the two types of dies used in pellet presses, the disc type is considered preferable to the ring type because of the former's lower power requirement to achieve the same effect, and reduced wear. The possibility of producing molassed pulp pellets in Italy is mentioned.

Pressed pulp storage. P. Vandergeten and R. Vanstallen. *Le Betteravier*, 1978, **12**, (124), 9, 12 (*French*).–Advice is given on storage of pressed pulp silage; data are given which demonstrate the correlation between the dry solids content and state of preservation of the silage: at a high dry solids content (of 22% and above) the proteins keep better, butyric acid production is slow (so that the silage does not give off any nauseating odour), and the acetic acid content is maintained at a sufficiently low level that, together with the low butyric acid level, it does not present any risks in *ad lib* feeding to cattle.

Beet pulp pressing. Experiment on technico-economic optimization. M. Demaux. *Ind. Alim. Agric.*, 1978, **95**, 811-820 (*French*).–A mathematical study is made of the technology and economics of pulp pressing with the aim of showing how to calculate the optimum target moisture content, based on the concept of maximum "pressability". It is stressed that the study is only an exercise in methodology but is not intended to show the actual costs of pressing.

Use of drum dryers for processing various industrial wastes into high-grade animal feeding stuffs. H. Fritze. *Escher Wyss News*, 1976, **49**, (1), 36-44; through *S.I.A.*, 1978, **40**, Abs. 78-1174. – Systems for using drum dryers for drying molasses and processing whey, potato wastes and effluent from potato starch factories are described. Molasses is preheated to approx. 50°C to decrease its viscosity, treated with milk-of-lime to improve its drying and storage behaviour, and foamed with air to increase its surface area, thus aiding drying. The molasses is fed via an oscillating distributor onto a single-drum dryer; the dried material is removed by a scraper onto a cooling drum, where it solidifies in flakes which are sent to a briquetting machine. Since the heating time is short, the nutritive value and taste of the molasses are not impaired.

Question of using sulphuric and hydrochloric acids in alcohol manufacture from (beet) molasses. V.N. Shvets and A.N. Ogorodnikova. *Ferment.Spirt.Prom.*, 1977, (8), 11-13; through *S.I.A.*, 1978, **40**, Abs.78-1176. – Tests on three molasses samples demonstrated that unclarified molasses acidified with H_2SO_4 gave at least as much ethanol as centrifugally clarified molasses acidified with HCl; effects of clarification were adverse with H_2SO_4 but usually beneficial with HCl.

Replacement of potassium by ammonium in molasses slops with precipitation of the double salt K_2SO_4, $CaSO_4$,H_2O. V.I. Chopik. *Ferment.Spirt.Prom.*, 1977, (6), 8-9; through *S.I.A.*, 1978, **40**, Abs.78-1180. Various processes proposed for improving the fodder value of vinasse by K removal and N enrichment are surveyed. Addition of 10% $(NH_4)_2SO_4$ (on vinasse) as approx. saturated solution to hot vinasse at 70.8°Bx decreased the K content from 7.5 to 4.8% on dry solids, replacing K^+ by NH_4^+ and precipitating K_2SO_4. Repeating the same process with simultaneous addition of 10% crushed gypsum gave a final K content of 3% on dry solids, *i.e.* 60% removal/replacement instead of 36%, owing to the formation of sparingly soluble double salts K_2SO_4,$CaSO_4$,H_2O and K_2SO_4, $5CaSO_4$,H_2O; in excess water, these give recyclable gypsum and K_2SO_4 for fertilizer use.

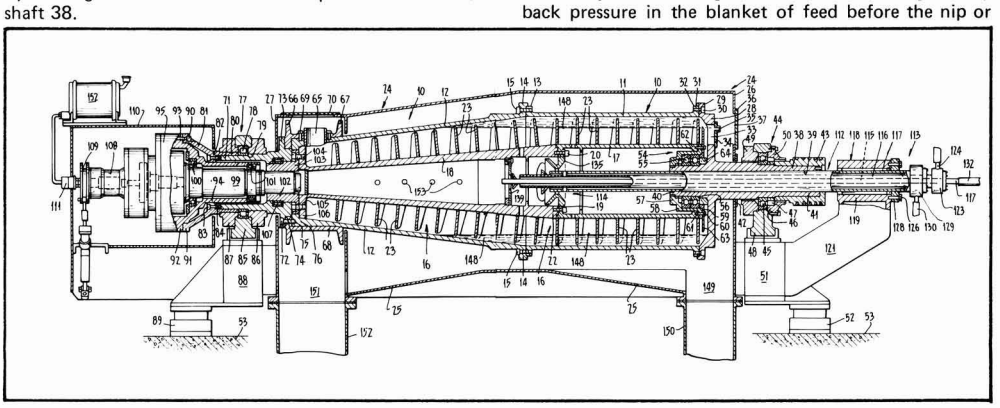
PATENTS

UNITED STATES

Centrifugal separator (for raw cane juice). R.J. Hunwick, of Wollstonecraft, Australia, *assr.* Dorr-Oliver Inc. **3,967,778.** April 14, 1975; July 6, 1976.

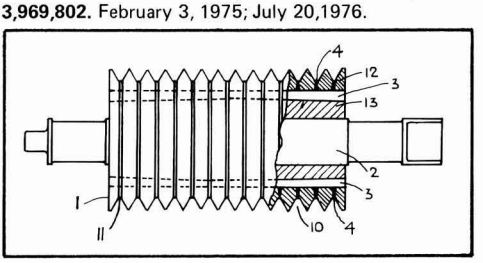
The solid tubular bowl or housing 10 of the centrifugal comprises a cylindrical portion 11 and a conical portion 12 bolted together at their flanged ends 13,14. Within the housing is a screw conveyor 16, also in the form of a cylindrical and tapered section 17,18 bolted together at the internal flange 19. A helical screw 23 extends around both parts of conveyor 16. Both housing 10 and conveyor 16 are supported for rotation about a common horizontal axis within the casing 24 which includes a circumferential wall 25 and end walls 26,27.

The input end of bowl 10 is closed by an end plate 28 with a flange bolted to the end flange of a cylinder 11. The plate has an overflow port 33 closed by a disc 34 in which is an overflow passage 35 ; the orientation of the disc with respect to the plate governs the radial distance of the passage 35 from the axis of rotation of the bowl and so the depth of the bath in the separator during its operation. Alteration of this orientation may be effected by access to disc 34 through a cover hatch 36 in end wall 26. The end plate 28 is attached or integral with a drive shaft 38 extending to a keyed pulley assembly 43 and supported by bearing assembly 44. The input end of conveyor 16 is supported internally by bearing 55 mounted on the inner portion 40 of drive shaft 38.



The wall of the output end of the bowl 10 has a solids discharge passage 65 and is bolted to a hollow shaft 71 supported by the assembly 77 which includes the main bearing 78. It is connected to the cyclic gear unit 95 such that the conveyor 16, also connected to unit 95, rotates about 1% slower than the bowl. By means of conduit arrangement 112, feed material is admitted to the bowl while there is separate addition of two further materials such as wash water for the separated solids and a flocculant to assist in coagulation of fine solids in the separator feed. This is achieved by means of concentric tubes passing through a central aperture in drive shaft 38 and delivering to appropriate zones within the bowl. The innermost tube supplied by conduit 132 provides wash water, the intermediate annular channel supplied by conduit 124 provides the flocculant, while the main feed provided through conduit 130 enters the bowl by way of the outermost annular channel. Solids in the juice are coagulated with flocculant and collect on the inner surface of the bowl, the supernatant clear juice passing out through overflow passage 35. The small relative rotation of the conveyor 16 carries the separated solids along the conical section of the bowl, where they are washed, and discharges them through passage 65.

Cane mill roller. J. Bouvet, of Ookala, Hawaii, USA. **3,969,802.** February 3, 1975; July 20,1976.



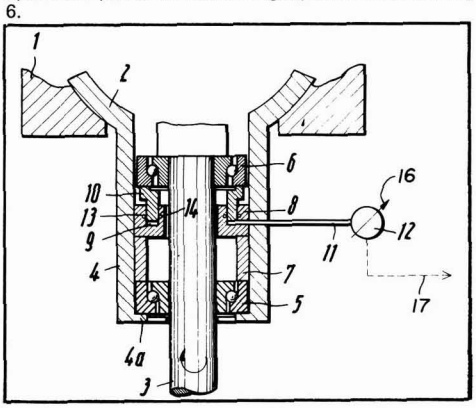
The top roller of a conventional cane mill is provided with holes 4 extending inwards radially from the bottom of the grooving of shell 12 to reach a series of interior channels 3 running across the length of the roller. Juice expressed from the cane at the first "nip" between the upper and feed side lower roller is directed by the pressure of the nip into the holes and so into channels 3 and into juice collecting means rather than being held by back pressure in the blanket of feed before the nip or carried through the mill opening and reabsorbed after this passage.

Support structure for a suspension centrifugal. V. Hentschel, of Braunschweig, Germany, assr. Braunschweigische Maschinenbauanstalt. **3,970,243.** July 15,

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 95p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

1975; July 20, 1976.

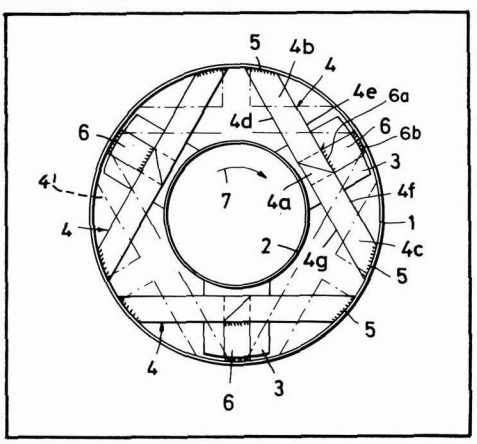
The shaft 3 of the batch-type centrifugal is supported by the ball head 2 in ball socket 1 for pivotal movement, support within the bushing 4 of ball head 2 being provided by radial bearing 5 and axial bearing 6. Between these two are a spacer bushing 7 and support ring 8, the latter with a cylindrical aperture into which fits the cylindrical piston 10 which is rigidly attached to bearing 6.



The space in the aperture below piston 10 forms an annular groove 9 and contains a fluid, the pressure on which varies with the downward displacement of piston 10, itself a function of the weight of massecuite fed into centrifugal. The pressure on the fluid is transmitted through conduit 11 to a device which cuts off feed to the centrifugal when the pressure, and thus the weight of feed, reaches a predetermined level.

Extraction tower. S. Matusch, of Braunschweig, Germany, *assr.* Braunschweigische Maschinenbauanstalt. **3,970,469.** November 7, 1975; July 20, 1976.

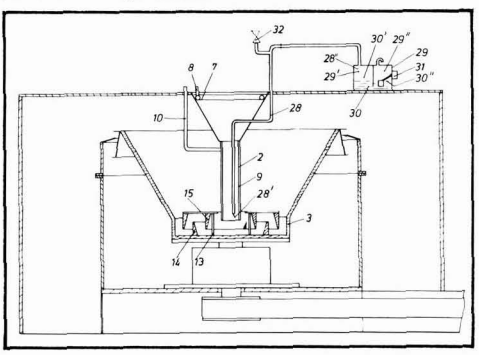
The beet or cane diffuser is in the form of a tower having a central rotating shaft 2 carrying conveyor elements 3 to raise the beet cossettes or cane chips against a down flow of water. The elements are interrupted by baffle plates 4 which, arranged in threes as chords of the circular cross-section of the tower, provide structural reinforcement. The plate sets 4,4' are staggered down the tower.



Each plate is supported from the middle by a strut 6 welded to the tower wall as are the ends 5 of the plates. The outer parts of the plates, 4b, 4c are at an angle relative to the centre part 4a such that the forward edge 4d of part 4b projects downwards, while the edge 4g of part 4c projects upwards. This may be achieved with flat plates joined at an angle to the horizontal plate forming part 4a or, alternatively, the change of angle could be continuous as in a propeller. These angled plates combine with the rotation of the shaft in the direction 7 to improve mixing and conveying of the material being extracted.

Continuous centrifugal. G. Trojan and R. Böhm, *assrs.* Hein, Lehmann AG, of Düsseldorf, Germany. **3,970,470.** October 18, 1974; July 20, 1976.

Massucuite feed to the centrifugal passes down through pipe 2, aided by the lubricating action of a thin film of water supplied from pipe 8 via the perforated annular pipe 7. The feed enters the acceleration pot 3 and is distributed by rods 13 and formed into thin films as it passes between upper and lower annular baffles 15, 14. Steam is admitted through pipe 10 to the annular jacket 9 surrounding pipe 2, enters the acceleration pot 3 and heats the thin film of moving massecuite but for such a short time that sugar is not dissolved, although the molasses viscosity is reduced, facilitating its separation on the centrifugal screen.



Passage of the feed through pipe 2 causes a slight under-pressure to be developed and this is sensed in pipe 28 which is connected to container 29. The latter is separated into two compartments by a suspended baffle and the other side from the connexion to pipe 28 is open to the atmosphere. This results in a difference in the level of liquid 30 on either side of the baffle. If the centrifugal becomes blocked so that the feed rises in pipe 2, the end 28' of pipe 28 is sealed off, the under-pressure disappears and the levels of liquid 30 are equalized, which operates the switch 31 connected to an alarm and to the massecuite feed valve.

Treating sugar mill molasses. J.E.A. Blaude and G.F.M.F. Duchateau, of Tienen, Belgium, *assrs.* Raffinerie Tirlemontoise. **3,971,667.** March 21, 1975; July 27, 1976. When diluted beet molasses is cooled by passing through a heat exchanger before transfer to a reaction tank where lime is added for sucrose recovery (e.g. the Steffen process), deposits form on the heat exchanger surfaces which are mostly an insoluble sucrose-lime combination. In the conventional process, this has to be stopped at intervals for manual cleaning of the heat exchanger. In the new system a valve and a second heat exchanger are provided and the molasses flow periodically switched to

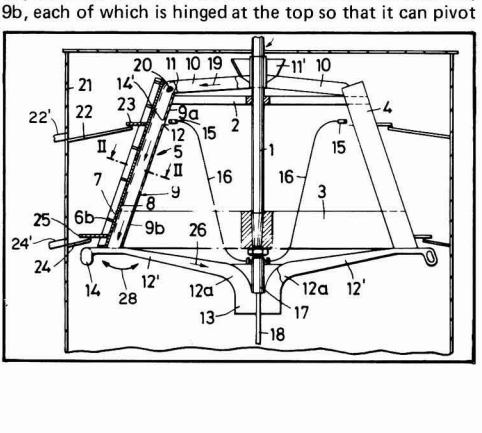
the latter. At the same time part of the limed molasses is recycled from the reaction tank through the encrusted first heat exchanger (in the opposite direction to the original flow) and is mixed with the feed passing through the second heat exchanger. This recycled treated molasses dissolves the deposits so that the first heat exchanger is cleaned. When the second heat exchanger becomes encrusted the valves are adjusted so that the molasses passes to the reaction tank via the first and the partial recycle passes through the second in order to clean it.

L-Glutamic acid production by fermentation. K. Takinami, T. Tanaka, M. Chiba and Y. Hirose, *assrs.* Ajinomoto Co. Inc., of Tokyo, Japan. **3,971,701.** October 7, 1974; July 27, 1976. – An L-glutamic acid producing micro-organism *(Brevibacterium lactofermentum* FERM-P.2307, *B. flavum* FERM-P.2308) is cultured in an aqueous medium containing assimilable sources of C and N, inorganic ions and minor organic nutrients necessary for the growth of the micro-organism (beet molasses, cane molasses), (2 $mg.cm^{-3}$ of) a surfactant (polyethyleneglycol monopalmitate or monomargarate, polyoxyethylene sorbitan monopalmitate or monostearate) and an amount of biotin too great to permit significant production of glutamic acid in the absence of the surfactant.

Production of crystalline sugar. W.M. Nicol, of Reading, England, *assr.* Tate & Lyle Ltd. **3,972,725.** April 9, 1975; August 3, 1976. – Crystallization of a supersaturated sugar syrup (containing < 15% impurities by weight) (at ⩽123°C and ⩽90°Bx) is achieved by subjecting the syrup [during a residence time of <1 sec (0.05–0.5 sec) (0.0001 – 0.001 sec)] in a nucleation zone to a shear force (applied by a colloid mill or homogenizer) having a velocity gradient of at least 5000 (at least 10,000; 20,000) $cm.sec^{-1}$ per cm to induce catastrophic homogenous nucleation of sugar, the syrup being discharged from the nucleation zone (onto a moving belt conveyor) before substantial crystallization has occurred, and the syrup thereafter crystallized to produce crystalline sugar.

Continuous centrifugal for white sugar. V. Hentschel, of Braunschweig, Germany, *assr.* Braunschweigische Maschinenbauanstalt. **3,973,984.** October 23, 1975; August 10, 1976.

Sugar is supplied by way of hopper 11' to a number of symmetrically located conduits (shown as two in the drawing) which feed to outwardly inclined channels 4,5 which are rigidly supported from the revolving shaft 1 by arms 2,3. The channels include an outer screen wall 6b, two side walls and an inner wall in two sections 9a, 9b, each of which is hinged at the top so that it can pivot



in the direction 28 and so remain in contact with the sugar within the channel. Between the sections 9a and 9b is a space 14' into which wash water is delivered by nozzles 15 from pipe 18 via rotary valve 17 and pipes 16. This washing in a thick layer is more effective than with a thin layer and is comparable to that in a batch machine.

Syrup from the sugar is initially separated in the upper part of the channel and passes over baffle 23, is collected by plate 22 in the housing and drains through pipe 22'. The washings are separated in the lower part of the channel, pass over baffle 25, are caught by plate 24 and drain through pipe 24'. At the bottom of the channel the sugar enters the radial conduit 12 and, assisted by an airflow through an opening 14 which faces the direction of rotation, passes inwardly to the bend 12a into the central port 13 from which it drops with minimum crystal damage.

Purification of beet juice and increasing sugar extraction. K.W.R. Schoenrock and H.G. Rounds, of Ogden, Utah, USA, *assrs.* Amalgamated Sugar Co. **3,973,986.** March 26, 1975; August 10,1976. – Beet juice is passed through a cation exchanger in NH_4^+ form and to the treated juice sufficient active MgO or $Mg(OH)_2$ added to liberate the ammonia which is distilled off. The cation exchanger is regenerated with a stoichiometric excess of concentrated ammonium carbonate solution, representing 150 – 500% of the cation exchanger capacity, and the excess $(NH_4)_2CO_3$ stripped from the regeneration waste by introduction of the ammonia-bearing vapours from the juice distillation. The vapours from the stripper are condensed and the free ammonia content converted to $(NH_4)_2CO_3$ by passage of CO_2, giving a concentrated solution for further resin regeneration. The residue from the stripper is concentrated to recover the beet juice cations as their carbonates. Before adding the MgO or $Mg(OH)_2$ to the NH_4^+ – cation exchanged juice, the latter may be treated by an anion exchanger in bicarbonate form; on evaporating the juice its free bicarbonate may be recovered. The MgO or $Mg(OH)_2$ is added to the carbonate–and bicarbonate–free juice and the latter evaporated to recover the liberated ammonia. The cation exchanger is regenerated with an excess of $(NH_4)_2CO_3$ solution and the waste converted with CO_2 to a cation: CO_2 molar ratio of 1.6; this is used to regenerate the exhausted anion exchanger. Excess ammonium carbonate/bicarbonate is stripped from the anion exchanger regeneration waste by introducing the ammonia and ammonium bicarbonate-containing vapours from the juice evaporations, and the condensable vapours from the stripper cooled and condensed to a concentrated solution of $(NH_4)_2CO_3$ which is used to regenerate the exhausted cation exchanger. The incondensable gases from the stripper are recycled to the absorber and the residue from the stripper concentrated to recover beet juice cations as carbonates.

Post-harvest treatment of sugar cane (to reduce sugar losses). J. Zdarsky, J. Rehor and R. Bretschneider, of Prague, Czechoslovakia, *assrs.* Vysoka skola chemicko-technologicka. **3,975,204.** April 30,1975; August 17, 1976. – Harvested sugar cane stalks are treated with allyl isothiocyanate [in the form of a 0.001 – 1.0% (0.1%) concentration emulsion] to the extent of 1 part per 1000 – 10,000 parts by weight of cane whereby sugar loss is reduced e.g. from 34.29% to 5.55 – 10.40%.

World sugar production estimates, 1979/80[1]

	1979/80	1978/79	1977/78
	tonnes, raw value		
BEET SUGAR			
Belgium/Luxembourg	870,000	902,000	791,000
Denmark	457,000	443,000	566,000
France	3,980,000	4,065,000	4,268,000
Germany, West	2,790,000	2,998,000	3,076,000
Holland	865,000	1,034,000	905,000
Ireland	192,000	204,000	182,000
Italy	1,630,000	1,630,000	1,355,000
UK	1,100,000	1,111,000	1,032,000
Total EEC	*11,884,000*	*12,387,000*	*12,175,000*
Austria	385,000	357,000	495,000
Finland	100,000	104,000	70,000
Greece	337,000	354,000	294,000
Spain	780,000	1,189,000	1,198,000
Sweden	346,000	339,000	343,000
Switzerland	103,000	107,000	85,000
Turkey	1,145,000	1,096,000	1,082,000
Yugoslavia	890,000	776,000	766,000
Total West Europe	*15,970,000*	*16,709,000*	*16,508,000*
Albania	20,000	20,000	12,000
Bulgaria	240,000	250,000	210,000
Czechoslovakia	850,000	885,000	939,000
Germany, East	690,000	780,000	780,000
Hungary	520,000	553,000	486,000
Poland	1,650,000	1,763,000	1,850,000
Rumania	710,000	602,000	775,000
USSR	8,400,000	9,100,000	8,825,000
Total East Europe	*13,070,000*	*13,953,000*	*13,877,000*
Afghanistan	8,000	15,000	12,000
Algeria	12,000	12,000	8,000
Azores	9,000	8,000	9,000
Canada	112,000	128,000	139,000
Chile	110,000	104,000	137,000
China	340,000	330,000	305,000
Iran	520,000	478,000	565,000
Iraq	15,000	13,000	13,000
Israel	18,000	13,000	37,000
Japan	420,000	408,000	364,000
Lebanon	8,000	13,000	14,000
Morocco	230,000	362,000	225,000
Pakistan	33,000	34,000	31,000
Syria	27,000	25,000	21,000
Tunisia	7,000	8,000	11,000
Uruguay	58,000	49,000	55,000
USA	2,540,000	2,959,000	2,820,000
Total Other Continents	*4,467,000*	*4,959,000*	*4,766,000*
Total Beet Sugar	33,507,000	35,621,000	35,151,000
CANE SUGAR			
Spain	4,000	5,000	15,000
Total Europe	*4,000*	*5,000*	*15,000*
Barbados	125,000	117,000	104,000
Belize	110,000	108,000	118,000
Costa Rica	215,000	210,000	192,000
Cuba	7,800,000	7,992,000	7,457,000
Dominican Republic	1,200,000	1,125,000	1,150,000
Guadeloupe	100,000	111,000	85,000
Guatemala	455,000	443,000	410,000
Haiti	65,000	65,000	51,000
Honduras	216,000	168,000	121,000
Jamaica	320,000	273,000	307,000
Martinique	9,000	10,000	14,000
Mexico	2,880,000	2,850,000	3,172,000
Nicaragua	170,000	200,000	214,000
Panama	260,000	226,000	187,000
Puerto Rico	196,000	175,000	185,000
St. Kitts	35,000	42,000	41,000
El Salvador	310,000	284,000	293,000
Trinidad	175,000	144,000	148,000
USA – Hawaii*	998,000	996,000	933,000
USA – Mainland	1,540,000	1,425,000	1,497,000
Total N. & C. America	*17,179,000*	*16,964,000*	*16,679,000*
Argentina	1,400,000	1,397,000	1,666,000
Bolivia	287,000	286,000	284,000
Brazil	7,000,000	7,770,000	8,760,000
Colombia*	1,182,000	1,131,000	1,014,000
Ecuador	320,000	334,000	295,000
Guyana*	350,000	320,000	342,000
Paraguay	72,000	68,000	72,000
Peru*	840,000	754,000	856,000
Surinam	12,000	10,000	9,000
Uruguay	48,000	49,000	58,000
Venezuela	390,000	360,000	402,000
Total S. America	*11,901,000*	*12,479,000*	*13,758,000*
Angola	50,000	39,000	45,000
Cameroun	60,000	45,000	38,000
Chad	20,000	20,000	15,000
Congo	25,000	27,000	16,000
Egypt	710,000	690,000	634,000
Ethiopia	164,000	169,000	159,000
Ghana	15,000	12,000	8,000
Ivory Coast	130,000	57,000	35,000
Kenya	340,000	244,000	203,000
Liberia	4,000	3,000	2,000
Madagascar	125,000	123,000	117,000
Madeira	1,000	1,000	1,000
Malawi	120,000	97,000	95,000
Mali	16,000	16,000	15,000
Mauritius	745,000	705,000	705,000
Morocco	30,000	36,000	18,000
Mozambique	200,000	190,000	220,000
Nigeria	60,000	40,000	37,000
Réunion	300,000	291,000	270,000
Senegal	49,000	34,000	30,000
Somalia	35,000	30,000	20,000
South Africa	2,236,000	2,241,000	2,244,000
Sudan	150,000	130,000	150,000
Swaziland	270,000	262,000	238,000
Tanzania	125,000	130,000	115,000
Uganda	8,000	9,000	10,000
Upper Volta	30,000	34,000	30,000
Zaire	40,000	39,000	55,000
Zambia	105,000	74,000	75,000
Zimbabwe-Rhodesia	230,000	250,000	290,000
Total Africa	*6,393,000*	*6,038,000*	*5,890,000*
Bangladesh	150,000	144,000	192,000
Burma	40,000	42,000	39,000
China*	2,200,000	2,120,000	1,825,000
India	5,500,000	6,360,000	7,000,000
Indonesia	1,600,000	1,570,000	1,260,000
Iran	110,000	132,000	108,000
Iraq	25,000	20,000	20,000
Japan	300,000	305,000	279,000
Malaysia	100,000	90,000	80,000
Nepal	20,000	25,000	29,000
Pakistan	600,000	628,000	907,000
Philippines	2,400,000	2,370,000	2,387,000
Sri Lanka	11,000	25,000	25,000
Taiwan	870,000	865,000	767,000
Thailand	1,500,000	1,861,000	1,624,000
Vietnam	30,000	25,000	33,000
Total Asia	*15,456,000*	*16,582,000*	*16,575,000*
Australia	3,090,000	2,978,000	3,440,000
Fiji	474,000	359,000	376,000
Total Oceania	*3,564,000*	*3,337,000*	*3,816,000*
Total Cane Sugar	54,497,000	55,405,000	56,733,000
Total Beet Sugar	33,507,000	35,621,000	35,151,000
Total World Sugar	88,004,000	91,026,000	91,884,000

*1980, 1979, 1978 calendar years.

[1] F. O. Licht, *International Sugar Rpt.*, 1979, **111**, 573-577.

BREVITIES

Ecuador cane by-products programme[1]. – Investments planned by the Ministry of Industry for the provinces of Canar, Azuay, Loja, Morona, Santiago and Zamora Chinchipe include the following projects: alcohol production from cane molasses, 70,000 tonnes per year of paper pulp and kraft paper from domestic raw materials incuding bagasse, and furfural.

Colombia-Venezuela sugar and derivatives project[2]. – The governments of Colombia and Venezuela are to set up a binational enterprise, Zulia-Ureña, to process sugar and derivatives. A sugar factory and 9300 hectares of cane are to be established in the Zulia Valley in the Norte de Santander department of Colombia, and a refinery and distillery for producing alcohol are to be installed at Ureña, Venezuela. The Colombian Government is to invest 2200 million pesos (£22 million) in the project over the next five years. The total cost is more than 4000 million pesos, and the Government is seeking an IDB loan of US $34 million to help finance the project.

Japan sugar consumption[3]. – In 1977/78, consumption of centrifugal sugar in Japan declined to 2,890,000 tonnes, raw value, from 3,320,000 tonnes, in the previous season (October – September). For 1978/79 the Sugar Supply and Demand Council estimates that consumption will recover to 3,240,000 tonnes; however, this is still lower than the 3,380,000 tonnes record consumption of 1973/74. The anticipated recovery in sugar consumption for 1978/79 is attributed to increased consumption of catering and bakery products containing sugar, and of beverages (dry and hot weather was forecast for after the middle of 1979).

West Germany HFCS plant[4]. – Süddeutsche Zucker-AG of Mannheim plans to build a plant for the manufacture of high fructose corn syrup at Offstein where the company already has a liquid sugar facility. Capacity of the new plant will be 6000 tonnes of fructose per annum and it will cost an estimated DM 10-15 million.

Alcohol from cane in South Africa[5]. – The President of Transvaal Suikerkorporasie Bpk. announced during a press conference that the company is to build an ethanol plant, using sugar cane, at Malelane in the Eastern Transvaal. The plant, which will cost 15 million Rand (U$ S18 million) will produce 40 million litres of ethanol per year.

Sugar production problems in St. Kitts[6]. – By the end of July 30,000 tonnes of sugar had been produced and prospects for reaching the target of 40,000 tonnes appeared to be poor. This shortfall is attributed to abnormally heavy rain during harvesting of the cane, low sugar content, one case of negligence at the sugar factory, problems with a new boiler, and cane fires. As a consequence of the low production only about 10,000 tonnes of sugar will be available for export in 1979/80, a situation described by the island's Prime Minister as an "economic catastrophe".

Philippines sugar refineries[7]. – The first of three modern sugar refineries in the Philippines has been completed at Calunog Town in Iloilo Province, 270 miles south of Manila. Like the other two refineries, proposed for the north and south of the Philippines, it has a daily capacity of 10,000 50-kg bags of refined sugar. The three refineries when completed will increase domestic refined sugar production by 40% and will permit sale abroad of refined sugar as well as raws. The refineries are Japanese-financed and are located near to raw sugar factories.

New Tunisian sugar factory[8]. – Erection of the country's second beet sugar factory, at Bou Salem, has been completed. After start-up, only 70% of Tunisia's sugar requirements will need to be imported.

Dominican Republic sugar production target[9]. – According to official sources the Dominican Republic Government set a target of 1,250,000 tonnes, tel quel, for domestic sugar output in calendar year 1979, which compares with 1,050,000 tonnes in 1978. Domestic sugar consumption in 1979 is estimated at 185,000 tonnes and the carry-over stock at the end of 1978 was 350,000 tonnes. According to unofficial sources sugar production this year could be 1,400,000 tonnes, somewhat higher than the official target. The International Sugar Organization recently reported, however, that 1978 production reached 1,199,000 tonnes, raw value, while end-year stocks were set at 233,498 tonnes.

Yugoslavia sugar detergent project[10]. – The Zorka Chemical Enterprise of Subotica in Vojvodina Province has concluded an agreement with a Dutch company on the purchase of a licence for production of raw materials for detergents based on sugar and residual fats. Zorka is to build a new factory with an annual capacity of 5000 tonnes of such raw materials, to be completed by 1982 at an investment cost of 50 million dinars ($2,600,000).

New Indian sugar factory[11]. – A new co-operative sugar factory, Ramala Sahakari Chini Mills Ltd., was opened in mid-1979 at Ramala in Meerut District, by the U.P. Deputy Prime Minister. The factory has a daily crushing capacity of 1250 tonnes and cost 738 million rupees. It was designed, engineered, supplied and commissioned by Prem Heavy Engineering Works Pvt. Ltd., of Meerut.

Angola sugar industry rehabilitation[12]. – The Belgian company Sopex has been asked to overhaul the sugar industry of Angola which has never fully recovered from the 1974/75 civil war. The company is reported to have signed a contract to study Angolan requirements and produce a long-term plan under which,over 20 years, Sopex will overhaul existing cane plantations, sugar factories and alcohol distilleries that have become unproductive, so raising sugar production from 30,000 to 80,000 tonnes per year.

Indian bagasse paper project[13]. – The Rahuri Sahakari Sakhar Karkhana Ltd. sugar factory is to invest about Rs.50,000,000 in a paper production project, the second co-operative paper venture in the district.

EEC exports to the USSR[14]. – The Soviet Union had, by the end of October, imported more sugar from the EEC than it is allowed under the rules of the ISA, of which it is a member, to import from non-members. The ISO is checking into this but has not as yet received an explanation. On October 19 the EEC Commission stated that EEC sugar exports to the USSR up to September had not exceeded 112,000 tonnes; however, according to Licht's record of national export statistics, the countries of the EEC had exported at least 237,123 tonnes, raw value, to the USSR up to the end of June. The limit for the whole of 1979 set for Soviet imports of all non-member sugar is 158,917 tonnes, raw value, corresponding to 75% of average imports from non-members in 1973-76 and excluding the lowest year.

Philippines sugar production[15]. – Sugar production from the 1978/79 crop, which ended in August, was 2.2 million tonnes, compared with 2.34 million tonnes in the previous season, as a result of a deliberate cut-back in production in marginal areas and because of the effect of adverse weather. End-of-season stocks totalled 1.2 million tonnes compared with 1.4 million tonnes in 1978 and 1.68 million tonnes in 1977. Exports also fell from a comparable 1.58 million tonnes to 1.28 million tonnes but domestic consumption showed a rise at 1.1 million tonnes compared with 1.03 million tonnes in 1978.

---

1 *Westway Newsletter*, 1979, (70), 9.
2 *Bank of London & S. America Review*, 1979, **13**, 559.
3 *World Sugar J.*, 1979, **2**, (3), 31.
4 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 515.
5 *Westway Newsletter*, 1979, (70), 10.
6 *World Sugar J.*, 1979, **2**, (3), 33.
7 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 549.
8 *Zuckerind.*, 1979, **104**, 881.
9 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 472.
10 *World Sugar J.*, 1979, **2**, (3), 33.
11 *Maharashtra Sugar*, 1979, **4**, (8), 57.
12 *Reuters Sugar Rpt.*, September 11, 1979.
13 *Maharashtra Sugar*, 1979, **4**, (12), 60.
14 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 622.
15 *Standard Chartered Review*, November 1979, 28.

BREVITIES

New Yugoslavian sugar factory[1]. — The sugar factory being built at Virovitica in Croatia is to be completed by the end of this year. The factory is to process about 4000 tonnes of beet per day and to produce annually about 50,000 tonnes of sugar, 15,000 tonnes of molasses and 26,000 tonnes of beet pulp. The investment is estimated at some 2200 million dinars ($114 million).

Phillipines sugar diversification projects[2]. — Six projects which would form the core of the sugar industry's future development are being seriously studied by the Philippine Sugar Commission. They are: (a) animal fodder plants using bagasse and other sugar by-products, (b) sucro-detergent plants, with technology developed by Tate & Lyle Ltd. and Daiichi Nippon Co., (c) cane separator systems to produce cane lumber, boards, low-cost construction materials, (d) cane wax, alcohols and cattle feeds from filter cake, (e) liquid sugar which may be in the form of sucrose, invert syrup, liquid brown sugar or refinery syrups, and (f) fuel alcohol production and plastics.

Indian sugar production 1978/79[3]. — Indian sugar production during the 1978/79 season, which ended in September, is estimated at 5,858,000 tonnes, white value (approximately 6,367,000 tonnes, raw value), down from 6,457,000 tonnes, white value, in the previous season. The Indian Sugar Mills Association expects 1979/80 production to drop even further, to about 5 million tonnes, white value; however, ISMA sources said that the recent Government announcement of a Rs.125 per tonne cane support price may bring more land into production and make the estimate over-pessimistic. Total closing stocks of sugar at the factories as at September 30 were about 2,063,000 tonnes against 3,289,000 tonnes at the same date in 1978. Total 1978/79 offtake was 6,222,000 tonnes for internal consumption and 862,000 tonnes for exports, against 4,491,000 and 253,000 tonnes the previous year.

Bagasse paper and cellulose in Mexico[4]. — Nine new plants were scheduled to start operations in 1979 with a total installed capacity of 431,000 tonnes a year, including a bagasse cellulose, newsprint, two tissue and kraft and cardboard plants.

Ivory Coast sugar production[5]. — The Ivory Coast is likely to become a sugar exporter in real terms for the first time in 1980. Industry sources estimate that raw sugar production could reach 108,000 tonnes, well above domestic requirements of around 50,000 tonnes. Provided sufficient cane is planted, an additional 145,000 tonnes could be available the next year with the expected completion of three more factories. By 1985, when a further four plants are scheduled to be in operation, total raw sugar production is expected to reach 300,000 tonnes, two-thirds of which will be for export.

Alcohol production Brazil[6]. — About 900,000 gallons of alcohol was to be distilled from the 1978/79 cane crop, compared with 390,000 from the 1977/78 crop. The Minister of Industry and Commerce has forecast alcohol production of 2,700,000 gallons by 1985, by which time the Government will have invested $5000 million in development of alcohol as a fuel.

Canadian sugar refinery closure[7]. — The Board of Redpath Sugars Ltd. has announced that the Montreal refinery is to close from January 1980. There is excess refining capacity in Eastern Canada and Redpath, with two refineries, was considered vulnerable; by consolidation of the Company's refining activities at one plant, its competitive position is expected to improve.

Chile refining capacity increase. — The privately-owned Cía. de Refinería de Azúcar de Viña del Mar S.A. is to increase, the capacity of its sugar refinery at Viña del Mar, near Valparaiso, from 130,000 to 180,000 tonnes per year. The increased output will represent about half of Chilean sugar consumption.

Mexico sugar production and consumption[8]. — Total sugar consumption in Mexico in 1979/80 is estimated at 3,000,000 tonnes, 200,000 tonnes more than estimated production. The Government has suspended exports and has recently announced that imports of sugar will be permitted. Mexico's sugar export quota under the ISA is 70,000 tonnes, raw value. During the past few years, sugar consumption has been increasing by 5-7% annually but in 1978 Mexico experienced a 10% increase and in 1979 appears to be heading for a similar increase. This steep increase is partly a result of artificially low prices on the domestic market; according to the USDA the government subsidy to the sugar sector of the economy is expected to exceed 8200 million pesos in 1979 and is projected at 13,000 million pesos in 1980. Industrial utilization of sugar in 1977/79 has increased dramatically and continuously, almost entirely through soft drink manufacture, and provides the major impetus to this consumption growth.

US loan programme sugar sale[9]. — The Commodity Credit Corporation held a tender in November for forfeited loan programme sugar, for delivery between November 26 and December 28. Interest in this sugar has increased following the rise in world prices, and 34,784 short tons of raws were sold at prices between 14.00 and 15.15 cents per lb. The CCC possesses 202,114 tons of 1977 crop cane sugar, 221,987 tons of 1978 crop cane sugar and 35,006 tons of 1978 beet sugar, all of which has been forfeited, while at November 20 it was also holding on loan a total of 802,131 tons of 1978 and 1979 crop cane sugar and 559,854 tons of 1978 and 1979 beet sugar.

Indian sugar factory closure. — The Bihar Sugar Works at Pachrukhi in Saran district of Bihar has been closed.

New Albanian sugar factory[10]. — The new sugar factory which has been built in 20 months near the existing factory at Meliq in Korce District was inaugurated on November 8. It was designed, built and equipped entirely from Albanian resources and its production capacity is double that of the old factory. It can process 2200-2500 tonnes of beet per day and thus makes Albania self-sufficient in sugar.

Peru bagasse newsprint production[11]. — The Sociedad Paramonga newsprint plant at Santiago de Cao, near Trujillo, should be operating at maximum capacity of 110,000 tonnes a year by mid-1980, although drought in the Chicama valley in the past two years has caused water and bagasse shortages and cane cut at the Casa Grande and Cartavio co-operatives has been reduced by 47%.

New Indonesian sugar factory[12]. — In September President Suharto opened the new Gunung Madu sugar factory in Lampung, South Sumatra. This has an annual production capacity of 90,000 tonnes of sugar.

PERSONAL NOTES

Lucio Rodriguez, for ten years General Manager of Central Azucarera de Bais in the Philippines, has accepted an appointment as Technical Director of Fabcon Inc., sugar processing chemicals and machinery manufacturer of San Francisco. Of Cuban origin, Mr. Rodriguez graduated from Yale University and rose to factory superintendent during 15 years service with Cuban-American Sugar Co.

Mr. Frazer Imrie has been appointed General Manager — Surfactants and **Dr. Wilson Nicol** General Manager — Trichlorogalactol sucrose of Talres Development Ltd., the company formed by Tate & Lyle Ltd. to develop and market the sucrose-based detergents and sweeteners discovered in the Group Research and Development Division. **Dr. R.C.Righelato** has been appointed Director of Research at this Division, located in Reading.

Sir Guy Sauzier who has been associated with the international sugar world for a considerable time is now a consultant to E.D. & F. Man on international sugar matters.

---

1 F.O. Licht, *Interntional Sugar Rpt.*, 1979, **111**, 516.
2 *Bank of London & S. America Review*, 1979, **13**, 676.
3 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 610.
4 *Bank of London & S. America Review*, 1979, **13**, 676.
5 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 656.
6 *Bank of London & S. America Review*, 1979, **13**, 604.
7 *Tate & Lyle News*, October 1979, **3**.
8 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 655-656.
9 C. Czarnikow Ltd., *Sugar Review*, 1979, (1467), 232.
10 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 688.
11 *Bank of London & S. America Review*, 1979, **13**, 620.
12 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 694.

Index to Advertisers

reader inquiry service

If you wish to receive further information on the products and services mentioned in the advertisements please fill in the inquiry section of this card and post it to us.

reader inquiry service

Please arrange for me to receive without obligation further details of the products referred to below which are advertised in your .....19.....issue.

Advertiser	Product	Page

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

FIRST FOLD

SECOND FOLD

photocopy service

We are able to supply one photocopy, for research or private study purposes, of most of the original papers abstracted in this journal. It should be noted that these are *not* translations but are in the original language of publication which, if not English, is indicated in italics in each abstract. The charge of 40 cents per page includes air mail postage and payment should be sent with the order.

photocopy service

Please supply one photocopy of each of the following original papers, abstracts of which appeared in your .....19.....issue.

Page	Author(s)	Title

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

Payment of $ is enclosed

FIRST FOLD

THIRD FOLD AND TUCK IN

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of U.S. $50.00 for supply by surface mail. The additional cost for air mail will be quoted on application.

additional subscription order

Please send a further copy of your journal each month to the address below starting with the issue of

. . . . . .19 . . . . . .

Block Letters

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Signature . . . . . .

Date . . . . . .

I enclose cheque/draft/M.O./P.O. for $50.00.

The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks,
England.

El azúcar representa una importante fuente de energía en el mundo entero. El extraerlo de la caña de azúcar con eficiencia es siempre una tarea difícil que depende sobre todo de las características y de la calidad del equipo utilizado.

El nombre Farrel es conocido y respetado mundialmente en el campo de la producción azucarera. Hace más de un siglo que sus técnicos están construyendo y perfeccionando los equipos para la molienda de la caña de azúcar.

Zanini, a través de su asociación con Farrel, adquirió la tecnología necesaria para llegar a lo que es lo más importante: fabricar los mejores trapiches del mundo: TRAPICHES ZANINI - FARREL.

En varias regiones del mundo, en las más rigurosas condiciones de trabajo, los Trapiches Zanini - Farrel fueron puestos a prueba y demostraron su alto grado de eficiencia, destacándose por su mayor capacidad de molienda.

Los trapiches son fabricados en varias dimensiones, pero Zanini también puede suministrarlos en tamaños especiales para proyectos específicos.

Si quiere conocer todo lo que hay que saber acerca de los trapiches Zanini, basta consultarnos. Y si quiere obtener mayores informaciones acerca de la calidad de los trapiches Zanini y de los trapiches Farrel, consulte o visite los mayores y mejores centrales azucareros del mundo: Cia. Agrícola Fazenda São Martinho (BRASIL), Usina Santa Elisa S.A. (BRASIL), Cia. Industrial e Agrícola São João (BRASIL); El Palmar (VENEZUELA); Central Romana (REPÚBLICA DOMINICANA); San Martin del Tabacal (ARGENTINA); Glades Sugar Cooperative (E.E.U.U.); United States Sugar Co. at Clewiston and Bryant, Florida (E.E.U.U.); Motsorongo (MÉXICO); San Cristóbal (MÉXICO); Victoria's Milling Co. (FILIPINAS); Del Cauca (COLOMBIA); etc.

TRAPICHES ZANINI-FARREL:

Zanini fabrica trapiches en las siguientes dimensiones (en pulgadas):

30" x 54"	36" x 72"	43" x 90"
30" x 60"	37" x 78"	44" x 96"
34" x 66"	42" x 84"	

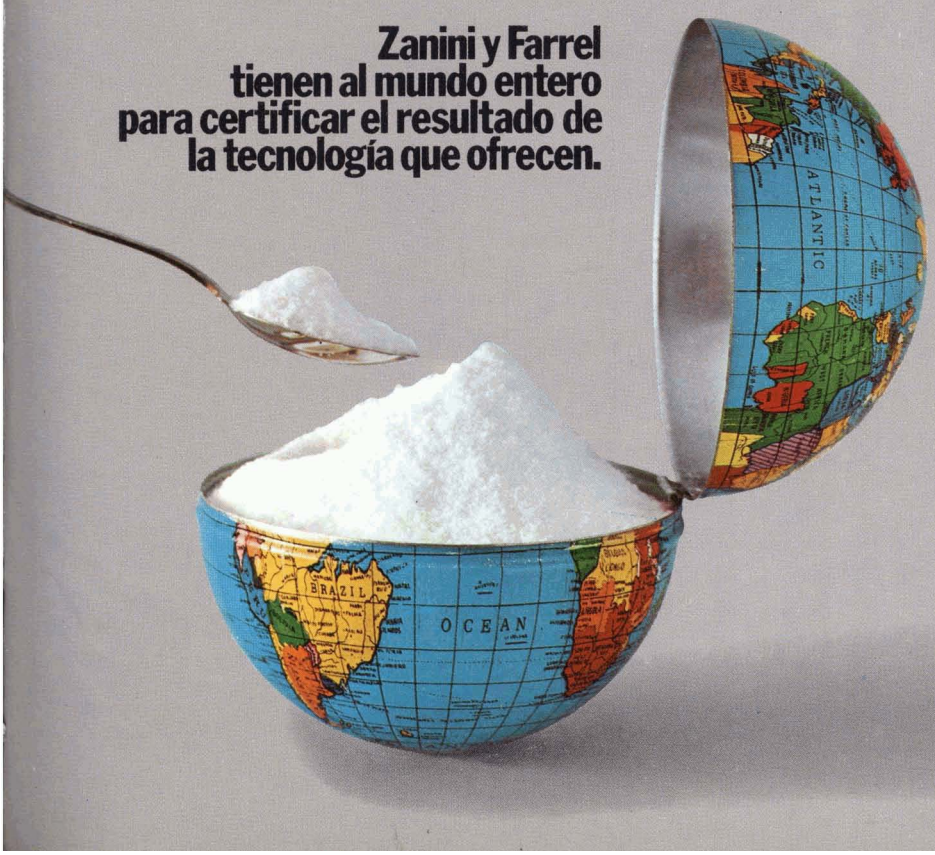
pero también puede suministrarlos en tamaños especiales.

Representando mayor seguridad para el cliente, los trapiches Zanini - Farrel son suministrados con dos (2) años de garantía contra cualquier defecto de fabricación.

zanini s/a
equipamentos pesados

Fábrica: Km 4 da Rodovia Armando de Salles Oliveira
Caixa Postal, 139 - 14160 Sertãozinho - SP - Brasil
Teléfono: (0166) 42.2255
Telex: 0166.315 - ZANI BR
Oficina Central: Avenida Paulista, 460 - 18º andar
01310 São Paulo - SP - Brasil
Teléfono: (011) 285.5122
Telex: 011.22901 ZANI BR - 011.21550 ZANI BR

Zanini y Farrel tienen al mundo entero para certificar el resultado de la tecnología que ofrecen.



Fator

County– world famous, world wide.

County. Tried, tested, acclaimed in over 100 countries. Whatever the task or terrain, for dependability and sustained performance, wherever you are, you can depend on County.

County

FOREMOST IN FOUR-WHEEL DRIVE

County Commercial Cars Limited, Fleet, Hampshire, England. Telephone: Fleet 22111. Telex: 858138.

6700-Four – 78 hp (58 kW)
7700-Four – 97 hp (72 kW)

4600-Four – 62 hp (46 kW)
6600-Four – 78 hp (58 kW)
7600-Four – 97 hp (72 kW)

774 – 78 hp (58 kW)
974 – 97 hp (72 kW)
1184 TW – 120 hp (89 kW)

1474 – 153 hp (114 kW)

FC1184 TW – 120 hp (89 kW)