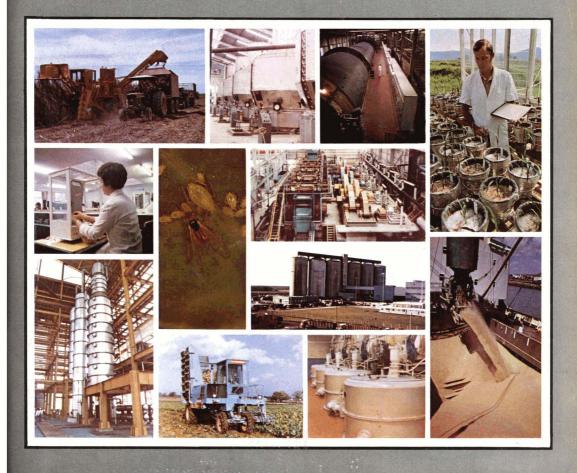
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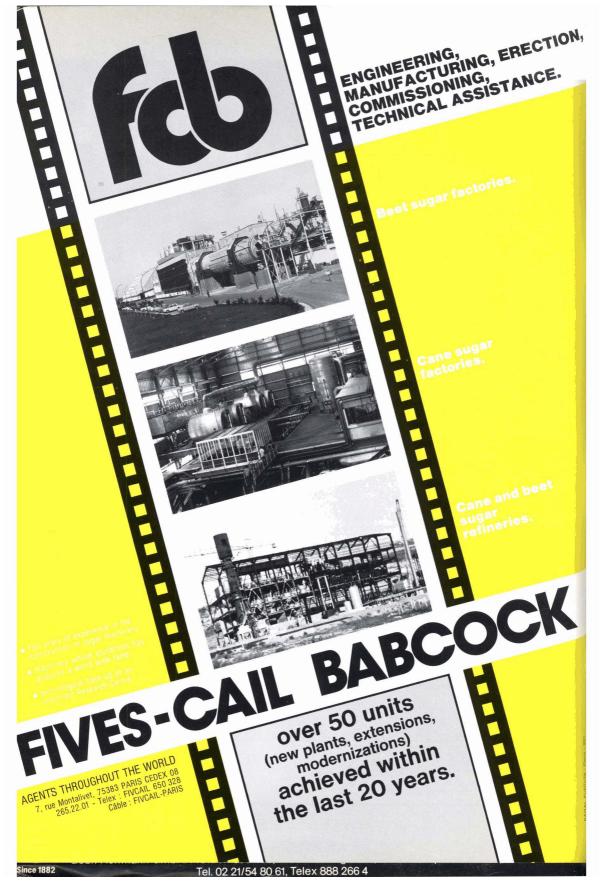
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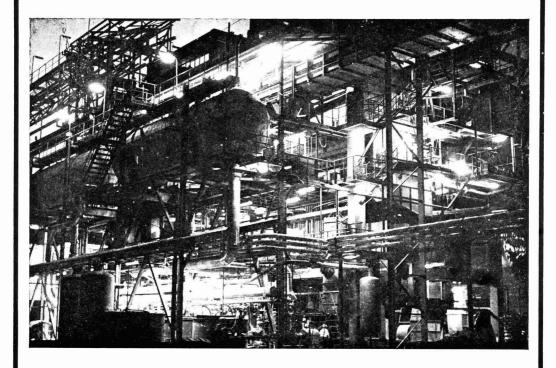
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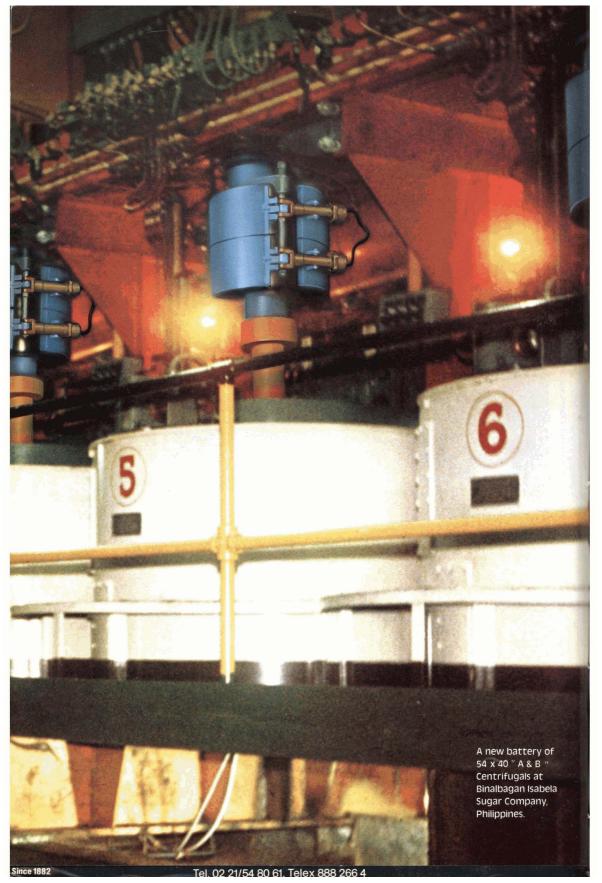
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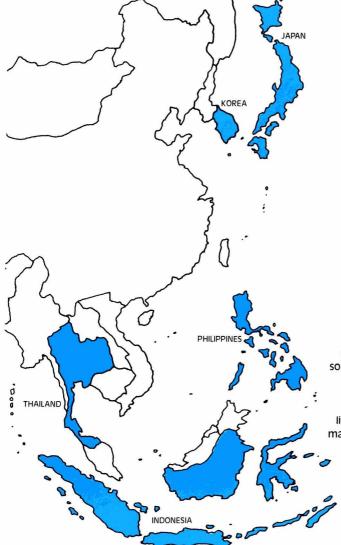
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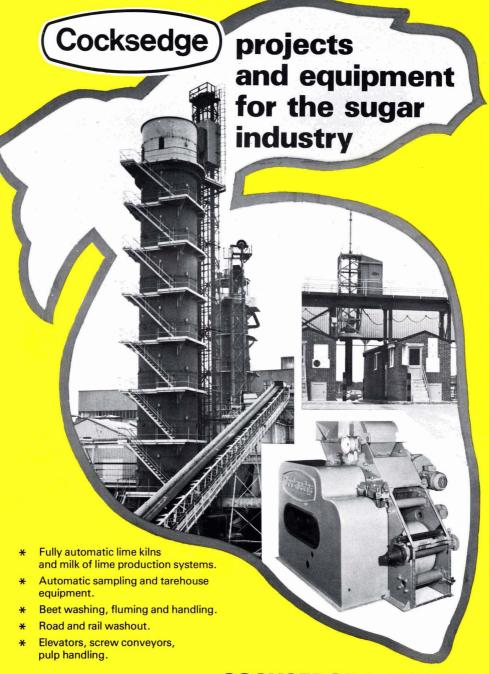
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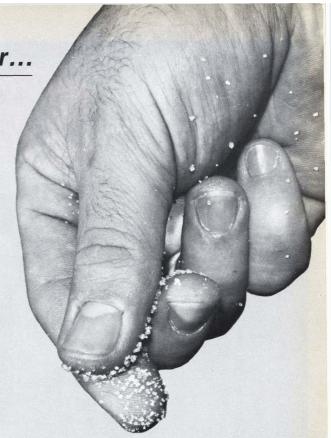
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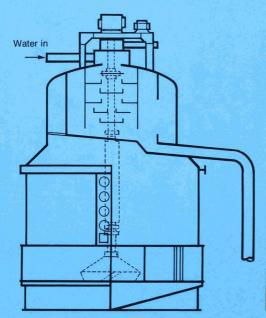
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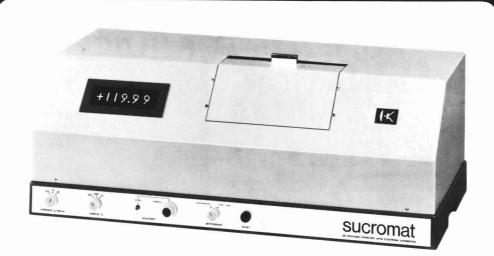


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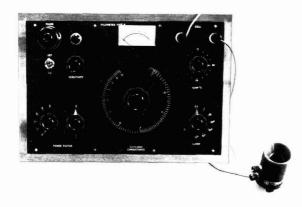
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UK ISSN 0020-8841

Annual Subscription: \$30.00 post free

Single Copies: \$3.00 post free

Airmail charges quoted on request to

The International Sugar Journal Ltd., 23A Easton Street, High Wycombe, Bucks., England HP11 1NX

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#### Published by

#### The International Sugar Journal Ltd.

23A Easton Street,

High Wycombe, Bucks., England HP11 1NX.

Telephone: 0494-29408 Cable: Sugaphilos, High Wycombe

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# NOTES AND COMMENTS

#### World sugar prices

The London Daily Price for raw sugar started the month of July at £101 per tonne and ended considerably lower at £93. This was in no small part the result of currency fluctuations and the strengthening of the pound sterling against the US dollar. Reports of crop prospects, both good and bad, in different countries led to a certain amount of variation during the month, and another factor was a reduction in the Caribbean/UK freight rate which contributes to the LDP. A slight weakening of the pound at the beginning of August helped to raise the price while further strength was given by the reported purchases of around 250,000 tonnes by China.

The LDP(W) was also affected by the currency movements during the month but its fall, from £104,50 to £100 over the month, was also affected by the sales of white sugar by India and the EEC and by news of improved weather conditions in the USSR which was thought to lessen the likelihood of white sugar imports by that country. The decline in the London Daily Price, which had gone down to £94 per tonne, was halted by the announcement of a number of buying tenders towards the end of the month.

#### **EEC** sugar regime

Negotiations between the Agricultural Ministers of the European Economic Community will start this autumn on the new regime to apply to farm produce from July 1, 1980. Options for a change in policy for sugar include an unchanged quota system, retention of the system but with reduced quotas, and abolishing the system and allowing free market competition to determine the amount of EEC sugar which should be produced<sup>1</sup>. However, the EEC Commissioner for Agriculture will not be making any firm proposals until September as his officials have not yet worked out their approach.

In the meantime the interested groups have been preparing arguments and statements of views, and one of these, setting out the position adopted by the CIBE (European Beet Growers Federation), has recently been published<sup>2</sup>. This contests the various criticisms made of the current regime in respect of high cost to the EEC taxpayer and of producing sugar surpluses, and indicates what the beet growers see as essential to a new regime in maintaining production potential and exports at their present levels but without formal participation in the International Sugar Agreement.

#### Colombia and the ISA3

With one exception, Colombia has exported yearly since 1965 more than 100,000 tonnes of sugar. The exception was 1977, when the new International Sugar Agreement was being negotiated and then, because of a serious drought and also the diversion of part of the existing supplies of cane to the production of non-centrifugal sugar, recourse to imports of almost 100,000

tonnes had to be made. No doubt it was the fact that Colombia was at that time known to be an importer that she was originally offered only Annex II exporter status under the ISA, that is to say an export entitlement of up to 70,000 tonnes but not an actual quota. After protest the country's status was changed and Colombia was offered a basic export tonnage of 75,000 tonnes.

This figure was not acceptable to Colombia and she has so far found it impossible to accede to the Agreement. Statistics showing last season's performance have now been published by the ISO and are reproduced below. Exports last year amounted to 132,000 tonnes, mostly to the USA. Exports of 264,000 tonnes have been authorized by the Colombian Government, of which no less than 240,000 tonnes has already been committed for the current year.

	1978	1977	1976
		tonnes, raw val	ue
Initial stocks Production Imports: Argentina Cuba Ecuador EEC Peru	61,907 1,014,075	19,999 853,366 24,697 39,188 5,859 25,521 4,502 99,767	29,834 934,632
	1,075, 982	973,132	964,466
Consumption Exports:	856,081	911,225	844,247
Chile Tunisia USA	24,000 12,000 96,000	200	12,177 0 88,043
	132,000	0	100,220
Final stocks	87,901	61,907	19,999

It is understood that members of an ISC working group have had discussions with Colombian representatives to try to find a formula under which Colombia could adhere to the Agreement which would meet with acceptance from all parties. It is to be hoped that these discussions eventually meet with success both from the point of view of the producer, whose sugar has sometimes had to be disposed of at a discount to world market prices, and from the point of view of the Agreement members as a whole.

#### Cuban sugar production 1978/79

The Cuban sugar crop finished on July 25 with a total production of 7,992,000 tonnes¹. This represents an increase of 641,000 tonnes on the previous year's output and is the highest figure for a normal harvest. The only time it has been exceeded was in 1969/70 when 8.5 million tonnes was produced after mass mobilization of workers which seriously disrupted the economy. The rise in production had been generally expected and the previous official forecast had been of 8.1 million tonnes. Cuba has extended the area planted to cane, and increased irrigation, fertilization and mechanical harvesting. Weather has also been generally favourable.

#### US sugar legislation

After a considerable delay due to other business, the House Ways & Means Committee passed a Sugar Bill and it was then quickly cleared by the Rules Committee for discussion in the full House of Representatives. Congress

Public Ledger, July 14, 1979.

F. O. Licht, *International Sugar Rpt.*, 1979, 111, 426-432. 3C. Czarnikow Ltd, *Sugar Review*, 1979, (1488), 85-87.

C. Czarnikow Ltd, *Sugar Review,* 1979, (1488), 85-87. *ibid.,* (1444), 117.

<sup>&</sup>lt;sup>5</sup>Public Ledger, July 28, 1979.

rose for its summer recess a few days later, however, so that the Bill will not be discussed until after the new Session starts in September.

The Bill is much the same as that approved by the Trade Sub-Committee and the Agriculture Committee. i.e. including loan support for 1979 crops at 15.8 cents per lb, raw sugar basis, plus 0.5 cents per lb in direct payments, and with the 50% ad valorem import fee limitation removed. The Bill also authorizes US ratification of the ISA. It is likely that, in the House discussion, advantage will be taken of a new rule whereby amendments may be proposed on the floor since feelings for and against the Bill are strongly held. Consumer groups, supported by many in Congress, have taken a stand against the Bill since they claim it will be inflationary1. However, the Agriculture Committee chairman claims that the proposed legislation is "so modest" that it "stands to lose the support of the sugar producers", while the Ways & Means Committee chairman referred to it as a "pro-consumer Bill".

#### Mexico sugar statistics<sup>2</sup>

The ISO has recently published adjusted figures for Mexico covering the year 1978. These show that exports in the year amounted to 73,711 tonnes, a quantity well within the tolerance of the ISA quota, which stood at 70,000 tonnes. It is interesting to note that the entire quantity, all of which was consigned to the USA, was shipped during the last two months of the year, after the new crop had started. The figures appear below.

1070

1077

	1978	1977
	tonnes, i	aw value
Initial stocks	233,801	121,261
Production	3,130,682	2,789,856
	3,364,483	2,911,117
Exports	73,711	0
Consumption	2,933,940	2,677,316
Final stocks	356,832	233,801

For several years consumption in Mexico had been relatively stationary, but the 1978 figures show a growth of some 250,000 tonnes. It would hardly be realistic to expect another increase of this size, which amounted to 9.5%, but in any case end-year stocks were higher than they had been for many years and in case of need no doubt these could, in part, be utilized for domestic and overseas markets.

#### **GEPLACEA** and the ISA

The Group of Latin American and Caribbean sugar exporting countries, GEPLACEA, is to hold a meeting in Mexico during October 22 - 26. Details of the agenda are not yet available but it is reported<sup>3</sup> that a possible topic is a change in the mechanism of the International Sugar Agreement to enable further cuts in supplies to the world market to support prices.

#### International Sugar Agreement

The Special Hardship Reserve Committee of the International Sugar Organization met on July 9 and 10 and allocated the balance of the Hardship Reserve to a number of countries; no objections were raised to their recommendations in the period allowed so that they entered into effect ten days later. C. Czarnikow Ltd.

have recently summarized the effects of these and other changes on the quotas in effect of Annex 1 countries4 and these figures and notes are reproduced below. Annex I countries are those members which have been alloted basic export tonnages on the basis of which their export quotas are calculated. There are, in addition, several countries listed under Annex II which do not have quotas but which are entitled to export up to 70,000 tonnes a year.

Member	Basic Export Tonnages	Initial Quotas (a) — tonnes,	Adjustments (b) . raw value —	Quotas in Effect
Argentina	450,000	366,750		366,750
Australia	2,350,000	1,997,500		1,997,500
Austria	80,000	70,000		70,000
Bolivia	90,000	73,350	+25,000	98,350
Brazil	2,350,000	1,915,250		1,915,250
Costa Rica	105,000	85,575		85,575
Cuba	2,500,000	2,037,500		2,037,500
Dominican				
Republic	1,100,000	935,000	+100,000	1,035,000
Ecuador	80,000	70,000	-10,000	60,000
Fiji	125,000	101,875	+130,000	231,875
Guatemala	300,000	244,500		244,500
Guyana	145,000	118,175		118,175
India	825,000	672,375		672,375
Jamaica	130,000	105,950		105,950
Mauritius	175,000	142,625		142,625
Mexico	75,000	70,000		70,000
Mozambique	100,000	81,500		81,500
Nicaragua	125,000	101,875		101,875
Panama	90,000	73,350	+80,000	153,350
Peru	350,000	285,250		285,250
Philippines	1,400,000	1,141,000		1,141,000
Salvador	145,000	118,175	+40,000	158,175
South Africa	875,000	713,125		713,125
Swaziland	105,000	85,575	+25,000	110,575
Thailand	1,200,000	1,020,000		1,020,000
Trinidad	85,000	70,000		70,000
	15,355,000	12,696,275	+390,000	13,086,275

(a) A number of countries overshipped their quotas in 1978 and these quantities are considered first charges on their 1979 quotas. In effect this means that their exportable tonnages are reduced by these amounts this year. The quantities involved are as follows: Argentina 72 tonnes, Australia 4,609 tonnes, Bolivia 4,466 tonnes, Brazil 9,341 tonnes, Cuba 9,929 tonnes, Bolivia 4,466 tonnes, Brazil 9,341 tonnes, Cuba 9,929 tonnes, Dominican Republic 1,693 tonnes, Fiji 5,011 tonnes, Guatemala 889 tonnes, Mexico 3,711 tonnes, Nicaragua 1,776 tonnes, Panama 2,846 tonnes, Philippines 926 tonnes, South Africa 5,196 tonnes, South Africa 1,965 tonn 5,196 tonnes, Swaziland 1,868 tonnes and Thailand 8,675 tonnes.

(b) (i) The Dominican Republic has received quota increases of 55,000 tonnes and 45,000 tonnes under Article 69 of the Agreement, which provides for such increases where Agreement obligations constitute an inequitable burden on a member.

(ii) The entire Hardship Reserve of 300,000 tonnes has been allocated to Bolivia, Fiji, Panama, Salvador and Swaziland. (iii) Ecuador has declared a quota shortfall of 10,000 tonnes.

In addition the following countries, while not holding basic export tonnages and therefore not having export quotas, are each entitled to export up to 70,000 tonnes under Annex II of the Agreement:

Bangladesh, Barbados, Belize, Cameroun, Greece, Haiti, Honduras, Hungary, Indonesia, Madagascar, Malawi, Pakistan,

Paraguay, St. Kitts, Uganda, Venezuela, Yugoslavia and Zambia. Belize shipped 3,263 tonnes in excess of her export entitlement in 1978 and, as is the case with Annex I countries, this quantity becomes a first charge against the 1979 entitlement.

<sup>4</sup>Sugar Review, 1979, (1450), 143.

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<sup>&</sup>lt;sup>1</sup> Public Ledger, August 4, 1979. <sup>2</sup> C. Czarnikow Ltd., *Sugar Review*, 1979, (1442), 109. <sup>4</sup> F. O. Licht, *International Sugar Rpt.*, 1979, 111, 424.

### Sugar boiling instrument control systems

By K. SULLIVAN (Taylor Instrument Ltd., Stevenage, Herts, England)

Before we can apply instrument systems to any piece of plant we must first study the physical and operational characteristics of this piece of plant and then measure and control in the best way possible.

#### The vacuum pan

It has been said that vacuum pans are as varied as finger prints and even the best ones can stand improvement in design details. Our experience has shown us that the best ones are pans having straight side walls, mechanical circulators, condensers with adequate capacity to maintain the desired vacuum conditions, and sufficient steam supply to produce the required circulation within the pan. The method of feed introduction has also been found to be an important but often neglected detail.

In many vacuum pans in operation we have noticed that the "low head pan", which has a larger upper diameter than that of the calandria, will not produce grain of as uniform size as that from the straight-sided pan. This is due to variability of the circulation pattern which allows areas of different supersaturation where crystals will grow at different rates; those spending time in a low supersaturation zone do not grow as rapidly as those in a more favourable environment. Mechanical circulators undoubtedly assist in improving the circulation in the calandria region but their influence in the upper section of the pan during the latter part of the strike is very limited. This can be illustrated quite easily by turning off the steam during the strike and noting how, after a short period, the grain begins to settle within the calandria zone, leaving the surface few inches void of crystals. It is, in fact, only the boiling action which produces the violent circulation in the upper portion of the pan noticed during the strike. For this reason, an adequate steam supply must be available if fast, clean strikes are to be boiled. A temperature drop over the heating surface of around 40°C is required to produce the circulation needed, particularly in the early stages of the strike when the crystals are very small. Without vigorous circulation at this time, conglomerates will form, producing agglomerate grain which is difficult to spin and dusty when being dried.

Reducing the boiling pressure to obtain a greater temperature differential across the calandria produces mixed benefits and often the choice of boiling pressure is dictated by the condenser equipment and cooling water temperatures available.

At low absolute pressures the hydrostatic head has a greater depressing effect on bubble formation owing to the changing slope of the vapour pressure curve. In these conditions, the bubbles simply disappear near the surface of the massecuite and do not produce the percolating effect which moves the material below this level.

We have experienced many different syrup feed arrangements — some where the feed enters the pan over the calandria where it flashes, causing entrainment losses, particularly during the early phases of the strike;

other systems introduce the feed down the centre well where it flashes vapour back up the centre well in the opposite direction to the desired flow. This arrangement usually leaves the agitator (if fitted) with the hopeless task of trying to pump bubbles down and out under the bottom tube sheet of the calandria. The best arrangement we have found is one which introduces the feed well out under the calandria surface at three or four places so that, on introduction, it flashes up through the tubes, adding impetus to the rising massecuite, and thus assisting pan circulation.

Other points that must be considered when discussing vacuum pan operation are adequate ventilation of the incondensables from the calandria and the ability of the condensing system to handle all the vapour that the pan is capable of producing. It has been noticed on many installations that the incondensable lines are not operating at their maximum efficiency in purging the calandria. The notion still persists that fixed gases will stratify in a calandria by virtue of their densities, and vents should be arranged near the top or bottom tube sheets. In one case a new pan failed to boil near its rated capacity because air vents were located just under the upper tube sheet. The whole of the bottom half of the calandria in that area was filled with air, dramatically cutting heat transfer. This was easily proved by simply opening a bypass valve around the steam trap for a few minutes to blow out this mass of moist air. Venting is best done through a tube or tubes perforated over their entire length. Baffling within the calandria should be such that air entering with the vapour is squeezed into a small corner down a long and tapering path so as to maintain maximum velocity and scouring effect to a point where it can be easily removed. Cold spots are produced in unpurged areas, with consequent loss in circulation and efficiency; the pan takes longer to boil and produces both conglomerates and mixed grain.

#### **MEASUREMENTS**

With all control systems the measurement is the most important; without good measurement proper control cannot be achieved even with the most sophisticated control equipment. Parallel with this must be the positioning of the sensors required to measure the process. Without due regard to the optimum point of measurement even the best sensors will fail to provide the required data for control. Let us look at the various pan parameters and our methods of measurement, and then discuss how a typical control system is configured.

#### Oversaturation

The most important variable in sugar boiling is undoubtedly the degree of syrup saturation in the pan, as the crystal growth rate is proportional to this variable. It has been shown many times that there is an upper limit of saturation that cannot be exceeded without the formation of new grain and this limit lies around 65% oversaturation. The method of measurement of this variable has been the subject of many experiments and

discussions. Temperature sensors in the massecuite have been used but they are only reliable during the early part of the strike when the level is constant. We know that, as the level in the pan increases, the hydrostatic head affects the temperature, making it an unreliable measure of saturation. The highest saturation occurs at the massecuite surface because this is at the lowest temperature of any point in the pan, and it is this measurement which we require. To overcome the problems of the change in level we measure the temperature of the superheated vapour as it leaves the surface of the massecuite. This method has been used for many years and has proved to be a most reliable means of supersaturation measurement. Because the boiling point of the syrup changes under varying vacuum conditions, we compare the reading with that of boiling water under the same vacuum conditions, i.e. we measure the boiling point elevation.

The other variable affecting this measurement is purity; to compensate for this, the instrument used is fitted with a dial which is set to the purity of the syrup entering the pan at the beginning of the strike.

During the course of the strike the syrup surrounding the crystals drops in purity, effectively lowering the oversaturation measurement and making the reading on the safe side of the upper saturation limit. If desired, in fact, the monitor dials can be re-adjusted during the Brixing period to allow for this small change in purity.

The positioning of the oversaturation probe is important; it must be at a point in the pan or adjacent vapour main where maximum vapour velocity will be achieved. The unique oversaturation transmitter is calibrated 0-100% oversaturation with a colour change interface at the 65% oversaturation limit on the scale for easy readability. The output signal is 4-20mA which can be fed into any desired control system.

#### Consistency

The consistency of the boiling syrup, measured in terms of viscosity, depends on its temperature and concentration but, surprisingly enough, at the saturation limit, the viscosity is almost constant. However, the overall consistency of a given syrup increases with the presence of sugar crystals in suspension. So the object of the consistency measurement is to maintain the pan consistency within certain limits by feeding fresh syrup into the pan during the boiling cycle.

Again, the point of measurement of consistency is important; the consistency probe is usually mounted in the bottom of the pan below the lower tube sheet of the calandria at a point of good circulation between two feed inlets, It can be mounted at any angle up to 70° elevation, which covers all normal requirements. The consistency transmitter calibration is 0-100%. 0% with the rotor running in free air and 100% when stalled. The output signal is 0-5mA or 4-20mA, which can be fed into any desired control system.

#### Absolute pressure

The third measurement required in the pan is that of the vacuum itself. This is achieved by the use of a vacuum or absolute pressure transmitter connected to the pan dome at a suitable point, high enough to avoid any entrainment. The line to the transmitter is airpurged to keep it clear, thus avoiding any condensate finding its way into the instrument.

The absolute pressure calibration is usually 250 mm Hg(Abs) around the desired control point. The output signal is 4–20mA, which can be fed into any desired control system.

#### I evel

The fourth and final measurement is that of level. A standard differential pressure level transmitter can be sited anywhere around the base of the pan. This should preferably be a flush diaphragm type with no crevices where sugar crystals can become lodged and compacted. The compensating or balance line to the low side of the level transmitter normally comes from the same purged connexion feeding the absolute pressure transmitter, thus avoiding condensate building up in this line also.

Generally there is no special calibration for the level transmitter and it is usually set during commissioning so that the charge level indicates 25–30% on the scale and the normal pan full level set at 80–90% of full scale. The output signal is 4–20mA, which can be fed into any desired control system.

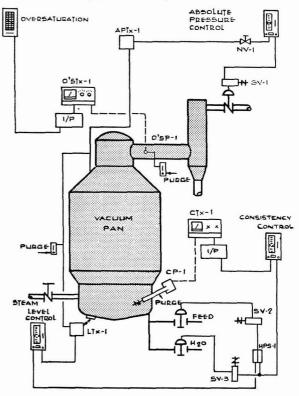


Fig. 1. Pan system typical layout 1

Fig.1 shows a basic analogue pan control system configured around the pan. This system measures and controls level, consistency and absolute pressure, and records oversaturation. It can be used on any pan where a minimum of control is required but is usually fitted to lower purity pans started from footing and not seeded. This same system can also be part of an integrated electronic or computer system supplied to the whole factory.

#### Automatic system

Fig. 2 shows an analogue system designed for boiling fast strikes from high purity syrups with the least operator attention.

The level, consistency, absolute pressure and oversaturation outputs are measured and controlled by suitable valves on steam, feed and water lines. Seeding can be done automatically, although generally is not, as it is usual for the pan-man to be present at this time and manual seeding is quick and simple.

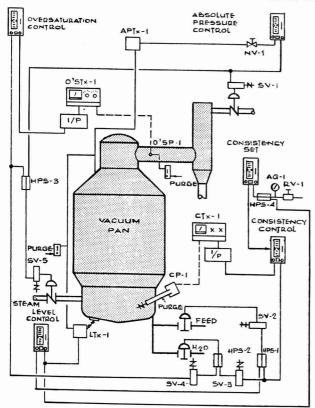


Fig. 2. Pan system typical layout 2

Fig. 3 shows the graphical representation of a typical boiling cycle for a high purity strike which operates as follows:

When the pan is clean and closed up ready to go, the system is started by a switch which actuates the condenser water, syrup feed and charge valves (if fitted) through their respective control functions. The absolute pressure falls to the control point and condenser water

flow is throttled to maintain it. When the syrup reaches the graining charge level the feed is throttled to maintain it and the steam valve opens at a controlled rate. If the syrup is thin and the evaporating rate exceeds the capacity of the condenser, the steam is throttled to prevent increase in absolute pressure until the syrup viscosity increases and reduces heat transfer. When the syrup approaches a preset limit of oversaturation, an alarm notifies the operator or automatic system that it is time to seed. The pan is seeded with a measured amount of standard fondant sugar.

The consistency is set at this time to introduce a low feed rate to prevent the oversaturation from rising too fast and causing conglomerates. If the pan is held too near the upper limit of saturation during this time, excessive conglomeration will occur. Yamane & Kamoda¹ determined that conglomeration is directly proportional to oversaturation and many observations confirm that this occurs mainly when the crystals are in

the 0.001 to 0.002 inch size range. We would, therefore, expect to seed the pan in the 35-40% oversaturation range and hold this for 10-15 minutes to allow the crystals to grow past this critical size range. Once this phase has passed, the consistency set point can be manually or automatically increased, reducing syrup feed and allowing the strike to pull together, which increases the syrup crystal ratio to a level suitable for boiling. The oversaturation will increase up to the maximum safe rate. If the consistency set point is not increased it will be noticed that the oversaturation reading will fall slightly. This is because the crystals are taking up a larger portion of the sugar than that made available by water removal. The consistency should not be allowed to go too high during this period the strike or good massecuite circulation will be lost.

When the high level is reached the feed is turned off and the pan will "Brix up". At this time the oversaturation increases and sugar deposition accelerates. This rising consistency reduces the evaporation rate slightly, slowing the rise in oversaturation during the final minutes of the strike. At no time should the oversaturation reading be allowed to go over the limit; to prevent this, the controls are set to throttle the steam valve to a preset open stop, without spoiling good circulation and if this is insufficient a small water feed will be introduced to maintain the control point until the dropping consistency is reached. Steam is then cut off and the pan emptied.

If the syrup feed to the pan is light, more time will be required to boil the strike because the evaporation rate will exceed the crystal growth rate. The massecuite will pull together at a lower level and it is likely that the oversaturation limit will not be reached until the final Brixing of the pan.

<sup>1</sup> Proc. Research Soc. Japan Sugar Refineries Tech., 1959, 8, 123-130.

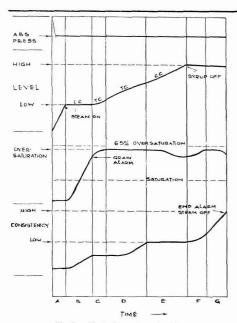


Fig. 3. Typical pan control cycle

If the syrup feed is heavy the pan will fill up with syrup near the safe limit of oversaturation before the proper crystal: syrup ratio can be achieved. Nothing can be done in this instance as the pan has the correct number of crystals but they have not had sufficient time



Fig. 4. Single pan panel, one of a number for Bukidnon refinery in the Philippines

to grow to their full size. The pan feed must be stopped and held on steam and water until final Brixing occurs. It is better, however, not to wait until the pan is full but to introduce some water feed at a lower level. There is nothing to be gained in steam economy or time by introducing feed at too high a concentration.

If it is required to hold the pan at any point in the strike for operational reasons, this is achieved by switching the consistency control from syrup to water, when conditions in the pan will remain constant indefinitely until it is switched back to syrup feed.

The above control system has been described in analogue format for the sake of clarity; however, pan systems of this type for all pan designs and syrup purities can be engineered, built and supplied in pneumatics, electronics, integrated electronic systems or in digital computer format. The same would apply to evaporator systems and other pieces of plant associated with complete turn-key projects for the sugar industry.

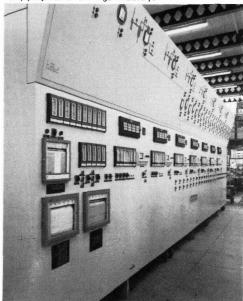


Fig. 5. A 7-panel system with level and temperature controls for Karun, Iran

#### Acknowledgement

The author would like to acknowledge the contributions made over many years by J. G. Ziegler to the whole area of measurement and automatic control in the sugar industry, much of which is reflected in the content of this paper.

#### Summary

Vacuum pan design factors, the location of sensors and the relative importance of specific process variables are discussed and automatic control of boiling described.

#### Systèmes instrumentaux de contrôle de la cuisson

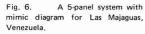
On discute de l'influence de la conception de l'appareil à cuire, du positionnement des capteurs et de l'importance relative des diverses variables spécifiques de la cuisson et on décruit un système de contrôle automatique de la cuisson.

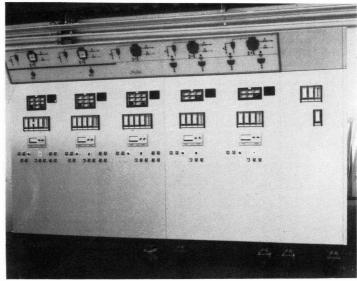
Instrumente und Kontrollsystem der Zuckerkristallisation

Diskutiert werden Bautypen von Eindampfkristallisatore, die Anordnung der Meßstellen und die relative Bedeutung von spezifischen Prozeßvariablen, ferner wird die automatische Kontrolle der Kristallisation beschrieben.

### Sistemas para el control de cristalización de azúcar por instrumentos

Factores en el diseño de tachos, la situación de sensores y la importancia relative de variables específicas del proceso se discuten y control automático de cristalización se describe.





# Role of diseased setts and soil in the annual recurrence of red rot in sugar cane

By V. P. AGNIHOTRI, T. R. BUDHARAJA and KISHAN SINGH

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#### Introduction

Red rot of sugar cane caused by Colletrotrichum falcatum Went (perfect stage = Physalospora tucumanensis Speg.) is the most widely distributed disease in India. 1.2.3 The disease has caused frequent epiphytotics in commercial cultivars such as Co 213. Co 281, Co 299, Co 312, Co 453, CoS 510, B03, B0 11, B0 17, B0 29, B0 34 and B0 54. About two decades ago, the disease was practically unknown in peninsular India and it was postulated by Srinivasen & Alexander<sup>4</sup> that the prevalence of high temperatures imparted resistance to the host and concomitantly made the pathogen non-virulent. Red rot has now spread to many parts of Andhra Pradesh and recently broke out in Tamil Nadu, both in peninsular India, suggesting that virulent biotypes of the pathogen have been developed or introduced in areas where the disease was hitherto unknown. Apparently this is due to the unrestricted movement of seed material from one location to another.

The available literature offers conflicting reports regarding the role played by infected cane setts in the spread of red rot in nature. Earlier workers in India<sup>5,6,7</sup> demonstrated the positive role of infected setts in the annual recurrence of the disease, while investigations in Louisiana<sup>8,9,10</sup> indicated a negative role, since infection did not pass from the diseased sett to young shoots. Only

limited information is available on the role of infected soil in initiating red rot infection. The present communication reports the results of studies on these two topics.

#### Materials and Methods

A pure culture of *Colletotrichum falcatum* ('D' strain) maintained on oatmeal agar was used. The following techniques were employed for obtaining setts having internal (pith region) and/or external (nodal) infections:

(i) Internal infection:- In the first method, apparently healthy, 8-month-old, standing stalks of Co 312 and Co 527 were inoculated with C. falcatum in the last

<sup>1</sup> Chona & Padwick: *Indian Farming,* 1942, 3, (2), 70-73.

<sup>&</sup>lt;sup>2</sup> Chona: *Indian J. Agric. Sci.*, 1950, **20**, 363-385. Agnihotri & Singh: *Coop. Sugar*, 1977, **9**, 90-95.

Agnihotri & Singh: Coop. Sugar, 1977, 9, 90-95.

Proc. 5th Conf. Sugarcane Dev. & Res. Workers, 1966, 676-684

<sup>&</sup>lt;sup>5</sup> Butler. Mem. Dept. Agric. India, Bot.Ser. 1906, 1, (3), 151-178.

Butler & Hafiz Khan: *ibid.*, 1913, 6, (5), 151-178.
Kilkarni. *Dept. Agric. Bombay Bull.*, 1911, (44), 1-8.
Edgerton: "Sugarcane and its diseases". (Louisiana State

University Press, Louisiana, USA, 1959.
Abbott: US Dept. Agric. Circ. 1935, 350.
Edgerton: Louisiana Agric. Expt. Sta. Bull., 1911, (133),

week of September by the plug method<sup>2,11</sup> using the IISR inoculator, <sup>12</sup> After inoculations, the punctures were sealed with plasticine and the stalks left standing in the field under normal cultural conditions for about 5 months. Then stalks with green foliage and viable buds but with internal infection were selected and cut into 3-bud setts. These were planted in the field in February. Disease development was recorded both before and after the rainy season (June-September). In the second method, 3-bud setts of Co 312, Co 419, Co 453, Co 527, Co 1148 and CoS 510 were inoculated in the middle as in the first method, and planted in the field. The control setts were treated identically except that sterile oat meal agar was used in place of *C.falcatum* inoculum.

(ii) External or nodal infection:- Two methods were employed. For the first method, 3-bud setts of Co 312, Co 1148, Co 1158, CoL 9, B0 17 and B0 50 and CoS 510 were steeped in the suspension of conidia of C.falcatum for 4 hours, and planted in the field. In the second method, surface-sterilized long setts (5 to 6 buds) were inoculated by the IISR method<sup>11</sup>, with slight modification. A few pricks were also made in the root primordia region with the help of a sterile needle before applying the conidial suspension. The inoculated area was covered with a moist cotton swab and the setts incubated for 15 days. Periodical observations showed that, during this period, typical nodal infections, 1 to 3 mm deep, appeared mostly in the root primordia zone. Three-bud setts prepared from inoculated canes were planted in the field.

(iii) Mixed infections:- Three-bud setts of Co 312, Co 7105, Co 7414, Co 7417 and Co 7324 naturally affected with red rot and having internal (pith region) and external (nodal) infection, were planted in the field. Healthy setts of these varieties were also planted simultaneously to serve as controls. Red rot development was recorded at frequent intervals up to harvest.

(iv) Infection from soil:- Soil was inoculated by mixing debris (12 kg per plot measuring 12.5 x 4.35 m), prepared by chopping red rot-affected canes or by mixing healthy cane debris inoculated artificially by sprinkling a conidial suspension of C.falcatum. The latter was incubated until fully covered by fungal growth. The two types of debris were mixed with soil in separate plots with four replications. Healthy cane debris mixed with the soil served as the control. Three-bud setts of two red rot susceptible varieties (Co 312 and Tuc 521) were planted and disease development recorded. In all cases, re-isolations were made from moribund shoots to confirm the presence of the pathogen.

#### Experimental results

(1) Internal infection: In the 1974-75 experiment, when setts were taken from inoculated canes five months after infection, pre-emergence death of shoots was recorded up to 24% in Co 312 and 47.3% in Co 527. In the experiment conducted the following year, post-emergence mortality of shoots was also recorded in Co 312. Diseased setts, when sliced longitudinally through the young shoots, showed conspicuously reddened vascular strands passing from the node of the sett to the young shoot. Such shoots had died before emerging from the soil. Isolations made from the moribund shoots always yielded C.falcatum.

With setts inoculated just before planting, preemergence mortality of shoots was recorded in all varieties, while post-emergence mortality was recorded in only Co 312 and Co 419. Ungerminated setts and those showing pre-emergence mortality were removed from the soil for recording the spread of the pathogen in setts and isolations. In a resistant variety such as 10 setts and isolations. In a resistant variety such as 1148, only the vascular strands of the middle portion of the node were affected while, in susceptible varieties like Co 312, Co 453 and CoS 510, most of the nodal tissues were destroyed. It was observed that in a three-bud sett, it was the middle bud (near the point of inoculation) that invariably died and one of the two remaining buds survived.

Sexual or asexual fruiting bodies of the pathogen did not develop on shoots that died before emergence. Free-hand transverse sections of the diseased young shoot material revealed the presence of abundant intercellular mycelium both in the parenchymatous cells and xylem vessels. In places, thick-walled hyphae, mostly of oval shape, were also seen.

(2) External infection: The two methods used for obtaining external infection gave different results. The disease did not develop in setts that were steeped in a spore suspension and planted after incubating for 48 hours. In nodally affected setts, however, both pre-and post emergence mortality of shoots occurred. In Co 312, only post-emergence mortality (27.2%) occurred, while in Co 527 and CoS 510 only pre-emergence mortality occurred. Mortality of clumps was greater in CoS 510 (38.6%) than in Co 527 (7.9%).

(3) Mixed infection: Setts displaying both internal and external (nodal) infection gave maximum shoot mortality, pre-emergence mortality being greater than post-emergence; the latter occurred mostly during the rainy season. The foliage (3rd, 4th and 5th leaves) of the affected stalk showed drying at the tip and also at the edges and when such stalks were split open typical symptoms of red rot were observed. In Co 7105, Co 7414, Co 7471 and Co 7324, abundant acervuli developed at the lower nodes. When the surface of the stalk below the acervuli zone was lightly scraped and examined under the microscope, numerous round-to-oval, dark coloured structures, resembling appressoria, were observed.

(4) Infection of healthy setts from diseased soil: The disease developed when chopped pieces of naturally affected red rot stalks were mixed with the soil, but not in plants raised in soil having artificially inoculated sugar cane debris. The absence of red rot in this and the control treatments was confirmed by plating tissue samples. Disease incidence was greater in Co 312 (30.8%) than in Tuc 521 (8.2%).

#### Discussion

Results from the study indicate that naturally affected red rot setts, carrying both types of infections (internal and nodal), are the most potent sources of disease infection. When such setts were planted, the loss in stand of the varieties tested varied from 33.7 to 100%, making the crop gappy and causing direct economic loss to the grower. Such setts may also provide inoculum for the secondary spread of the disease. The results regarding spread of the disease through naturally affected setts are in agreement with earlier findings 5, 6, 13.

Of the two methods employed for obtaining external infection, dipping of setts in conidial suspension did not produce the disease, indicating that either this time

<sup>11</sup> Singh & Budhraja: Plant Diseases Reporter, 1964, 48, 991-993.

<sup>12</sup> Menon & Singh, Indian J. Sugarcane Res. & Dev., 1960, 4, 249-250.

<sup>13</sup> Mehta & Sinha: Indian Sugar, 1975, 7, 337-339.

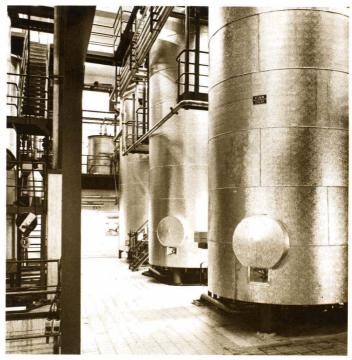
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interval was not sufficient for the pathogen to establish a firm infection in cane tissues or the sporeling/hyphae lysed in the soil because of the preponderance of antagonistic and/or lytic microbes 14.

On the other hand, setts with nodal infections displayed both pre- and post-emergence shoot mortality. Nodal infections are mostly responsible for the spread of the disease in nature. These escape detection, in some cases because of their minute size, while fungal mycelium stays alive longer in the nodal tissues than in internodal ones. Because of these two factors, the problem of red rot continues, though there has been some awakening in favour of healthy seed cane. Both the methods used for creating infection caused pre-and postemergence shoot mortality; however, this was less in the crop raised from setts planted immediately after inoculation than that from setts carrying five-month-old infection. This might be due to the failure of the pathogen to invade the tissues of the bud or young shoot before it became independent of the seed cane.

The results of this study clearly indicate that diseased setts are the main source for spreading infection in a crop, thus confirming earlier observations 5, 13, 15. Conversely, the results differ from the reports of foreign workers8,10,16 who observed that disease did not spread from the emerging shoots. These differences might have been due to different varieties of sugar cane as well as different biotypes of the fungus. In India, red rot is mainly a disease of standing cane, while in the USA it is found in seed cane. Irrespective of the type of infection, internal and/or external (nodal), complete mortality of setts/clumps was never observed. Several plausible explanations can be forwarded for this: (i) infection reaches the shoot after the latter is independant of the mother sett, (ii) infection remains confined to the central portion of the node and the vascular strands that pass from the node to the emerging shoot do not carry infection, and (iii) wide-spread occurrence of soil fungistasis; when the sett germinates it imbibes soil water and, along with water, certain fungal inhibitors, such as antibiotics, toxins and lytic products of microbes, may also enter the sett. These substances may immobilize the pathogen till the shoot becomes independent.

Considerable infection of red rot occurred in the field soil ammended with red rot-affected debris, indicating that even healthy setts can become infected. Therefore, the earlier concept of "clean sett and no red rot" 5.6 may not be correct in all instances. For getting a disease-free crop, a clean field as well as disease-free seed material are essential. That infected debris can initiate infection in planting material (seed cane) has also been reported by earlier workers 2, 17.

New bulk sugar terminal in Cuba<sup>18</sup>. — Another bulk sugar terminal was opened at Ceiba Hueca, in Granma Province, on January 16, 1979. The terminal can store up to 44,000 tonnes and load 15,000 tonnes cargo in 24 hours, at a rate of 700 tonnes. The superior of 10 hours, and is the seventh to be put into operation in Cuba, the others being located in Guayabal, Matanzas, Cienfuegos, Guantanamo, Puerto Padre and Mariel.

Swaziland sugar project 19. — Further contracts have been awarded by the Royal Swaziland Sugar Corporation for work on its third sugar factory at Simunye in the north-east, close to the Mozambique border 20. Total cost of the project is estimated at 140 million Emalangeni (approx. £80 million) and the factory project, managed by Tate & Lyle Ltd., is due to come on stream in 1980 with a rated annual capacity of 130,000 tonnes, while estate development under cane is expected to reach 9400 hectares by 1981. The overall project in the area involves a site for a new dam and the development of the township to accommodate more than 8000 people.

#### Summary

Diseased setts are the main source of infection of red rot and the disease passes from the mother sett to the shoots. Setts having both internal and external infections cause much more damage than setts having either internal or external (nodal) infection. Nodal infections are mostly responsible for the spread of the disease in nature because of their very small size. Healthy setts can become infected if planted in a soil contaminated red-rot affected debris.

Le rôle des boutures atteintes par la maladie et celui du sol dans la réapparition annuelle de la morve rouge de la canne à sucre.

Les boutures atteintes par la maladie sont la principale source d'infection de la morve rouge et la maladie passe de la bouture mère aux pousses. Les boutures présentant des infections à la fois internes et externes causent plus de dégâts que les boutures à infection soit interne, soit externe (nodulaire). Les infections nodulaires sont les grandes responsables pour la propagation de la maladie dans la nature du fait de leur très faible dimension. Les boutures saines peuvent être infectées si elles sont plantées dans un sol contaminé par des débris atteints de la morve rouge.

Die Rolle von verseuchten Stecklingen und Boden bei der jährlichen Wiederkehr der Rotfäule in Zuckerrohr. Kranke Stecklinge sind die Hauptursache für Rotfäuleinfektionen. Dabei wird die Krankheit vom Muttersteckling auf die Sprosse übertragen. Stecklinge mit innerer und äußerer Infektion verursachen wesentlich mehr Schaden als Stecklinge mit entweder nur innerer oder nur äußerer (Knoten –) Infektion. Knoteninfektionen sind wegen ihrer geringen Größe meistens fur die Verbreitung der Krankheit in der Natur verantwortlich. Gesunde Stecklinge können infiziert werden, wenn sie in Boden gelegt werden, der fäulnisverseuchten Schutt enthält.

Papel de estacas enfermas y suelo en la reaparición anual de pudrición roja en caña de azúcar.

Estacas enfermas están el fuente principal de infección para pudrición roja y la enfermidad pasa de la estaca madre a las brotas. Estacas con infecciones ambas interna y externa (nudal) causan mucho más daño que estacas con cualquiera de las dos. Infecciones nudales tienen mayor responsibilidad para la extensión de la enfermidad en el natural a causa de su tamaño muy pequeño. Estacas sanas pueden infectarse si se plantean en un suelo contaminado con escombres afectado por pudrición roja.

Cuban aid for the Ethiopian sugar industry<sup>21</sup>. — An agreement signed by the two countries provides for Ethiopian engineers, chemists and technicians to receive training in Cuba, for expansion of the Metahara sugar factory in Shoa province, and establishment of a new sugar factory in the Fincha valley of the Wollega Region.

<sup>14</sup> Sinha: Ph.D Thesis, Kanpur University, Kanpur, India.

<sup>15</sup> Rafay & Singh: Proc. Conf. Sugarcane Res. & Dev. Workers, 1959, 333-335.

<sup>16</sup> Steib & Chilton: Phytopathology, 1966, 41, 522-526.

<sup>17</sup> Abbott: US Dept. Agric. Tech. Bull., 1938, (641), 1-96.

 <sup>18</sup> Cuba Economic News, 1979, 15, (91), 19.
 19 Standard Chartered Review, May 1979, 32.

<sup>20</sup> See also I.S.J., 1978, 80, 352.

<sup>21</sup> F. O. Licht, International Sugar Rpt., 1979, 111, 280.

### Microbiological control in the milling station

By MARÍA T. HERNÁNDEZ NODARSE (Central University of Las Villas, Cuba)

#### PART I

#### Introduction

The physico-chemical characteristics of cane juice make it an adequate culture medium for the development of a wide variety of micro-organisms. That is why the milling station is that stage of the technological sugar process where microbial activities are more pronounced. These activities result in the destruction of sucrose and the incorporation of metabolic products in the intermediate materials, which cause troubles in the later stages of the process.

In the cane sugar industry, these activities are highly favoured by the conditions of the juice extraction process, in which juice temperature does not rise to values at which microbial development is inhibited. Also, juice becomes aerated when it falls from the mill to the juice tanks, and these two factors determine the characteristics of cane juice microflora, which is composed fundamentally of aerobic, mesophilic microorganisms.

The microbial population of crusher juice varies, depending on the conditions in which cane is received, i.e. its cleanliness and the time elapsed from cutting to milling. In the juice of cane milled less than four hours after cutting, populations between 106 and 20 x 106 micro-organisms per cm3 of juice are reported. This wide range arises from the variable state of the stalks, that is, if they have been attacked by diseases, insects and rodents, or not.

Mayeux & Colmer<sup>1</sup> found that in canes attacked by borer, the micro-organism content was very high, Bevan & Bond<sup>2</sup> studied the speed of dissemination of microbial infection in chopper-harvested cane, and they found that 1.5 hours after the cane was cut, infection had reached 6 inches from the initial cut. For this reason even when extreme measures are taken in order to minimize microbial population of the cane, it is impossible to obtain micro-organism-free juices.

If, as the juice passes through the milling tandem, it is stopped in regions of stagnation or low speed, the microorganisms which arrived with it find favourable conditions for their development. There they receive continuously fresh nutrients and, at the same time, metabolic products are separated and incorporated into the juice stream. It has been established that, in such stagnant regions a continuous culture of micro-organisms develops which utilizes sucrose and other sugars present in the juice as a source of energy while they deliver a great variety of metabolic products into the juice, including organic acids, reducing sugars and polymers with long and complex chains, such as gums. As a rule these metabolic products have a negative influence upon juice clarification and on sugar crystallization, resulting in high losses in the factory, the actual amounts of which remain unknown.

From the above analysis, the importance may be seen of achieving adequate microbiological control in the milling station. This enables detection of when the microbial population is growing through the tandem, and adoption of measures to avoid this increase. The existence of a reliable index that adequately reflects the microbiological conditions of the section is the fundamental premise for the establishment of this

Hernández<sup>3</sup> has proved that indirect indexes used up to now in the cane sugar industry for this purpose do not have any relationship with the increase in microorganisms occurring in the juice as it travels through the tandem. Based on this fact, the author concludes that they cannot adequately reflect the existence of infections in this stage of the process.

The resazurine test, based on the property of this colorant to pass from a coloured structure (oxidized) into a colourless structure (reduced) by the action of micro-organisms present in the medium, was adapted for the estimation of the microbial population in cane juices4. The time needed for the reduction or decolorization of the resazurine has been shown to be an unbiased indicator of the microbial population present in the juice. This test has a quick response, with relatively high precision, factors which make it suitable for assessing hygienic conditions in the milling station. Its introduction for routine factory control requires prior knowledge of the following:

1. Manner in which the indicator behaves in normal working conditions, without addition of any disinfectant substance; this requires study of the microbiological characteristics of the juice in the milling station of production units.

2. Analysis of the variation of response of the index when hygienic conditions of the station are improved by the addition of disinfectants or by the heating of maceration juices.

3. Comparative study of the behaviour of the index as a reflection of varied hygienic conditions in an industrial milling station.

This paper contains the results obtained in the study of these three objectives.

#### EXPERIMENTAL PROCEDURE

For the first part of the study, samples were taken from milling stations of two industrial units and a pilot plant throughout a whole campaign. In each production unit, two sampling systems were examined; these differed from each other in the frequency with which samples were withdrawn. The first or "continuous sampling" system, consisted in taking instantaneous and simultaneous samples of crusher and mixed juices, at intervals of 15 minutes. Four samples were composited, so that a 1-hr interval was maintained between two consecutive composite samples. A 1-cm3 aliquot of juice taken from each 15-minute sample was added to an equal volume of resazurine in a test tube4 and incubated

Sugar J., 1960, 23, (7), 28-32.
 Proc. 38th Conf. Queensland Soc. Sugar Cane Tech., 1971,

Mem. XXXIX Conf. Asoc. Tecn. Azuc. Cuba, 1970, 184-201. Hernández: Cuba Azúcar, 1970, (Jan.-March), 27-30.

at 37°C. The time required for total decolorization was measured, by means of observations each half hour.

The so-called "instantaneous sampling system" consisted in taking, at the beginning of each hour, 4 consecutive and instantaneous samples of each juice. This system proved to be the most practical and that which gave the best response; consequently, it was selected for the work on a pilot plant scale.

Experiments were conducted on a pilot plant scale in order to compare the microbiological characteristics of the tandem of the "José Marti" experimental plant with those of a production unit. If both characteristics were similar, the pilot plant tandem could be employed for subsequent microbiological research. Satisfactory results obtained in this part of the research confirmed the validity of results from the experimental tandem, which was therefore suitable for trials on the response of the index studied when microbiological conditions of the milling station were improved.

The study of the variation in the index in the face of improved hygienic conditions comprised experiments in which disinfectant agents were added, and those in which maceration juices were heated. All the experiments were carried out using an experimental tandem in the "José Marti" pilot plant at Las Villas University. This tandem has an approximate daily milling capacity of 100 tonnes and comprises two crushers and three mills. Compound imbibition is used, and maceration is recycled to the first mill. Imbibition water is fed at the entrance of the second mill; its temperature is 70°C.

Trials were carried out:

(a) without addition of disinfectant.

(b) with addition of formalin at various time intervals,

(c) with heat treatment of maceration juices. The "instantaneous sampling" system was employed for all the variants.

#### Without addition of disinfectant

Experiments carried out without addition of disinfectant and without heat treatment of maceration juices served as the standards for comparison of experiments using such treatments, as well as for the production units already studied. In this period, cleaning with hot water and application of steam to the mill supports, conveyors, juice strainers and other accumulation points was the cleaning system employed. This is the system normally employed in the industrial milling stations.

#### With addition of disinfectant

Shock treatment with disinfectant was effected by addition of a large dose of formalin over a period of 3 to 5 minutes. It was added to the third mill juice, collected in a tank, at 0.1% by weight, and the interval between two successive additions was 2 or 4 hours.

#### Heat treatment of maceration juices

Heat treatment of maceration juices, which is practised in some production units, was previously studied experimentally by Monterde & Hernández<sup>5</sup> in this same pilot plant. It had proved to be an effective means of arresting microbial development in the tandem. Consequently, the response of the index when maceration juices were heated to 70°C was also studied; the authors cited had reported the inhibition of microbial activity at this temperature<sup>5</sup>.

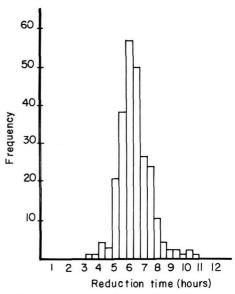


Fig. 1. Instantaneous sampling system; industrial unit, crusher juice

The heating of maceration juices was accomplished in a heat exchanger adjacent to the milling tandem, in which juice flows through the interior of the tubes and steam on the outside. The juice temperature was controlled at the exit of the heat exchanger.

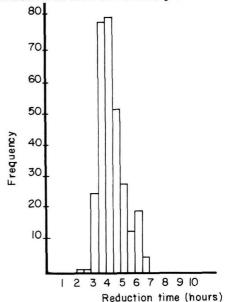


Fig. 2. Instantaneous sampling system; industrial unit, mixed juice

<sup>&</sup>lt;sup>5</sup> Mem. XXXVIII Conf. Asoc. Técn. Azuc. Cuba, 1968, 141.

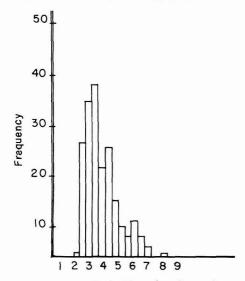
#### Index response under different hygiene conditions

Experiments were carried out at "George Washington" sugar factory throughout one month. In the first 15 days, data from crusher and mixed juices were collected, while the normal cleaning system was maintained. These data enabled us to establish the standard for comparison when disinfectant was added. This was a chlorinated disinfectant, and it had shown itself very effective in laboratory trials at 10 ppm. It was therefore added at this concentration to the juice contained in the fifth mill tank. The effect on the resazurine reduction times of crusher and mixed juice was studied during 15 days.

#### **RESULTS AND DISCUSSION**

#### Microbiological characteristics of a milling station

The frequency distribution of the resazurine reduction times of crusher and mixed juice from an industrial unit and from the "José Marti" pilot plant are shown in Figs. 1-4. In Table I, frequency distribution of the resazurine reduction times from both units studied is presented as well as pilot plant data. These results were obtained using both the sampling systems previously described.



#### Reduction time (hours)

Fig. 3. Instantaneous sampling system; pilot plant scale, crusher juice

Each frequency distribution found was compared with a normal distribution by means of a  $\chi^2$  test. This comparison showed that the fit of the distributions studied may be accepted as good with a 5% level of significance, *i.e.* on this basis they are normal distributions.

In Table II are given the values of means and dispersion of the time distributions. Comparison of average values for resazurine reduction time of crusher and mixed juice from each unit by means of Student's t-test shows that crusher juice reduction time is significantly higher than that of mixed juice.

These results, which indicate the presence of a higher microbial population in the mixed juice, may only be

Table I. Frequency distribution of the resazurine reduction time

Mill		Un	it "A"		Unit "B"			Pilot plant		
Sampling system	Cont	inuous	Instant	taneous	Cont	inuous	Instan	taneous	Conti	nuous
Time, hr	C1	MJ	CJ	MJ	CJ	MJ	CJ	MJ	C1	MJ
0.1-0.5	-	4		II-		-		-	141	2
0.6-1.0							-		-	10
1.1-1.5			2	~	-	14	-		1	36
1.6-2.0		8		8		151			29	50
2.1-2.5	5	14	5	13				-	39	29
2.6-3.0	13	39	13	27		2		2	42	23
3.1-3.5	17	116	8	52		2	-	2	22	12
3.6-4.0	18	78	7	42	1	24	1	24	27	32
4.1-4.5	30	40	18	9	1	71	2	66	14	6
4.6-5.0	52	26	37	12	5	76	8	66	8	0
5.1-5.5	52	9	24	5	5	49	8	40	6	1
5.6-6.0	52	- 1	23	0	25	27	27	25	9	6
6.1-6.5	44	1	21	1	45	13	46	14	6	
6.6-7.0	25		11	-	66	19	61	16	3	1
7.1-7.5	13				58	15	60	7	-	
7.6-8.0	11		3		31	1	29	7	1	
8.1-8.5					29	1	18	1	-	-
8.6-9.0	-		2.1		12		7			
9.1-9.5					5		2	2		
9.6-10.0					2	2	2	1		
10.1-10.5	140				2	-	2			
10.6-11.0					2					
Total	332	332	170	170	289	289	273	273	207	207
CJ: crus	her jui	ce	MJ:	Mixed ju	ice					

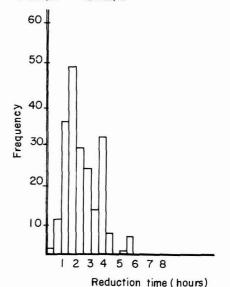


Fig. 4. Instantaneous sampling system; pilot plant scale, mixed juice

explained as a consequence of the existence of contamination foci at different points in the tandem, from which micro-organisms are continuously incorporated in the flowing juice and increase its population.

The comparative analysis of the sets of data obtained from both production units, with different milling capacities, and a pilot plant, shows that frequency distribution of all have similar characteristics, showing a good fit to a normal distribution curve.

Differences may be established between the frequency distributions of reduction times with crusher juices, reflecting the parameters which characterize a normal distribution, its mean and its dispersion. The same may be established in regard to frequency distributions of the reduction times with mixed juices, in each unit studied, however, a higher average value of the

Table III. Resazurine reduction time of crusher and mixed juice from a pilot plant

Without	For	malin		malin		ng of
treatment	every	2 hours	every	4 hours	macerat	ion juice
CJ MJ	Ċ1	MJ	CJ	MJ	CJ	MJ
8.04 8.00 7.13 6.00 7.13 6.00 7.13 6.00 3.63 2.00 3.63 2.00 3.00 1.50 3.50 2.50 3	4.00 5.25 5.75 5.25 4.38 5.13 4.40 3.50 4.50 3.13 3.50 2.75 3.27 4.50 4.13 3.50 2.75 3.80 4.50 4.73 3.80 4.50 7.13	11.50 4,00 10.50 4,00 7.13 5.25 4.00 5.50 3.75 6.63 2.25 6.00 3.00 8.00 3.50 3.50 3.50 3.50 3.50 3.50 3.50 3	2.00 2.00 3.50 2.38 3.25 2.50 2.75 1.75 2.75 2.75 2.75 2.75 2.75 2.75 2.75 2	1.50 3.00 1.50 3.00 1.50 1.00 2.37 3.00 2.00 2.50 2.50 2.50 2.50 2.50 2.50 2	5.00 3.68 3.13 4.00 3.00 3.00 3.00 3.00 3.00 3.00 3.50 2.50 2.50 2.75 4.00 2.50 2.50 2.50 2.50	5.88 4.37 5.63 2.00 2.00 3.00 4.25 5.00 4.00 4.00 4.00 4.00 2.75 3.20 2.00 1.00 1.75

Table III shows the values obtained when formalin was applied every two hours. Average reduction time for the crusher juice was 4.23 while that for mixed juice was 4.73. No significant differences were detected between

Total: 54

the times recorded, which indicates that the microbial development in the tandem was stopped or inhibited by the action of formalin

In Fig. 6 these data are plotted for a 14-hour milling period. On the abscissa, applications of formalin are indicated. Hourly resazurine reduction times for the mixed juice throughout this period are higher than those for crusher juice.

from the experiment in formalin which was applied every 4 hours are also shown in Table III. The average values of resazurine reduction times for crusher and mixed juice were 2.58 and 2.19, respectively. No significant differences between these values were detected. On this basis, it may be concluded that this

Mill		Unit	"A"			Uni	t "B"		Pilot p	lant
Sampling ( system	Continu	ious I	nstantar	neous	Continu	ous	Instantar	neous	Instanta	neous
Average value	CJ 5.60	MJ 3.88	CJ 5.16	MJ 3.56	CJ 7.50	MJ 5.50	CJ 7.03	MJ 5.00	CJ 2.82	MJ 1.57
Disper- sion	8.0	1.5	2.3	1.7	2.1	2.0	2.0	2.4	2.6	2.3
Number (n)	332	332	170	170	289	289	273	273	207	207
Hypothesis $\mu C = \mu M$			Нуре	otheses	is accept	ed if	$t < t_{\alpha}$ ;	nx+ny-	.2	
t	3.	68	7.	33	35	.97	11	.75	5.	18
tα;nχ+ny		,355= .345		,238= 346		1,576: 33		)1,54= 33		,410= 341
Result	μC	> μM	μC	> μM	μС	> μM	μΟ	; > μM	μC >	μΜ
CJ: crush	er juice		MJ: M	lixed ju	ice					

resazurine reduction time of the crusher juice has been found, and the coincidence of the characteristics of the three units studied leads us to conclude that the pilot plant experimental tandem, from a microbiological point of view, behaves similarly to an industrial tandem so that results obtained with this experimental tandem may be extrapolated to the industrial scale,

#### Response of the index to varied hygienic conditions in a mill

Table III contains resazurine reduction time data from crusher and mixed juices from the pilot plant "José Marti", obtained according to the four working variants studied. The values shown are the average values of the four individual determinations which form one sample. In the variant in which only steam and hot water were utilized for cleaning the tandem, average reduction time was 3.58 for the crusher juice and 2.52 for the mixed juice. Statistical comparison of the results established significant differences between them, with a higher value for the crusher juice.

In Fig. 5, the resazurine reduction time of crusher and mixed juice during 20 milling hours is plotted. Interruptions in the milling operation shorter than half an hour are indicated by means of vertical lines. It may be observed that crusher juice resazurine reduction times were always higher than that of mixed juice; therefore, both curves do not have any common point.

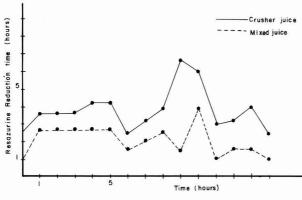


Fig. 5. Reduction time of crusher and mixed juice from a pilot plant

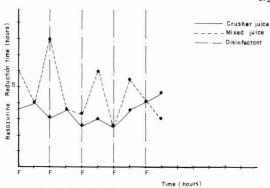


Fig. 6. Reduction time of crusher and mixed juice from a pilot plant when formalin was applied every two hours

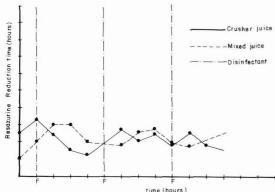


Fig. 7. Reduction time of crusher and mixed juice from a pilot plant when formalin was applied every four hours

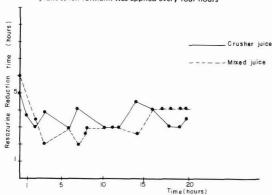


Fig. 8. Reduction time of crusher and mixed juice from a pilot plant when the maceration juices were heated to 70°C

treatment stops the microbial development in the milling tandem. Fig. 7 shows the behaviour of the resazurine reduction times for both juices throughout a 14-hour milling period. It may be observed that the values of the measured parameter oscillate around a common value.

If values reported for the treatments with formalin at intervals of 2 and 4 hours are compared, it may be inferred that the former really causes the death of microorganisms entering with the cane.

> Treatment with formalin every 4 hours prevents microbial development in the juice or destroys those which grow in the stagnant regions of the mill. As a result, the resazurine reducton time is around the same value for both juices.

> Fig. 8 shows the behaviour of the parameter studied when maceration juices were heated at 70°C. Values obtained hourly for the reduction time of both juices oscillate around a common value. The average value for the crusher juice reduction time was 3.30 hours and that of the mixed juice was 3.26; no significant differences between those values were detected.

> > (To be continued)

#### **USSR** sugar imports and exports1

	1978	1977
	- tonnes,	raw value —
Imports		
Argentina	12,199	0
Belgium	0	60,467
Brazil	83,270	24,188
Cuba	3,797,337	3,652,000
Czechoslovakia	0	0
Dominican Republic	45,923	0
France	25,879	151,540
Germany, East	0	0
Germany, West	13,753	0
Guatemala	12,003	0
Holland	0	36,765
Hungary	1,714	0
Philippines	0	634,998
Poland	1,385	0
Rumania	0	164,475
UK	0	0
Other countries	0	51,338
3	3,993,463	4,775,771
Exports		
Afghanistan	58,236	23,119
Algeria	3,170	0
Belgium/Luxembourg	7,525	0
Bulgaria	4,309	2,389
Congo	4,268	0
Gambia	430	0
Guinea-Bissau	1,344	2,688
Ivory Coast	5,310	0
Laos	1,076	0
Mali	1,075	0
Mongolia	33,741	32,077
Niger	12,954	0
Vietnam	10,750	10,750
Yemen, North	0	0
Yemen, South	30,100	16,072
Other countries	0	0
Total	174,288	87,095
1 I.S.O. Stat. Bull., 1979,	38, (5), 92-	93.

<sup>1</sup> I.S.O. Stat. Bull., 1979, **38**, (5), 92-93.

### SUGAR CANE AGRONOMY

A new sugar cane planting technique. M. N. Sath. Sugar J. 1978, 40, (12), 20-21. — Details are given of the "bud chips" planting method which uses a chip of the cane stalk at the node, the chip including a bud and part of the root band.

Response of sugar cane to N, P and K in fixed rotation in a long-term trial and its effect on soil fertility. K. Thakur, P. K. Bose and Y. Rai. Indian Sugar, 1978, 27, 811-815, 821. — Trials over a number of years showed that cane yield after a green manure crop was greater than after maize (which had not received any fertilizer, so that the cane yield was particularly low). N and P both increased cane yield irrespective of rotation and cane variety, but the quantity of P required for cane could be halved when green manure preceded the cane crop. Rotation mainly affected the nutrient status, although green manure had no long-term or cumulative effect on soil fertility or productivity.

Cane research in Jamaica. Ann. Rpt, Sugar Ind. Research Inst., 1974, 21-36. - Trials conducted on two estates in 1974 showed that "Polaris" at 3.5 lb.acre-1 applied as a solution at the rate of 6 gal.acre-1 was an effective ripener and increased cane content and sugar yield per acre when the cane was growing in an area of high rainfall under poor natural ripening conditions. However, on irrigated estates, the chemical did not have any pronounced ripening or sucrose retaining effect when applied during the drying-off period, from which it is inferred that, even in an area of high rainfall, its activity would be reduced if it were applied during a drought, "Polaris" induced severe physiognomic effects in mature cane, including leaf desiccation and discoloration and the sprouting of axillary buds at the top of the cane stalk, "Polaris"-treated cane showed a "flush" of ratoon shoot growth soon after harvest. Treatment of setts with "Tillex-C" organo-mercurial fungicide at 0.015% mercury or with plant growth regulator "Cycocel" at 5 x 10-3 M (both as aqueous solutions) did not stimulate germination of two cane varieties to any great extent, differences in the effects between the two varieties not being significant. Three-year field and greenhouse investigations with the above and other chemicals demonstrated that, provided corrected attention is paid to the selection and preparation of planting material and to the planting procedure, pre-planting treatment of the material is unnecessary. N-P-K trials at different locations are reported for two cane varieties. Evidence from trials in which K was applied in split doses or its application delayed suggested that there is no justification for changes in the standard technique, viz, application to plant cane 6-8 weeks after planting, and to ration cane within 1 week of harvest. On the other hand, a 15:15:23 fertilizer mixture applied at a total of 3 cwt.acre-1 in two equal doses, one at planting and the

other 6 weeks later, was better, as was application of the full amount in one lot 6 weeks after planting, than application of the complete amount at planting. "N-Serve" nitrification inhibitor (containing 2-chloro-6trichloromethyl pyridine) was mixed with sulphate of ammonia before application to cane. At one site the cane did not respond to untreated fertilizer while the "N-Serve" appeared to exert a phytotoxic effect, At another site, cane yield was increased by sulphate of ammonia, regardless of treatment with "N-Serve". At a third site, the treated sulphate of ammonia was the most effective N source in increasing cane yield, followed by untreated (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, sulphur-coated urea and uncoated urea. Studies on the S status of Jamaican soils showed a highly significant correlation between soil C, N and S, suggesting that a large proportion of the S is associated with soil organic matter. Of a number of extracting solutions tested, sodium bicarbonate removed significantly more sulphate-S than did water which was, in turn, more effective than potassium dihydrogen phosphate, ammonium acetate and lithium chloride. However, greenhouse investigations indicated that chemical extractants are of limited value in predicting the S-supplying capacity of soils, and that, of the extractants tested, ammonium acetate was probably the most useful.

Herbicide trials in Jamaica. Ann. Rpt. Sugar Ind. Research Inst., 1974, 67-70. — Pre- and post-emergence herbicide trials are reported. Results indicated that certain pre-emergence herbicides were effective against some weed species but not against others. Formulations of "Sencor" ("Metribuzin") were particularly active against sprangle top (Leptochloa filiformis) but were less effective than herbicides of the triazine type in controlling specific dicotyledonous weeds. However, it is suggested that combining "Sencor" with "Actril-D" at 2.25 lb + 1 pt per acre would give an effective all-round pre-emergence herbicide. Of the post-emergence herbicides, the most effective was "Roundup" ("Glyphosate"), even at its minimum dosage rate of 0.75 lb.acre-1.

A criterion for evaluating the state of the cane fields by examination of the crop. T. C. Ripoli, L. G. Mialhe and H. P. de Novais. Brasil Aquc., 1978, 92, 113-118 (Portuguese). — The condition of the cane field is reflected in the harvesting operation, whether it be manual or mechanical. A number of parameters are mentioned which can be used to assess the condition of the cane fields: these include soil granulometry, stool size, plant population, weight of cane per metre of row, burn quality and stalk erectness.

Herbicides for sugar cane in TSC plantations. M. Y. Chen and Y. T. Hsu. *Taiwan Sugar*, 1978, **25**, 96-99. — Details are given of herbicides recommended for use in Taiwan cane fields, with names of the weeds against which they are most effective.

Improved agronomic practices for adsali cultivation in the Nizamsagar ayacut. P. N. Rao and B. R. Rao. Indian Sugar Crops J., 1977, 4, 64-65. — Recommendations are given on adsali (16—18 months crop) cultivation of cane in a region of Andhra Pradesh, covering transplanting of setts in between growing plants, weed control by preemergence herbicides, intercropping, fertilization and planting times. The economies that are possible by adoption of the suggested measures are indicated.

<sup>1</sup> Ramaiah et al.: I.S.J., 1979, 81, 147.

### CANE PESTS AND DISEASES

Cane pest research in Jamaica. Ann. Rpt. Sugar Ind. Research Inst., 1974, 9-12. - The decision to suspend a programme of biological control of the moth borer (Diatraea saccharalis) was based primarily on the low field populations of the pest, but also on the effectiveness of the tachinid, Lixophaga diatraeae, an established predator. In studies on the jumping borer, Elasmopalpus lignosellus, mouldboard ploughing soon after harvesting was found to cause a significant reduction in the percentage of cane shoots killed by the pest, but was also associated with a reduction in shoot population 2-3 weeks later. Visual observation showed, however, that rows covered with trash had a lower percentage of dead hearts than did bare rows or rows moulded 4 days after harvesting. It is concluded that, where moulding is a normal practice, it may be advisable to carry it out within a week of harvesting. Since all insecticides tested had proved ineffective, it was not easy to evaluate the losses caused by the borer; hence, damage was artificially created by cutting individual shoots at or just below ground level. The yields in plots where 20, 40, 60, 80 and 100% of the total shoots were cut were to be used as a measure of borer damage, although it is admitted that the effect of the cutting (immediate death) is not the same as delayed death due to jumping borer attack. Moreover, buds that would have grown if the shoots had been killed by the borer might have been destroyed by the knife. However, it was considered that these two opposite sources of error would tend to balance each other. Studies on sampling for jumping borer damage estimation showed that optimum as regards the time involved was 6 ft of row in 324 plots. Investigations of jumping borer parasites and predators showed that the jumping borer is well protected from natural enemies in cane fields. The number of parasites is small and the level of parasitism low. Populations of predators, destroyed by pre-harvest cane burning, are only in the 'rebuilding' stage when the borer infestations are at their highest. In an experiment on chemical control of the termite, Heterotermes tenuis, in ratoon cane, none of the three chemicals studied proved successful in eliminating the pest, although stale cane soaked in "Mirex" solution did show some promise as a bait, by comparison with "Chlordane" and "Kepone" sprayed at 2 lb.acre-1 a.i. (The bait was formulated to correspond to 2 lb of "Mirex" per acre.)

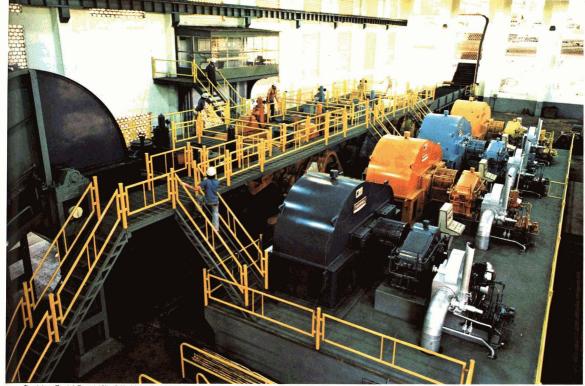
Mass liberation of Trichogramma australicum Girault for the control of sugar cane moth borers in Taiwan. W. Y. Cheng and T. H. Su. Taiwan Sugar, 1978, 25, 81-87. — T. australicum egg parasites of moth borers Argyroploce schistaceana, Chilo infuscatellus, Proceras venosatus, Scirpophaga nivella and Sesamia inferens were mass-produced on eggs of Corcyra cephalonica and released in cane fields. The numbers of host eggs and cane dead-hearts were then determined every four weeks, and the percentage of internode infestation was established just before harvest. While the number of host eggs varied considerably between farms and fields, the

difference between control and release plots was not significant. However, egg parasitization in the release plots was 73.0-74.8% (compared with 10.2-29.2% in the control plots), while dead-heart incidence fell by 44.4-75.3% and internode infestation by 37.5-65.4% in release plots. While increase in parasite numbers did not have any effect on the reduction in internode damage caused by smaller numbers of parasites, it did cause further reduction in the dead-heart incidence.

A brief report on the control of soil insects in sugar cane fields. M. Y. Chen and S. T. Tseng. Taiwan Sugar, 1978, 25, 93-95. - The life histories of wireworms and white grubs, two of the most important groups of soil insects in Taiwan cane fields, are described. Of the three species of wireworm found, the most abundant is Melanotus tamsuyensis; it is responsible for 98% of wireworm damage, and frequently causes much damage near the foot of mountains or in uplands where the soil is a light sandy loam and irrigation is not normally practised. At least 23 species of white grubs have been found associated with cane in Taiwan; some do not cause apparent injury, while others are of minor importance. The three most important are Alissonotum impressicolle, Holotrichia horishama and Anomala expensa. Advice is given on use of soil insecticides as a function of insect population density. Information is given on the various chemicals used against the above mentioned pests, although, because of problems associated with chemical control, the use of rotation or interplanting with paddy rice, flooding of fallow fields 5-6 days before cane planting, or deep ploughing is recommended.

Sugar cane diseases observed during the 1977 ISSCT sugar cane germplasm collection expedition in Papua-Guinea. H. Koike. Sugarcane Pathologists' Newsletter, 1978, (20), 1-3. - Details are given of diseases found on Saccharum spp. and related genera collected for use in breeding and for incorporation into the world collection of cane varieties. Among those found were 15 fungal diseases, but red stripe (Pseudomonas rubrilineans) was the only bacterial disease observed; of the virus diseases, only Fiii disease was widespread, while mosaic symptoms were exhibited by only one stool of S. officinarum. Several leaf spots, blotches, white flecks and red stripes were observed; brown stripe, leaf scorch, red stripe, ring spot and sooty mould were found for the first time in Papua-New Guinea. A target-like blotch similar to one found in Indonesia in 1976 was found to be common, while examples of S. officinarum and S. robustum growing along river banks or along the roadside in areas of high rainfall carried large leaf spots resembling those of zonate leaf spot (Gloeocercospora sorghi) of sorghum. These had also been found in Indonesia in 1976. A reddish-purple spot observed on S. officinarum resembled those of purple spot disease found in Taiwan but the diseases are not thought to be identical. Culmicolous smut, leaf scald, gumming disease, grassy shoot and ratoon stunting disease were not found.

Association of a small coryneform bacterium with RSD in Puerto Rico. L. J. Liu. Sugarcane Pathologists' Newsletter, 1978 (20), 4. — Small coryneform, xyleminhabiting bacteria, having mesosomes measuring 1.43-1.83 nm x 0.14-0.17 nm, were observed in negatively stained juice extracted from cane varieties B 49119, PR 1059 and PR 1140 showing internal symptoms of ratoon stunting disease, but were not found in juice from healthy cane of the same varieties.



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

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

#### A rotary moulding unit.

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

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



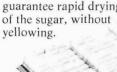
After moulding, the lumps are deposited on metal plates in groups

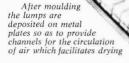
corresponding to one horizontal layer (1/3 kg) of the finished box.

The lumps are arranged to provide channels for the circulation of air which facilitates drying.

Driven by an endless chain, the plates are carried into a vertical or horizontal drying unit according to the power of the plant. The relatively low temperature, the good distribution of the air heated by low-pressure steam and the permanent renewal of this air

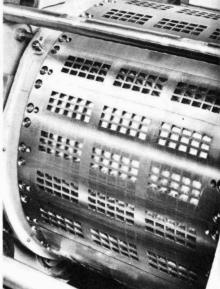
guarantee rapid drying









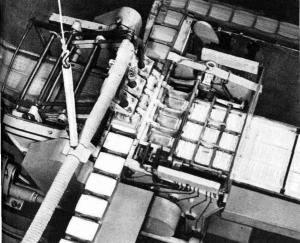


# simple product.

#### Automatic conditioning.

On leaving the drying units, the lumps are gathered and deposited by pneumatic fingers

in three successive layers in the boxes, which are formed on a connected machine and automatically supplied to the conditioning line. The full box is conveyed to the closing machine, which forms and glues the lid of the box.



#### A well-designed production unit.

A moulding and conditioning unit comprises certain basic inseparable elements synchronised with each other, all the functions of which are automatic, and optional elements (such as the machine for printing and forming the lids or the one-piece boxes, and the machine for parcelling in packets of 5 or 10 boxes). Entirely automatic, it allows the production

of 500 to 4,500 boxes of 1 kg per hour, according to the unit, without any manual intervention. Four persons are sufficient to supervise all the operations.

To increase production, minimize costs, meet rising charges, while at the same time

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



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Since the bacterium is non-cultivable and because its pathogenicity has not yet been established, its role in the etiology of the disease remains to be determined.

An anti-serum to the ratoon stunting disease-associated bacterium. A. G. Gillaspie. Sugarcane Pathologists' Newsletter, 1978, (20), 5-6. - The RSD-associated bacterium was selectively concentrated from the juice of RSD-infected sugar cane and Sudan grass hybrid by "Celite" filtration and ultracentrifuging. The preparations were injected intravenously and intramuscularly into rabbits over a 3-5 month period; the resultant antisera were cross-absorbed against normal plant material and found to cause specific clumping of the bacterium in juice from infected cane as well as removing the infectivity from the juice. The anti-serum permits utilization of rapid and inexpensive serological diagnostic methods and determination of serological relationships between the bacterium and other organisms; however, the micro-agglutination test is not applicable for RSD diagnosis in cane juice because of the low concentration of bacterial cells, but an indirect fluorescent antibody test has been found to be a sensitive, specific and relatively inexpensive test for diagnosis of the disease.

The rapid spread and downfall of Q 83 in Guatemala due to mosaic disease. A. L. Fors. Sugarcane Pathologists' Newsletter, 1978, (20), 6-8. - Australian cane varieties have been popular in the Western Hemisphere because of their high sucrose contents, thick stems, ease of trashing and erect growth. Q 83 was introduced by private individuals into Guatemala in the late 1960's or early 1970's; it was rapidly propagated throughout the coastal cane belt because of its high sucrose content and general impressive appearance. However, during the 1974/75 crop, lack of uniformity in growth of cane in fields near Santa Lucia prompted inspection, which revealed the presence of many stunted stools and of leaves carrying the typical mottling symptoms of mosaic; necrosis of leaves was frequently observed, and the lack of growth was always associated with the mosaic symptoms, an average of 20% of the stubbles in different fields being affected. As a result, yields were severely reduced, but even more so in the following season. Investigations are to continue in order to establish the strain of mosaic involved.

Association of the coryneform bacterium with ratoon stunting disease of sugar cane in India. N. Rishi and P. Nath. Sugarcane Pathologists' Newsletter, 1978, (20), 9-10. — Examination, by phase contrast and electron microscopy, of root exudate and nodal tissue diffusate from RSD-affected cane revealed the presence of the coryneform bacterium already reported by a number of authors and associated with the disease.

Screening of sugar cane clones for resistance to smut. S. Vir and M. S. Behniwal, Sugarcane Pathologists' Newsletter, 1978, (20), 11-13. — Of 71 varieties tested for resistance to Ustilago scitaminea at Haryana Agricultural University in India, 5 were found to be highly resistant, 17 resistant, 26 moderately susceptible, 13 susceptible and 10 highly susceptible. Co 1148, which is grown on about 75% of the cane area in the state, was found to be resistant. A variety, Co 997, found to be highly susceptible, had been rated as resistant in earlier studies in Tamil Nadu; the difference is attributed to the possibility of different strains of the pathogen as found by Leu & Teng¹ in Taiwan.

Role of midrib lesion isolates of Glomerella tucumanensis in causing red rot in sugar cane. H. D. Lewin, S. Muthusamy and P. S. Sanjeevi. Sugarcane Pathologists' Newsletter, 1978, (20), 13-16. — Two types of red rot midrib lesions were observed on infected cane, viz. (i) isolated lesions and (ii) ones which extended from the stem lesions. The pathogen from (ii) was found only on two out of three highly susceptible varieties inoculated with culture from the midrib lesions; it was capable of causing stalk rot and was similar to stalk isolates. On the other hand, isolates from (i) failed to produce stalk rot, even on susceptible varieties. It is suggested that the virulent type of pathogen from (ii) might have evolved from the normal isolated midrib lesion (i) by adapting itself to the local hosts and local climatic conditions.

Abnormal side-shooting of sugar cane in Senegal. C. Ricaud. Sugarcane Pathologists' Newsletter, 1978, (20), 17-18. - Young plant or ration cane on a plantation in Senegal exhibited abnormal growth which took the form of a horizontal growth pattern with excessive tillering, such stools usually having one single dominant stalk much more developed than the others, with secondary and tertiary tillers developing at its base from up to the 2nd or 3rd node above soil level; occasionally, lateral buds developed higher up these stalks. In mature stools, millable canes showed prolific side-shooting, starting from the basal nodes upwards. Affected stalks showed signs of stress, with shortened internodes somewhere along them, and side-shoots usually developing from the region of restricted growth and below. Sometimes the side-shoots gave tertiary and other tillers, so that several shoots could develop from a single node. Other symptoms of abnormal morphology were also found to be common, viz. stem bifurcation and double or triple buds at nodes. The symptoms were found mostly in the varieties B 41227 and B 52298, although other varieties have since proved to be affected. The exact causes of the abnormality are not known, but no disease seems to be involved. It is suggested that the problem may be due to imbalance between root and shoot hormones, since side-shooting was more pronounced and common in areas affected by poor drainage, a condition which is known to affect root hormone production.

Preliminary results on nematode tolerance commercial sugar cane varieties in the state of São Paulo, Brazil. M. M. Aguillera and S. Matsuoka. Sugarcane Pathologists' Newsletter, 1978, (20), 23, - Cane varietal tolerance of nematodes was evaluated by comparing the yield in plots treated twice at a 4-month interval with 10% "Aldicarb" at 30 kg.ha<sup>-1</sup> with that in untreated plots. The differences in cane yield varied from 15% for the most tolerant variety to 48% for the most susceptible variety. The two varieties most cultivated in São Paulo proved to be highly intolerant of nematodes, their yields falling by 40%. The nematodes found in soil samples from the test area were Meloidogyne spp., Pratylenchus spp., Helicotylenchus spp., Trichodorus spp., Xiphinema spp., Mononchus spp. and Tylenchus spp. Other genera belonging to the Dorylaimoidea superfamily were also found as well as other free-living ones. An indication of the rapid recovery of the nematode population after nematicide application was the higher population of Meloidogyne spp, in treated than in untreated plots.

<sup>1</sup> I.S.J., 1973, 75, 312.

### SUGAR BEET AGRONOMY

Weed beet - summer work, W.Perowne and P.Longden. British Sugar Beet Rev., 1978, 46, (2), 10-11. - Flowering of bolters often starts in the UK in late June (when yellow pollen may be released by light tapping), becoming maximum in mid-July and decreasing in early August. The pollen is easily carried by the wind, so that cross-pollination is common; the pollen seems capable of fertilizing even after travelling great distances. After fertilization, seeds develop and may take only 30-40 days to become viable under favourable weather conditions (90-100 days under cool and wet autumn conditions). Flowers which open later than mid-August have normally little chance of producing live seeds. Where manual labour is unavailable for uprooting of bolters, toppers should be used, first in mid-to-late June and again in mid-August (possibly also in early September when growing conditions favour seed production). While cutting does not stop seed production completely, it does prevent the problem getting worse. Early harvesting of beet in plots with many bolters is recommended, since this will destroy the bolters early and thus reduce the number of viable seed; it will also facilitate harvesting and allow light cultivation of the soil, so that any shed seed will germinate (to be killed by chemical treatment or cultivation) before the autumn temperatures become too low. Since weed beet is most difficult to control in sugar beet (there being no selective herbicide available), it is advisable to carry out control measures in other crops in the rotation.

A most successful operation. W. Hollowell and D.Charlesworth. *British Sugar Beet Rev.*, 1978, 46, (2), 21-22. — Some information is given on the practices used on a Norfolk farm where 80 ha are devoted to sugar beet.

Improvement in land fertility. W.Hollowell and D.Charlesworth. British Sugar Beet Rev., 1978, 46, (2), 22-24. — Farming practices on a Yorkshire farm which grows sugar beet on 121 ha are described. The owner points out that, while the beet crop gives a cash return, its main benefit lies in the improvement in land fertility created by the crop and in the yields of crops succeeding the beet.

The relationship between the degree of photosynthetic assimilation in sugar beet and sugar production. J. Královič. Listy Cukr., 1978, 94, 139-140 (Czech). Studies showed that the rate of photosynthetic assimilation was greatest in leaves 4-6, after which it fell sharply; growth of leaves from 13 onwards adversely affected beet yield. The yield of beets from which the five oldest leaves were removed in one half of the months of July, August and September were 6.0, 4.5 and 3.0 tonnes.ha<sup>-1</sup> greater, respectively, than were the yields of the controls with all leaves intact. The average sugar content of beets infected with Cercospora beticola

rose with fall in the proportion of healthy leaves. It was found that an inordinate increase in the leaf canopy from the beginning of August (under the effect of the photosynthetic assimilation rate) had an adverse effect on sugar formation. The optimum assimilation rate, at which root growth and sugar content were maximum, was that corresponding to 5-6.5 mg.dm-2hr-1 for leaves 5-6; sugar production fell with reduction in the assimilation rate, but also with rise in the rate above a certain level, since the assimilate, localized in the root, is used in the formation of new leaves. This explains why beets, growing under dry, sunny conditions of August, were found to contain more sugar than in the rainy months of September or October, when conditions favour leaf growth.

Planting to stand, replanting studied at Texas Experiment Station. Anon. Sugarbeet Grower, 1978, 16, (4), 4. — A 4-year trial on planting to stand at Texas Agricultural Experiment Station is reported. The results showed that planting to stand can be successful under Texan conditions, but that replanting might be profitable if the plot had at least 30% of skips greater than 18 inches, i.e. representing about 70 beets in a 100-ft row.

Experiences with sugar beet harvesters in the 1977 harvest and harvesting equipment shown at the 1978 DLG (German Agricultual Machinery Exhibition). W.C.von Kessel. Die Zuckerrübe, 1978, 27, (4), 7-12, (German). - A survey of harvester use in 11 West European countries includes the total beet area, row spacing, leaf yield and indicates the percentage of the total area harvested by the farmer's own equipment, by group machinery or by contractors' machinery. The types of harvester used on farms representing more than 5% of the total national area are indicated, and details are then given of the exhibits shown at the 1978 DLG. It is pointed out that more than 90% of the sugar beet in West Germany was harvested in 1978 using single-row. tank-type harvesters; however, while this type of harvest is considered the most reliable as regards supply of highquality beet, other harvesters continue to be tested and The author stresses the considerable difference between operating under good weather conditions or standing in an exhibition hall and operating under wet conditions on a heavy soil.

Thoughts on optimization of water supply in sugar beet. A.Bramm and C.Sommer. Die Zuckerrübe, 1978, 27, (4), 17-19 (German). — The question of when to use irrigation, as governed by such factors as ground water availability, rainfall, beet root and leaf growth, is discussed, and trials with drip irrigation are reported. While both overhead and drip irrigation in 1975 and 1976 increased yield by comparison with the unirrigated control, the beets received more water by overhead irrigation than by drip irrigation. However, the root yields from both forms of irrigation were about the same, although sugar content was not enhanced. The results showed that, to achieve a certain expected yield, beets do not require as much water as has been assumed, the extra water being used for leaf formation.

The profitability of different irrigation processes, taking into account agricultural interest. F. J. Braun. Die Zuckerrübe, 1978, 27, (4), 22-25 (German). — A comparative cost analysis is made of drip irrigation and two forms of sprinkler irrigation used for sugar beet; the analysis is based on evaluations relating to practical

results plus information from various institutions concerned with irrigation. It is shown that drip irrigation gives a greater increase in yield than do the other techniques and that, as a result, its profitability is about double that of overhead irrigation. Illustrations are given of the "Aqua-drop" system of drip irrigation, manufactured by Fränkische Rohrwerke.

Beet agricultural research in France. Ann. Rpt. Inst. Tech. Franc. Betterave Industrielle, 1977, 326pp (French). - Reports are presented of investigations conducted by the ITB in 1977, covering four main areas: (1) spring work, (2) harvesting, (3) agronomy, and (4) pests and diseases. Experiments under section (1) concerned seedbed preparation methods and their effect on beet yield and quality, comparison of drills and sowing methods, and elimination of bolters. Under section (2) were leaf harvesting experiments and trials with harvesting equipment as well as tests on cleaning of beet reclaimed from piles (involving Bütfering, Fives-Cail Babcock and Maguin equipment as well as a cleaner used at Nangis sugar factory, all of which are described and their advantages and disadvantages listed). Experiments in the third section covered varietal trials, chemical weed control and fertilization experiments, and dried pulp feeding trials involving dairy cattle and sheep. Work under section (4) covered fungicidal treatment of beet seed, insecticide incorporation in beet seed coating, control of beet virus yellows, aphids, cutworms (Agrotis ypsilon), leaf spot, powdery mildew and violet root rot. The final report concerns a viral root disease, first discovered in Italy and subsequently in Japan where the pathogen was isolated and the disease described as beet necrotic yellow vein (BNYV). The disease, referred to as "rhizomania", has been recently discovered in France and West Germany; its symptoms, which appear in the leaves after the roots, are described, BNYV causes a considerable fall in the sugar content and often makes its appearance in beets at the edge of the field. Control is through extension of the rotation to at least 4-5 years, with cereals being particularly recommended, and proper attention to field hygiene.

Winter cultivation of sugar beet in warm countries. Z. Srzednicki. Zuckerind., 1978, 103, (German). - Trials carried out in various countries since 1970/71 are reported, showing beet and sugar yields and sugar content of winter-grown beet. Details are given of those countries and regions where the climate is sufficiently warm to permit winter cultivation.

From field to factory. T. P. J. Dyke. Paper presented at 24th Tech. Conf., British Sugar Corp. Ltd., 1978, 9pp. Trends in beet mechanization in the UK and their effect on losses and factory processing are discussed. Although since 1966 there has been a steady increase in the quantity of beet drilled to stand (the amount representing 73% of the total national crop by 1977), in no year has more than half of the quantity involved reached the target population and allowed the grower to dispense with manual labour; the main reasons for the failure have been too many plants and inadequate weed control. Resultant variations in the size of roots at harvest time lead to erratic topping - the larger roots are overtopped (so that yield falls) while the smaller roots or doubles are not topped at all (possibly leading to processing difficulties). Because of greater reliance on chemical weed control, which may or may not be successful (depending on the weather conditions), there is risk of unacceptable levels of weed growth and hence of

excessive trash, some of which accompanies the beets into the factory. While there is a tendency to favour multi-row harvesters, such as manufactured in France, these machines give a much greater top tare than do conventional UK machines (using a different topping system); however, the larger harvesters give more consistent topping and far lower losses than do UK single-row machines. (The average loss in beet fields is calculated at 31/2 tonnes.ha-1.) The author also calls for a cut in delays suffered by beet transport at factories.

Controlling weeds in sugar beets without labour: a progress report. E. E. Schweizer. The Sugarbeet Grower, 1978, 16, (5), 6-7, 13-14. - Pre-planting, pre-emergence and post-emergence herbicide trials in 1976 and 1977 are reported. Comparison between the various herbicides tested showed that the most effective in terms of root vield was "Nortron" + "Hoelon" applied at the rate of 2 + 1.5 lb.acre-1 before planting, followed by "Betanal" + "Betanex" at 0.5 + 0.5 lb.acre-1 as post-emergence treatment. The results were comparable to those achieved in an untreated but weed-free control plot; where at least 80% of grasses and 90% of broad-leafed weeds were eliminated, root and sugar yields could be expected to approximate to the weed-free control results. In one case, "Nortron" applied as pre-emergence treatment at 2 lb.acre-1 followed by a post-emergence split application of 1.5 lb.acre-1 "Nortron" and "Betanl" + "Betanex" each at 0.375 lb.acre-1 gave yields that were slightly higher than from the weedfree control. The adverse effect of weed competition on beet yield was demonstrated by a study in which plots containing weeds of given plant density were untreated or treated with "Roundup". The maximum yield reduction of 54% occurred with 24 plants per 100 ft of row; at this density, treatment increased yield by 10.2 short tons per acre.

Underground drainage in agriculture, Prospects offered by the new technology. G. Gallarate. Ind. Sacc. Ital., 1978, 71, 69-75 (Italian). - The advantages of underground drainage with PVC tubing are discussed and the technique and equipment used to lay the tubing are described with the aid of photographs. Advice is given on the layout of a drainage system according to the topography, and the crop benefits obtainable as a result of underground drainage are demonstrated by a table showing increases in yields of a number of crops, including sugar beet, in a region of France.

Optimum starter fertilizer placement for sugar beet seedlings as determined by uptake of radioactive 32P isotope. F. N. Anderson and G. A. Peterson. J. Amer. Soc. Sugar Beet Tech., 1978, 20, 19-24. - The uptake of 32P-labelled potassium phosphate applied to seeds planted in pots was found to depend on the point of placement of the fertilizer relative to the seed, Hence, maximum uptake occurred about 15 days after application of the phosphate 2 inches below the seed; within 4 weeks the uptake fell to the level of uptake where placement was 4 inches below the seed. In contrast, uptake was very low where placement was 2 inches below and 2 inches to the side of the seed or where it was at the same level as the seed but 2 inches to the side.

### BEET PESTS AND DISEASES

Mice. Anon. Die Zuckerrübe, 1978, 27, (2), 30 (German). — Brief information is given on the various species of mice that are regarded as beet pests, with mention of control means. It is pointed out that only natural enemies can adequately reduce the large numbers of mice bred each year, although weather and disease also help.

Don't forget about curly top. D.L.Mumford. Sugarbeet Grower, 1978, 16, (3), 12. - Severe beet losses from curly top have been reported regularly in the western USA for more than 75 years, and 68 years ago it was shown that the only way in which the disease spread from plant to plant was by the beet leafhopper. Weather conditions greatly affect the rate at which populations of the pest develop, so that prediction of disease incidence is difficult. However, losses from the disease can be reduced by (1) early planting, since the effects of curly top diminish as the seedling gets larger. and avoiding conditions such as moisture stress; (2) growing resistant varieties; and (3) spraying with insecticides. It is pointed out that during years of mild or no curly top outbreaks, farmers tend to forget that the disease potential still exists and fail to carry out practices to prevent the disease or reduce losses.

Aphanomyces cochlioides Drechsler on sugar beet plantations. N. Jarowaja. Gaz. Cukr., 1978, 86, 93-95 (Polish). — Black leg caused by the fungus A. cochlioides was found in fields in the vicinity of Lapy sugar factory in Poland. Highest losses among seedlings and young plants occurred where the soil was warm and moist. Photographs clearly show the blackening of the part of the stem adjacent to the leaves and even of the bottom of the leaves themselves. Photomicrographs of the pathogen are also reproduced. Control depends on proper attention to agronomic factors. Liming of acid soils and application of superphosphate where there is a P deficiency in the soil are recommended; care in proportioning fertilizers is advised.

The level of beet crop health in recent years and results and methods of controlling diseases and pests. M. Kubacka-Szmidtgal. *Gaz. Cukr.*, 1978, 86, 113-116 (*Polish*). — The state of health of beet in Polish fields since 1973 is surveyed and advice given on chemical control of named diseases and pests.

The impact of yellows control on California sugar beets. J. E. Duffus. J. Amer. Soc. Sugar Beet Tech., 1978, 20, 1-5. — After studies in the late 1950's had confirmed a close correlation between virus yellows incidence and the proximity of over-wintered beet fields, farmers and processors agreed to maintain an interval of time between harvesting of the old crop and start of planting of the new. These "beet-free" periods varied among the different districts in the state but were put into general

use for the 1968 crop. During the beet-free periods, efforts are made to eliminate weed beets. After initial setbacks, yields (which had been declining significantly for some years) improved; although several factors have contributed to this improvement (including the introduction of two moderately resistant varieties), the use of the beet-free periods is considered the major contributor. It is calculated that, in the five-year period 1971-75, an average increase of 0.86 short tons of sugar per acre has been obtained by comparison with the 1950-67 period. The economy of the state is calculated to have benefited by over \$792,000,000 in the time.

Effect of pesticides and nitrogen fertility on Rhizoctonia root rot of sugar beet. R. J. Hecker and E. G. Ruppel. J. Amer. Soc. Sugar Beet Tech., 1978, 20, 6-10. Application of the herbicide "Cycloate" at 3.4 kg a.i. per ha or of N at 90 or 202 kg.ha-1 had an insignificant effect on the incidence of root and crown rot caused by Rhizoctonia solani. "Aldicarb" systemic insecticide and 1,3-dichloropropene as nematicide also had practically no effect.

Daylight light-trapping: a method for monitoring adult activity of the sugar beet root maggot, Tetanops myopaeformis (Roder). G. L. Ayre and R. B. Semple. J. Amer. Soc. Sugar Beet Tech., 1978, 20, 11-18. - After adults of T. myopaeformis were found to be attracted to light traps used in tests to monitor noctuids in beet fields, light traps incorporating black-light blue fluorescent tubes were set up to operate from 5 a.m. to 7 p.m. with the aim of monitoring the activity and relative population levels of T. myopaeformis adults. Of the various insects found in the light traps, an average of 56% were found to be T. myopaeformis; better placement and operation of the traps would, it is concluded, increase the level to about 90%. The overall ratio of males to females in the light traps was 2.2:1. Possible reasons for the smaller numbers of females are indicated

The control of root-knot nematodes (Meloidogyne spp.) in sugar beets by fumigant and non-fumigant nematicides. R. Smith, L. M. Burtch and I. J. Thomason. J. Amer. Soc. Sugar Beet Tech., 1978, 20, 48-54. - In two replicated field trials carried out in California in 1974 and 1975, fumigants "Telone" (1,3-dichloropropene) and D-D (1,3-dichloropropene + 1,2-dichloropropane) proved superior, at 16 and 14 gal.acre-1, respectively, to granular nematicides "Temik", "Furadan" and "Nemacur" at 4, 4 and 6 lb.acre-1 in terms of beet and sugar yield, root-knot nematode counts and root-knot gall ratings. The economics of treatment with fumigant were also more favourable. The level of control achieved with the granular nematicides was not sufficient to protect the beet throughout a 6-10 months growing season where conditions were ideal for nematode development.

Factors affecting the miscibility of herbicides and of herbicides with insecticides. M. Kubacka-Szmidtgal. Gaz. Cukr., 1978, 86, 164-166 (Polish). — The question of mixing of herbicides and of herbicides with insecticides is discussed in relation to the quality of the water used and the settling tendencies of the products. It is stressed that hard water should not be used and that only herbicides of low settling rates should be mixed.

Possibilities and prospects of beet protection. V. Kovács. Cukoripar, 1978, 31, 46-48 (Hungarian). — Chemicals available for control of fungal diseases and soil-inhabiting pests of sugar beet are surveyed.

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### BEET SUGAR MANUFACTURE

Results of investigations on a RZ-PPZh-1.5 hydropneumatic lift for beet. N.D.Khomenko, V.G.Yarmilko and B.I.Kurinskii. Sakhar.Prom., 1978, (7), 15-19 (Russian). — Details are given of the design parameters of and trials with a RZ-PPZh-1.5 beet lift, a combination of conventional beet pump and compressor designed for a head of 20.5 m at a beet: water ratio of 1:7.

Simple modernization. A.P.Parkhod'ko. Sakhar.Prom., 1978 (7), 31-33. (Russian)., — A vertical preliming tank at Ryzhavskii sugar factory was modified by separating it into compartments having perforated floors (the perforations being arranged randomly). Each compartment was provided with a bladed agitator attached to the central shaft and with a feed port attrached instead of milk-of-lime. The raw juice was admitted instead of milk-of-lime. The raw juice feed port and limed juice discharge port are at the bottom of the tower. The modifications have raised the level of juice alkalinity and permitted control of the process, thus facilitating filtration.

Experience in payment for beet on a sucrose basis at factories in the Khar'kov group. V.M.Karasik, K.I. Yuzefchuk and Yu.A. Poltavskii. Sakhar. Prom., 1978, (7) 47-50 (Russian). - Information is given on the benefits of the system of payment for beet on sucrose content as adopted in an important sector of the Ukrainian sugar industry. Apart from the incentive to farms to raise the sucrose content and obtain premium payments, there is the encouragement to factory workers to ensure that storage losses are minimal and sugar output and hence revenue increased. However, the authors consider that some improvements should be made in the system, particularly the introduction of penalties for beet having a sucrose content below a fixed level (at present only basic payments or premium payments are made), an improvement in the reliability of equipment used for beet analysis and a dramatic reduction in the time taken to repair apparatus, and sharing of some of the reward money with those specialists and advisers who have helped raise the beet sucrose content. Disagreement is also expressed with the recommendation that only 90% of the premium should be paid where mechanical harvesting is used.

Sugar beet payment on a sucrose basis. A.I.Chekal' and V. V. Popovich. Sakhar. Prom., 1978, (7), 50-52 (Russian). — At the authors' sugar factory, the average beet sucrose content fell during the period 1975-77, as did the annual sugar yield (% on beet), while the payment made for the quantity of beet above the norm and the production costs per tonne of sugar rose. Reasons for the fall in beet sucrose content are examined, and include adverse weather conditions and considerable damage to the beets caused by mechanical handling.

The struggle for increase in beet sucrose content — a most important task. S.R.Bostanov. Sakhar, Prom., 1978, (7), 52-54 (Russian). — The need to raise the sucrose content of beet delivered to the author's factory is emphasized — payment on the basis of sucrose content has been made since 1973, but there has been a steady fall in sucrose content over the 5-year period, accompanied by a drop in processing quality. Of particular importance in the fight for improvement in the situation is considered the need to impose penalties for sub-standard sucrose contents (since at present only the state suffers a loss). Agronomic factors governing beet sucrose content are briefly indicated.

Experience in reception and storage of sugar beet at Salivonkovskii sugar factory. V.S.Vyshtak and A. I. Sidorenko. Sakhar. Prom., 1978, (7), 54-59 (Russian). — In a short survey of the practices used at this factory (where payment for beet has been made on a sucrose basis since 1975), particular mention is made of the beet yard system which comprises artificially ventilated storage areas served by rail-mounted pilers. Advantages and disadvantages of the system are discussed.

The effect of sugar beet weight on changes in its processing properties during storage. J.Zahradníček, M.Ondráček and J.Očenášková. Listy Cukr., 1978, 94, 121-127 (Czech). - Beets were classified according to their weights (from below 100 g to 1200 g in 100-g stages, sometimes to 1300 g and, in one experiment, to above 2000 g) and 100 beets of each class analysed, while another 100 of the same class were placed in sacks and inserted in beet piles for 40-52 days' storage at two sugar factories in Czechoslovakia. After storage, the beets were analysed and their composition compared with that of the previously analysed samples. Tabulated results showed that daily sugar losses generally fell with increase in the weight of the individual beet, although the maximum sucrose content occurred in the weight range 300-800 g. A positive correlation was found between sucrose content and state of health of the beet.

Mechanical equipment in sugar factory boiling houses. M. Friml and R. Štengl. Listy Cukr., 1978, 94, 127-132 (Czech). - It is pointed out that, while considerable progress has been made in the design of equipment for diffusion, juice purification and filtration, it is only comparatively recently that attention has been turned on boiling house equipment, particularly for continuous processing. As regards the pan, concentration has been on increasing the volume, while the design has been along conventional lines, although boiling was one of the first processes to be made automatic. However, following the introduction of continuous pans, there has been a greater effort in respect of continuous crystallizers, especially vertical ones. The question of centrifugal selection on the basis of throughput is discussed, and details are given of boiling schemes and boiling house equipment used in new or reconstructed sugar factories in various countries.

New separation line for dry unloading of beet. J.Ružička, J.Hluže and V.Jozefy. *Listy Cukr.*, 1978, 94, 132-136 (*Czech*). — Details are given of a Czechoslovakian-designed system for separation of dirt and stones from beets. The beets are carried up an inclined belt conveyor and pass from this across a narrow gap to a downward sloping trough which leads to a vibratory grid section (also sloping downwards). Dirt and stones fall down a chute

from the upper end of the belt conveyor onto a horizontal belt conveyor to which also leads a chute located below the vibratory grid. The beets fall from the grid onto a conveyor leading to the flume. Advantages of the system are indicated.

Planning the conveying routes of massecuites, syrups and sugars. V.Urban. Listy Cukr., 1978, 94, 137-139 (Czech). The question of transfer of the title products between process stations and between individual pieces of equipment is discussed. It is pointed out that the object of good transfer planning is to minimize the distance and time in transit and so prevent changes in composition and deterioration in quality. The most suitable types of transfer equipment for products of a given temperature, concentration and composition are indicated.

Criteria for an optimum multiple-effect evaporator regime with intermediate vapour bleeds. L. I. Kornienko. Pishch. Prom., 1977, 23, 76-79 (Russian). — Theoretical equations are developed for calculation of evaporation parameters aimed at establishing optimum conditions under which a desired juice Brix is obtained and bled vapour supplied at a required rate to the various users at lowest operational costs.

The validity of equations describing the kinetics of CO2 absorption by alkaline solutions at high temperatures. I. M. Fedotkin, L.P. Reva, V. M. Logvin and A. A. Korzun. Pishch. Prom., 1977, 23, 98-101 (Russian). The CO<sub>2</sub> absorption acceleration factor at 20-90°C measured in investigations in which carbonatation juice was represented by NaCl and NaOH solution. Comparison was then made with calculated values obtained from equations, derived by three different groups of authors, which allow for saturation of the gaseous phase by water vapour and the resultant fall in partial pressure of the CO2. At temperatures higher than 50°C, the calculated values were lower than the experimental data, while maximum difference (about 30%) was found between experimental values and values obtained by one of the equations for the temperature range 70-80°C.

Methods of 2nd carbonatation optimization. Zuckerind., 1978, 103, 551-557 W. Uhlenbrock. (German). - The chemistry of 2nd carbonatation is briefly explained and the need for a method of checking the Ca++ ion concentration (which should be minimum in order to avoid excessive scaling of the evaporator) discussed. While a liquid-membrane electrode gave satisfactory results with 15% sugar solution of known calcium content, it proved unsuitable for use with thin juice. A Bran & Lübbe "Sensimeter E", provided with a liquid electrode, was unsuccessful in that it suffered from disturbances in both the electrode and electronic sections. However, a Bran & Lübbe automatic "Titrometer U" gave good juice hardness readings in continuous operation during the campaign. Titration is carried out with an aqueous EDTA solution, the end-point being established by means of an aqueous reagent containing (per 1000 cm<sup>3</sup>) 125 cm<sup>3</sup> of 25% ammonia, 12,1 mg of copper nitrate and 18.6 mg EDTA. A copper-specific electrode and a silver/silver chloride reference electrode are incorporated. An excess of EDTA occurring at the end of the titration affects the concentration of free copper ions and thus causes a jump in the potential of about 50-70 mV, which indicates the end of the titration. 278

"Titrometer" is suitable only for use with filtered juice, to which a small quantity of formalin should be added to prevent growth of slime-forming bacteria during the period between filtration and titration. A shift in the range of the potential change also occurred at various periods in the 1976/77 campaign and necessitated frequent readjustment; addition of 0.01% hydrogen peroxide to the dilution water countered the effect, which did not occur in the following campaign, A control system is described which operates the CO2 valve of the carbonatation vessel in accordance with the lime salts concentration in the juice as determined by "Titrometer". Although the system is not continuous, it has been found that over a period of 6 minutes the lime salts content remains relatively constant, while 8 minutes is suitable to establish the effect of change in the CO<sub>2</sub> flow on the lime salts. The unit operated for more than 60 days at Elsdorf factory in 1977. The question of quantity of sodium carbonate to add to the juice to raise the alkalinity to a desired level (where necessary) is discussed; it is recommended that the amount should be such that the juice pH in the 1st evaporator effect is greater than 7 at 130°C.

Packet palletization. T. A. Field. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 79pp. Details are given of an automatic palletizer developed by Marryat Handling Ltd. for the British Sugar Corporation which receives 1-kg packets of sugar on three metering conveyors, placed side-by-side, at the rate of 50 per minute per conveyor. At the end of the conveyor run, a pusher to the side of the conveyor transfers 21 packets (7 per conveyor) to a collation table at right-angle to the conveyors. The packets are assembled in a layer of 10 x 7, being compacted by side pushers; a suction lift head then descends onto the layer and transfers it to the pallet on a stacking turntable, which rotates through 90° between each transference, so that the final stack contains alternate layers of 10 x 7 and 7 x 10 packets (this promotes load bonding and stability). When 15 layers of packets have been stacked (representing a total pallet load of 1050kg), the pallet is discharged to an Inpac Automation stretch-wrapper, where the load is enveloped in polythylene sheeting. Costs of the scheme are indicated, showing a saving on the system in which 1-kg packets were placed in paper packages before palletizing.

The rapid collation and production of technical information and reports. J. R. Vyse and H. Morten. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd.., 1978, 76pp. — With the initial aim of reducing the calculation workload at the laboratory of Newark sugar factory, various types of calculator were tested and their suitability evaluated. Particularly mentioned is a "Tektronix 31" programmable calculator, with built-in printer and magnetic tape unit, which was programmed to calculate and type an extraction statement (an example of which is given) showing yields and losses for a specific period. The viability of the unit is discussed, and advantages and disadvantages of programmable calculators by comparison with computers are examined.

A computer approach to technical records in the beet sugar factory laboratory. B. L. Karren and M. K. Faviell. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 58pp. — Details are given of the Hewlett Packard 9830A programmable calculator system installed at the Winnipeg factory of Manitoba Sugar Co.

Ltd. and the Taber factory of Canadian Sugar Factories Ltd. (both companies subsidiaries of B. C. Sugar). Programmed in BASIC language, the calculator is linked to a Model 9871 printer/plotter (which can plot graphs from input data as well as final copy reports) and a Model 9865 auxiliary tape drive for data storage. The system is used (1) to collect laboratory data covering a 24-hr period, calculate averages, issue a report and store the entire set of data for later recall, merging the averages with the factory data for permanent storage and retaining the actual laboratory data for 8 days as well as producing graphs each day to show results for the current day and for the previous six days; and (2) to collect and process all data gathered from the factory outside the laboratory. Auxiliary programmes utilize the stored basic data to produce various special reports and calculations, including an extraction statement, heat balance and material cost report. Examples of the various types of output are reproduced.

Sugar factory: Appeldorn. U. Curdts. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 39pp. Details are given of the Appeldorn factory of Pfeifer & Langen<sup>2,3,4</sup> with details of equipment and processes. In its first campaign (which lasted 69 days), major difficulties were encountered in beet handling and conveying as a result of excessive quantities of stones, sand and mud adhering to the beets, special provisions having to be made to enable the beet to be flumed without interruption. Most of the stoppage time of 20 hours was due to a defect in the generator excitation. Despite the problems, the total quantity of beet sliced was equivalent to a daily rate of 4500 tonnes.

Association between juice quality and factory performance in 1976 and 1977. J. F. T. Oldfield, M. Shore, J. V. Dutton and H. J. Teague. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 31pp. - An average increase of 7.4% (absolute) in sugar extraction at 16 British Sugar Corporation factories (excluding Newark, which has been under reconstruction) in the 1977/78 campaign by comparison with the previous campaign was largely due to improvement in beet and juice quality, the major change being a marked reduction in the pyrrolidone carboxylic acid (PCA) content of thick juice as a result of low nitrogen uptake by the growing beet. (In 1976 the high N uptake had been caused by adverse weather conditions and a high incidence of beet virus vellows.) Unfavourable K:PCA ratios in 1976/77 were confirmed by analysis of composite molasses samples and correlated with a high soda ash usage necessary to ensure juice stability in evaporation<sup>1</sup>.

Diffuser mid-bay acidification - supplementary studies. J. F. T. Oldfield, M. Shore and N. W. Broughton. Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 17pp. - In the British Sugar Corporation, the continuous addition of 5% v/v sulphuric acid to diffuser midbay ensures that optimum pulp pressing efficiency can be maintained under sterile diffusion conditions. Although the invert sugar content of the sterile raw juice may increase by up to 0.05 g/100 g apparent sucrose as a result, such acidification is shown to be generally cost-effective compared with increased dryer fuel usage. Corrosion problems associated with midbay acidification have been overcome. The alternative of regulating the diffuser pH profile by thermophilic bacterial fermentation of sucrose to lactic acid reduces factory profitability, even before the other undesirable consequences of fermentation have been considered. The alternative of adding phosphoric acid merits further examination.

Beet reception data collection. D. F. A. Horsley and A. Williams, Paper presented at 24th Tech. Conf. British Sugar Corp. Ltd., 1978, 22pp. - While the British Sugar Corporation operates a central computerized beet payment system to which tarehouse information is sent from the individual factories, the scheme can only provide each factory with important controlling data on a day-to-day basis. However, a computerized data collection system has been developed at Ipswich factory which does permit the factory to process its own statistical information, although the system is not designed to work in complete isolation from the centralized one. Details are given of the scheme, developed in collaboration with Cornard Electronics Ltd., whereby signals are transmitted to a central computer from in and out-weighbridges and from the tarehouse for calculation of the payment to be made to the grower on the basis of the dirt and top tares and beet sugar content. Advantages of the system are listed, A similar but slightly more advanced system has been installed at Bury St. Edmunds factory.

Selection of a valve for control of liquid flow. J. Blanc. Ind. Alim. Agric., 1978, 95, 569-574 (French). Theoretical equations are presented for calculation of flow parameters applicable to valves as used for liquid and steam flow regulation in sugar factories and distilleries. Despite differences arising in the conditions of flow through a diaphragm valve, the equations have been found to give values approaching true flow rates to within ± 3-4%.

The technical application of electrodialysis, particularly with regard to the sugar industry. F. Perschak. Ernährung, 1978, 2, 341-345 (German). - The fundamentals of electrodialysis are explained and factors affecting the efficiency of the technique are discussed. Details are given of a pilot plant in which juice from the 2nd body of a quadruple-effect evaporator at 30°Bx was passed through a heat exchanger where it was cooled with already electrodialysed juice and then treated in succession in a column of absorbent resin and then in an electrodialyser before most of it was fed to the 3rd body of the evaporator. If necessary, the pH could be adjusted by passage of the juice through a strongly basic anion exchange resin in OH form, Results showed that initially sufficient ash was removed (0.4213 meq.cm<sup>-2</sup>.hr<sup>-1</sup>) to provide extra sugar without the need for a Quentin unit, However, because of the failure of the membranes, which became brittle and leaked after 350 hours' operation, causing dialysate to mix with concentrate and thus leading to considerable sugar losses, the system is unworkable until better membranes are available. Moreover, further tests on membranes also revealed a high energy consumption. Promising results were obtained in H2SO4 recovery from cation exchanger effluent after thin juice demineralization. A doublechamber system (a cathode and an anode chamber separated by an anion exchange membrane) was used, but it is considered that a multi-chamber system would give even better results.

<sup>1</sup> See also Karren: I.S.J., 1978, 80,54.

<sup>&</sup>lt;sup>2</sup> Anon: *ibid.*, 1978, **80**, 346.

<sup>3</sup> Bruhns: ibid., 376.

<sup>&</sup>lt;sup>4</sup> Weidner: *ibid.*, 1979, **81**, 217.

<sup>&</sup>lt;sup>5</sup> Oldfield et al.: ibid., 1977, 79, 37-43, 67-71.

### **NEW BOOKS**

Relatório Anual 1977. 38 pp; 19.5 x 26.5 cm. (Instituto do Agúcar e do Álcool, C.P. 420, Rio de Janeiro, Brazil.) 1978.

This Annual Report of the Brazilian Institute is full of information on the sugar industry of that country with many tables and charts — of production by months and by region in 1977, per caput consumption of sugar, alcohol production, sugar exports, sugar prices and other statistics. A note is included on the construction of the Planalsucar experiment station in Araras and the bulk sugar terminal at Maceió, etc.

Viability of the use of herbicides in admixture with vinasse in sugar cane ratoons. A. Buss. 68 pp; 15.1 x 20.8 cm. (Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, SP. Brazil.) 1977.

This booklet is the text of a dissertation by the author for his Masters' degree and reports experiments on the use of a number of herbicides mixed with vinasse and applied to ratoon cane for combined weed control and fertilization. The herbicides had a tendency to precipitate quickly from the mixture and so should be vigorously mixed and applied as soon as possible. The vinasse encouraged weed germination and development but also enhanced cane growth and sucrose content. "Diuron" in vinasse gave poor weed control but "Ametryne" and 2,4-D performed better than when applied alone. Use in vinasse did not affect the performance of "Tebuthiuron" or "Oryzalin" in weed control. Consequently use of the last four herbicides mixed with vinasse is considered viable.

Food microscopy. Ed. J. G. Vaughan. 651 pp; 14.6 x 22.7 cm. (Academic Press Inc. (London) Ltd., 24-28 Oval Road, London NW1 7DX, England). 1979. Price: £29.60.

This book is one of a series of monographs having the general title "Food Science and Technology" and is concerned with the microscopy of fruits and vegetables, oil seeds, cereals and bakery products, etc. The section which is of interest to our readers is that on sugars, written by a well-known expert in the field, H. E. C. Powers, formerly Chief Chemist of Tate & Lyle Ltd.

Mr. Powers retired some years ago so that it is quite a while since the reviewer saw photomicrographs of sugar crystals of the type which he has included in his survey. This covers not only his own work over more than 20 years but also the work of other sugar crystallographers and quoting references as recent as 1976. He briefly describes sugar production and then indicates present knowledge on the different forms of sugar crystals, how they grow, their internal structure, including water and air inclusion, the effect of pulverization, conglomerate formation, the nature of the crystal surface, nucleation and thin-film crystallization.

Triboluminescence and the hazards of electrostatic charges igniting sugar dust are discussed and the 280

reduction of the latter by close control of crystal regularity mentioned. Finally, Mr. Powers describes a simple apparatus for experimentation and recording of crystallization by cine- and still photomicrography.

We would imagine most of the book's buyers will be professional food microscopists, however, rather than sugar men since its price is rather high to pay for just the 41-page section on sugar, most interesting as it is.

Annual Report, 1977-78. 73 pp; 19.5 x 27.2 cm (Taiwan Sugar Research Institute, Tainan, Taiwan.) 1978.

This well printed and illustrated book is a record of the work of the Taiwan Sugar Research Institute and its outstations during the year from mid-1977 to mid-1978. The bulk of the volume describes projects under way and completed by the staff of the Institute's different sections, including those concerned with cane breeding and cultivation, weed control, irrigation and drainage, plant physiology, ground-water resources, soil and plant nutrition, plant pathology, entomology, sugar manufacture and by-product utilization. A list of publications originating from the Institute is given where more complete details of the studies are to be found. Technical service functions are also described; these include the data processing and publication centre, extension and training, chemical analysis, instrument service and farm management, Personnel of the Institute are listed and lists given of seminars by Institute staff and their participation in international symposia and congresses, overseas training and foreign visitors. The overall picture is of a well equipped and highly-motivated group of workers contributing to the systematic advancement of their country's sugar industry.

Remont, modernizatsiya i naladka diffuzionnykh ustanovok (Repair, modernization and adjustment of diffusers). I. O. Andrianov, A. P. Parkhod'ko and V. D. Sklyarenko. 143 pp; 14.0 x 21.5 cm (Izd. "Pischchevaya promyshlennost" ", 1-i Kadashevski per. 12, Moscow M-35, USSR 113035.) 1979. 0.50 rouble.

Of more than 400 diffusers employed in Soviet sugar factories, the DDS type of sloping trough and tower diffusers dominate, rotary and other types being in the minority. This book is intended for those involved in maintenance, repair and operation of equipment in diffuser sections; it covers not only diffusers, and their components, but also pulp presses, pulp traps, centrifugal pumps and pipelines. The advice contained in the 22 chapters is based on the experience of the authors and others. Unfortunately, the work is of limited value outside the USSR, since it is in Russian and applicable to Soviet equipment, but it does contribute to the world literature on sugar technology by shedding some light on Soviet machinery and practices.

Cukrownictwo (Sugar manufacture). S. Nikiel. 424pp; 17 x 24.5 cm. (Wydawnictwa Szkolne i Pedagogiczne, Warszawa, Poland.) 1978. 58 zloty.

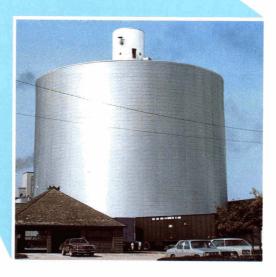
The author is the editor-in-chief of the Polish sugar journal "Gazeta cukrownicza" and could be regarded as the ideal person to write a book which describes all the processes involved in raw and white sugar production from beet. The work is divided into 25 chapters, including one devoted to process control and automation. Every aspect of sugar factory operation is covered, and a 11-page chapter deals with refined sugar production from raw sugar and thick juce. The quality of the printing is good. For those readers interested in the Polish sugar industry and its practices (and who can read Polish), the book is a very useful asset.



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### LABORATORY STUDIES

Evaluation of sugar quality with regard to the content of surface-active substances. A. Kurkowska-Mielczarek. Gaz. Cukr., 1978, 86, 25-28 (Polish). — Comparison was made between the polarographic determination of saponin in sugar (for which 25 cm³ of 0.04% KCl was added to 6.5 g of sugar) and the colorimetric method of Nagornaya et al¹. Close agreement was found between the values given by the two methods; the polarographic method has the advantage of good reproducibility and is less labour-consuming, taking only 10-20 minutes compared with 1-10 days for methods based on "haze" formation. Tabulated results refer to sugar samples from four Polish factories.

Analysis of the dependence of viscosity of unsaturated aqueous solutions of sucrose on concentration and temperature. K. Koziol, L. Broniarz and S. Nowakowski. Gaz. Cukr., 1978, 86, 55-58 (Polish). — Sucrose solution viscosity as a function of temperature at constant concentration and of concentration at constant temperature was analysed mathematically. At a w/w ratio of solids to liquid phase in the range 0-0.6, the equation of Cornellisen & Waterman² was found to be valid. A generalized equation has also been derived for defining log  $\eta$  (coefficient of dynamic viscosity) in terms of concentration and temperature in the range 20-80°C.

The melassigenic capacity of nucleosides. N. V. Remeslo, I. A. Prikhod'ko, G. P. Voloshanenko and N. A. Arkhipovich. *Izv. Vuzov, Pishch. Tekh.*, 1978, (2), 162-164 (*Russian*). — Investigations showed that nucleosides obtained from beet molasses hydrolysate were highly melassigenic, their coefficients having the following decreasing order: cytidine > inosine > 6-methyl uracil > deoxyribonucleic acid (DNA) > uridine > guanosine. On the other hand, adenosine and ribonucleic acid (RNA) had a negative melassigenic coefficient. The nucleosides differed in their effect on the viscosity of saturated molasses: 6-methyl uracil, DNA and uridine increased it, while the purine derivatives reduced it.

Estimation by a wet method of the mineral matter collected in leaves of sugar cane harvested mechanically. T. C. Ripoli, H. P. de Novais and L. G. Mialhe. *Brasil Açuc.*, 1978, 92, 69-71 (*Portuguese*). — Studies were made on 24 cane samples harvested by three different types of harvester and the mineral content separated wet. The amounts present were in the range 5.09-7.97%, and about 1.42 kg of mineral particles were present per tonne of cane. It is concluded, however, that the dry method of estimation is adequate for the conditions of the study.

Behaviour of the components of invert sugar in beet and cane molasses during hot storage of short duration. E. W. Krause. *Branntweinwirtsch.*, 1978, 118, (5), 85-91; through *S.I.A.*, 1978, 40, Abs.78-679. — Four

beet molasses samples, eight samples of cane molasses, a mixture of cane and beet molasses, seven cane molasses samples to which glutamic acid and glutamine had been added, and ten model solutions were heated on a water bath to 70° and 80°C for four days. The dextrose and levulose contents, pH and colour were measured each day. Heating accelerated the reactions which would occur much more slowly at room temperature. Tabulated results show that, for beet molasses, invert sugar degradation occurred mainly by the Maillard reaction; the dextrose:levulose ratio decreased. However, in cane molasses this ratio increased, owing to the presence of excess carboxyl compounds in relation to the amino-N. This confirms that the higher the invert sugar content of beet molasses, the lower its value for fermentation after storage; the nitrogen in the compounds formed is not available to micro-organisms; melanoidins and their precursors are even biostatic. Beet molasses and cane molasses should therefore be mixed just before fermentation, and not before storage.

Cane payment according to sucrose content. A. C. Sturion. Boletim Técnico Copersucar (São Paulo), 1977, (4), 3-6; through S.I.A., 1978, 40, Abs. 78-744. Some experiments on cane sampling and direct analysis are reported, and it is recommended that cane payment be based on sucrose content rather than weight of cane. Brix, pol and fibre in cane samples were determined using juice from a hydraulic press or extract from a cold digester; typically, slightly fewer samples were needed for reliable results using the press. Effects of the presence of 0-4.1% vegetal or 0-8.2% mineral trash on values for pol, Brix and fibre % cane derermined using the press are shown. Values of pol, Brix and fibre obtained by averaging analyses of 30 samples were within 5% (relative) of those obtained by 3 sets of analyses on a composite sample of the 30.

Device for measuring the electrical resistances of white sugar. A. M. Kostenyuk, V. E. Krutikova, O. B. Zdikhovskii and I. I. Ivanov. *Pishch. Prom.*, 1977, 23, 36-39 (*Russian*). — Although earlier investigations had established an empirical relationship between resistance and moisture content of a layer of white sugar, on the basis of which a conductimetric device was developed for moisture measurement in the range 0.03-0.20%, a difficulty arose regarding the measurement of high resistances (up to 1013 ohms). The problem has been resolved by means of a system in which the time taken for a charge applied to a capacitor to pass through two connected shunts is measured. By this means it is possible to measure resistance in the range 109-1013 to within ±5%.

Frosts and cane fibre. V. H. Chiappino. La Ind. Azuc., 1978, 85, 126-129 (Spanish). — Severe frosts occurred during the 1975 season in Argentina and the author observed from the records of his own and other sugar factories that, while there were post-frost falls in Brix, pol, purity and yield of sugar % cane, there was a steady increase in the fibre % cane which is measured indirectly in the Argentine chemical control system. He discusses the phenomenon and concludes that climatic conditions after the frost are conducive to loss of the other components so that the relative stability of the fibre produces an apparent increase.

<sup>1</sup> I.S.J. 1967, 69, 121.

<sup>&</sup>lt;sup>2</sup> Chem. Eng. Sci., 1955, 4, 238.

### BY-PRODUCTS

Alcohol from sugar cane. Brazil "harvests" energy crop. R. P. Humbert, World Farming, 1978, 20, (5), 30-31. Reference is made to the production of ethyl alcohol from cane in Brazil and to the use of the alcohol as fuel for road vehicles. Mention is also made of research into the use of methyl alcohol as a substitute for gasoline and its possible manufacture from bagasse. It is stated that the US Congress is considering legislation to encourage alcohol production — under this, gasoline to which more than 10% ethanol or methanol is added would be exempt from federal gasoline tax.

Use of gas turbines in the sugar industry. W.J.Leibig. Sugar J., 1978, 40, (12), 13-15. — The advantages of using a gas turbine to produce some of the heat required for beet pulp drying are discussed. Since the efficiency of a gas turbine operating under design load conditions is substantially higher than that obtainable with a backpressure steam turbine, continuous operation of a pulp dryer may be necessary. For a beet sugar factory slicing 4000 tonnes of beet daily, with an increase from 22% to 90% in the pulp refractometric dry solids as a result of drying, it is calculated that a gas turbine power output of 3255 kW per day is required. Calculations of the capital investment on power plant needed to produce this quantity shows that the gas turbine is considerably cheaper than steam cycle plant.

Drying of excess sludge. J. Yamaga and S. Shirakawa. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1978, 28, 9-14 (*Japanese*). — Details are given of the installation used at the authors' refinery to dry excess sludge from the activated sludge process. At a daily throughput of 6000 kg, the twin-drum dryer reduces the sludge moisture content from 86 to 12%. The dried sludge contains 5% nitrogen and 5% phosphate, and so is of value as a fertilizer.

Animal fodder from sugar beet. I. Feeding of dry sugar beet pulp to ruminants. A. Giouzelyianne. Hellenic Sugar Ind. Quarterly Bull., 1978, (32), 67-94, (33), 116-176 (Greek). — The literature on beet pulp composition, the effect of molasses addition and the value of both pelleted pulp and molassed pulp as fodder for cattle and sheep is reviewed, with 132 references.

A new process for the continuous fractionation of dextran. P. E. Barker, F. J. Ellison and B. W. Hatt. Ind. Eng. Chem. Process Des. Dev., 1978, 17, 302-309. Details are given of a gel permeation chromatography (GPC) method for continuous fractionation of dextran hydrolysate, produced after initial sucrose fermentation, to give polymers of high molecular weight (29,000-95,000) and low molecular weight (16,000-29,000). The effects of feed concentration and flow rate on the sequential counter-current procedure were investigated. Significant quantities of dextran were fractionated at feed concentrations of up to 22% (w/v) and flow rates of up to 1700 cm<sup>3</sup>.hr<sup>-1</sup>.

Marketing of dried molassed pulp and some aspects of producing pulp nuts and pellets. N. B. Davis and P. Tory. Paper presented at 24th Tech. Conf., British Sugar Corp. Ltd., 1978, 27pp. — Details are given of the dried molassed pulp products available from the British Sugar Corporation, and aspects of marketing of the products are examined. The equipment used for pulp nuts and pellets productions is described, and the technology of manufacture discussed.

Some components of the non-alcohol coefficient in cane spirits. Determination by gaseous-phase chromatography. L. G. de Souza and A. M. S. Llistó. *Brasil Açuc.*, 1978, 92, 109-112 (*Portuguese*). — By means of a gas chromatographic analysis the presence of 9.24 - 29.36 mg *n*-propanol, 4476.78 mg (average) iso - propanol 7.68 - 20.55 mg *n*-butanol, 2.24 mg (average) of iso-butanol and 24.24 - 54.02 mg iso-amyl alcohol per 100 cm<sup>3</sup> was established in 11 samples of cane spirit.

Waste water as new raw material from the sugar industry. G. Kaiser, A. Dziengel and W. Mauch. Zuckerind., 1978, 103, 659-662 (German). — Biological treatment of sugar factory effluent, with or without molasses addition, is described, with details given of fermentation processes to yield such by-products as single-cell protein (for use as animal fodder), ethanol, methane or fertilizer. Ecological prerequisites for fermentation are discussed, including the minimum quantity of substrate, conditions required for micro-organism activity, and the selection of micro-organisms suitable for a given task.

Investigation of the efficiency of molasses wort fermentation by yeasts of the V-30 strain. V. N. Shvets, E. I. Knogotkova and A. N. Ogorodnikova. *Izv. Vuzov, Pishch. Tekh.*, 1978, (3), 91-94 (*Russian*). Investigations are reported in which yeast of the strain V-30 generally yielded more baker's yeast and alcohol (the latter containing more higher alcohols and organic acids and less aldehydes) from molasses than did yeast of strain V.

The recycling of vinasses in alcohol distilleries. N. Taygun, R. Özdemir, G.Ülkü and H. Isik. Şeker, 1978, 28, (106), 1-16 (Turkish). - Because of the problems associated with disposal of distillery waste which typically contains 6-7% organic matter and has a COD and BOD<sub>5</sub> of 70-80,000 and 50,000 mg.litre<sup>-1</sup>, respectively, tests were conducted on recycling vinasse to the fermenter. Experiments were first carried out to determine the effect of vinasse on molasses fermentation; results showed that a 1:1 vinasse:molasses mixture yielded more alcohol (on the basis of the sugar content in the mixture) than did the same quantity of wort solely in the form of molasses, while the fermentation efficiency was only slightly reduced by comparison with that obtained without vinasse. On the basis of these findings, a scheme was worked out in which 32% of the vinasse is recycled; the remaining 68% of the vinasse, of 13.220Bx, represents a total daily discharge at Eskisehir distillery of 580 tonnes, compared with 850 tonnes.day-1 when no vinasse was recycled.

Feasibility of sugar production from agricultural and urban cellulosic wastes with Trichoderma viride cellulase. N. Toyama. Proc. Biotech. Bioeng. Symposium, 1975, (6), 207-219; through S.I.A., 1978, 40, Abs. 78-869. — Experiments on the enzymic saccharification of bagasse and other substrates are reported.

### **PATENTS**

#### UNITED STATES

Dextrose-isomerizing L. E. Coker enzyme. D. E. Gardner, assrs. A. E. Staley Mfg. Co., of Decatur, IL, USA. 3,956,066. August 16, 1973; May 11, 1976. An aqueous solution of a hexose (dextrose, levulose) [a starch hydrolysate comprising mainly (at least 90%) dextrose] is subjected [at a temperature of at least 55°C (about 65°C) (65°-85°C) (70°C) and pH between 6.0 and 8.0 (6.8-7.2)] to the action of a dextrose isomerase obtained from Flavobacterium devorans NRRL B-5384, F. devorans ATCC 10829, Brevibacterium incertum NRRL B-5383 or Streptomyces phaeochromogenes ATTC 15486 [in the presence of a polyvalent cationic thermal stabilizing agent (comprising Co, Mn or Mg ions) to stabilize the dextrose isomerase and enhance its activity] for sufficient time to provide a levulose:dextrose ratio in the product of at least 1:4.

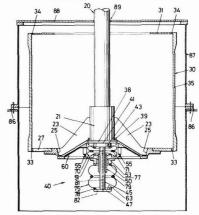
Mixed partial esters of carbohydrates. V. Prey, of Vienna, Austria, assr. Krems-Chemie Ges.m.b.H. 3,956,278. November 5, 1973; May 11, 1976. - A carbohydrate which may be a monosaccharide (dextrose, xylose), an oligosaccharide or an acid hydrolysis product from an oligosaccharide or polysaccharide [a disaccharide (sucrose)] is reacted (in aqueous solution or in the absence of a solvent) (at at least 90°C) with an aliphatic acylation agent having up to two C atoms in the chain (acetic acid and/or acetic anhydride) until the resulting product has a minimum of one acyl group per monose unit. The reaction mixture is then reacted (at a higher temperature than the first reaction) with a higher fatty acid or acid anhydride having at least six C atoms in the chain (lauric, palmitic, stearic, myristic, sacacid or cocofatty acid) in the presence of a proton acid, a Lewis acid or a cation exchanger in the H+-form (p-toluene sulphonic acid) as an acid catalyst. This reaction is continued until the content of the fatty acid moeity is 4-5%. The water of reaction is removed continuously by distillation [with the aid of an azeotrope (a lower alkyl

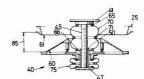
Hatching agent for sugar nematode. J. D. Willett and L. M. Cheek, assrs. Research Corporation, of New York, NY, USA. 3956,485. February 15, 1974; May 11, 1976. — A terpenoid-containing neutral liquid fraction derived from sugar beet or its seedlings is obtained by extraction of finely divided or minced tissue with methanol or chloroform and is applied to the soil (by spraying a suspension onto the soil or injecting beneath the surface) prior to planting or sowing beet. It causes or enhances premature hatching of nematode cysts (of species Heterodera schachtii, H.rostochiensis, H.glycines, H.trifolii or H.avenae) so that they die since no host plants are available.

Production of xylose (dextrose) isomerase enzyme preparations. F. C. Armbruster, R. E. Heady and R. P. Cory, assrs. CPC International Inc., of Englewood Cliffs, NJ, USA. 3,957,587. June 23, 1975; May 18, 1976. The enzyme is produced by inoculation of a nutrient medium (which is free of xylose or xylose-supplying material and of cobalt) with a mutant strain (obtained by ultra-violet irradiation) of Streptomyces olivochromogenes ATCC No. 21713-21715 characterized by the production of twice as much enzyme activity as the original strain when grown in the absence of xylose.

Centrifugal. W. Werner and K. Buge, of Braunschweig, Germany, assrs. Salzgitter Maschinen AG. 3,961,746. June 28, 1974; June 8, 1976.

The sugar discharge aperture at the bottom of centrifugal drum 30 is closed by the plate 60 which is held by springs 55 apart from the annular plate 51, held by ring 53 on the sleeve 50 which slides along the guide rod 45 between the flanges 43 and 47. Bellows 70 is connected by metallic end rings 65, 66 to the end ring 43 on flange 41, which is connected by bolts 39 to the flange 38 at the lower end of hub 21, and the annular plate 51. Bellows 75 is connected by similar rings 77, 78 to the underside of ring 53 and to the upper side of base plate 47. Each bellows has a restrictive central ring 71, 79 and a passage 81 in the guide rod and aperture 82 in the end plate 47 connect with the interior of the bellows so that compressed air or gas or other fluid may be admitted or withdrawn.





A control head (not shown) is fitted to the end plate 47 so that, as required, each of the bellows in turn may be inflated and the other deflated whereby the sleeve 50 is moved up and down the guide rod 45, raising and lowering the plate 60 to the centrifugal operating and discharging positions.

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).

Continuous isomerization of dextrose. M. Tamura, S. Ushiro and S. Hasagawa, assrs. CPC International Inc., of Englewood Cliffs, NJ, USA. 3,960,663. September 13, 1974; June 1, 1976. — A (30-70%) dextrose solution of pH about 6-9 (7.0 - 8.5) (about 8.0) is passed (at a temperature of 20° - 80°C) through a bed of immobilized dextrose isomerase prepared by bringing a solution of dextrose isomerase into contact with a porous or macroreticulate strongly basic anion exchange resin having a trimethyl quaternary ammonium group as the ion exchange group; a levulose solution is withdrawn until a decrease in enzyme activity occurs, when additional dextran isomerase is (added to the dextrose solution and) passed through the bed to reactivate it, and dextrose treatment is resumed.

Molasses feed block. C. O. McKenzie, of Fullerton, CA, USA. 3,961,081. March 12, 1974; June 1, 1976. A fluid feed comprising 50-100% molasses is heated at ambient pressure to  $225^{\circ}$  -  $300^{\circ}$ F ( $260^{\circ}$  -  $285^{\circ}$ F,  $270^{\circ}$ F) to drive off most of its water content and the heated molasses then subjected (in a sheet-like flow) to a vacuum [of 24 or more (29) inches Hg] to remove most of the remaining water, i.e. to a content < 5% (< 3%) and the hot material formed into blocks of 20-100 lb weight which are allowed to cool and solidify.

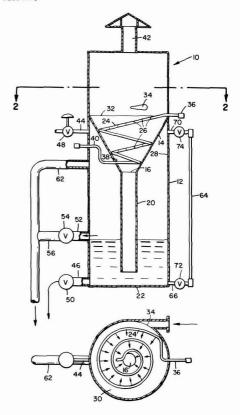
Method for increasing the sucrose content of growing plants. K. W. Ratts, of Creve Coeur, MO, USA, assr. Monsanto Company. 3,961,934. December 19, 1974; June 8, 1976. — The sucrose content of sugar cane is increased by treating the plants, prior to harvest, with N-acetyl or chloroacetyl derivatives of aminomethylene phosphonic acid and certain of their esters and salts.

Refining of sugar containing liquids by ion exchange. F. X. Pollio and O. Campos, assrs. Rohm & Haas Co., of Philadelphia, PA, USA. 3,961,981. August 22, 1974; June 8, 1976 — Beet juice or (clarified) cane juice (at 10-25°Bx) is passed (at 40-65°C) through a bed of weakly basic anion exchange resin in bicarbonate form so as to remove colour and to convert salts present into bicarbonates, removing other anions. The juice is then brought into contact (under 2-10 atm pressure) (at 40°-65°C) with a strongly acidic sulphonic acid cation exchange resin in Ca<sup>++</sup> form whereby non-Ca cations are exchanged. The treated liquid is then either heated (under reduced pressure) to convert the calcium bicarbonate to CO<sub>2</sub> and insoluble CaCO<sub>3</sub>, or limed to convert the bicarbonate to carbonate.

Cane planter. L. G. Fowler, of Belle Glade, FL, USA, assr. Sugar Cane Growers Cooperative of Florida. 3,963,138. March 10, 1975; June 15, 1976.

Treatment of cane juice. J. A. Casey, of San Francisco, CA, USA. 3,963,513. October 21, 1974; June 15, 1976. Juice is treated in the tower 10 which is in the form of an insulated cylinder 12 having a conical funnel 14 within it connected to a central vertical pipe 20. The upper edge 32 of the funnel forms a tight seal against the wall 28 of tower 12. A flexible plastic pipe 24 with perforations 26 along its length is fastened to the inner surface of the funnel and connected to an inlet conduit 36 and an outlet conduit 40 with a seal at the opening 38 in the funnel and an S-bend in the outlet 40 to provide a hydrostatic head. A gas vent 42 is provided at

the top of the tower and the lower part of the tower is connected through pipe 44 and valve 48 to a source of vacuum.



Exit ports 46, 52 and 62 are provided by means of which juice may be withdrawn from different levels in the bottom of the tower, and the level of juice is shown by the sight glass 64 connected through valves 72, 74 and pipes 66, 70 to the top and bottom of the lower part of the tower. Juice is admitted tangentially to the tower through port 34 and passes in a spiral path along the surface of the cone, into pipe 20 and so into the lower part of the tower from which it is withdrawn through one of the exit ports. Additive material such as a lime solution or flocculant, etc., is supplied from inlet conduit 36 and passes through the perforations 26 in tube 24 into the juice, the arrangement preventing any local high concentrations, and encouraging deaeration of the treated juice.

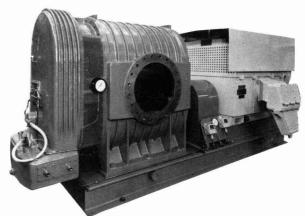
Synthesis of higher polyol fatty acid polyesters. G. P. Rizzi and H. M. Taylor, of Cincinnati, OH, USA, assrs. The Proctor & Gamble Co. 3,963,699. January 10, 1974; June 15, 1976. — A mixture of (10-50% of) a polyol (sucrose, xylitol, sorbitol), 40-80% of) a fatty acid C<sub>1</sub>-C<sub>2</sub> alkyl (methyl) ester (derived from soybean oil, sunflower oil, safflower oil or corn oil), (1-30% of) an alkali metal fatty acid soap and (0.05 - 5% of) a basic catalyst [an alkali metal or alloy (a dispersion of potassium metal in sucrose octa-acetate or mineral oil), an alkali metal hydride (K or Na hydride), or an alkali

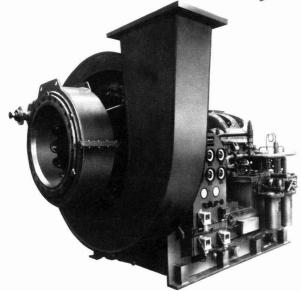


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Photocopies Dept., The International Sugar Journal Ltd., 23a Easton Street, High Wycombe, Bucks, England.

Subscriptions Dept., The International Sugar Journal Ltd., 23a Easton Street, High Wycombe, Bucks., England. metal alkoxide (K t-butoxide, Na methoxide)] is heated to a temperature of about 110° - 180°C (135°-145°C) at 0.1 - 760 mm Hg pressure to form a homogeneous melt of partly esterified polyol and unreacted materials. Excess fatty acid alkyl ester is added to the melt to form the polyol fatty acid polyester and the latter separated.

Method for storing bagasse, R. Hesch, of Nettetal. Germany, assr. Becker & van Hullen Niederrheinische Maschinenfabrik. 3,964,961. March 11, 1975; June 22, 1976. - The bagasse is piled into a stack on a bare structure protected against ground water and having a good run-off of surface water. The stack is built up with a substantially horizontal layer structure, wherein each successive layer is piled on only after the preceding layer has completed the phase of most intensive fermentation. The stack is piled up so that it tapers toward the top and forms a ridge, and the top of the stack is covered with a rain-shedding material at the earliest possible time after the top layer has passed its fermentation peak. The rate of fermentation may be controlled by either (1) decoring the bagasse before storage to remove the parenchyma, (2) separating the fine material, (3) slightly pre-drying the bagasse before storage, (4) adding fermentation-controlling or -inhibiting substances to the bagasse, or (5) providing air ducts in the stack to vent off the moist air.

Decolorizing sugar solutions with hybrid ion exchange resins. J. H. Barrett and D. H. Clemens, assrs. Rohm & Haas Co., of Philadelphia, PA, USA. 3,966,489. December 21, 1973; June 29, 1976. — Hybrid copolymers are prepared by at least partially filling the voids of a macroreticular copolymer with a gel-type, cross-linked copolymer of either the same or different monomers. The hybrid copolymers can be readily converted into ion exchange resins with markedly improved physical and chemical properties and especially useful for decolorizing sugar solutions.

#### UNITED KINGDOM

Recovery of sucrose. Tate & Lyle Ltd., of London, England. 1,417,344. May 11, 1973; December 10, 1975. See US Patent 3,909,287<sup>1</sup>.

Production of cane sugar. Tate & Lyle Ltd., of London, England. 1,428,790. September 28, 1973; March 17, 1976. — See US Patent 3,926,662<sup>2</sup>.

Non-oxidized cane juice. P. Grau y Triana, of Monte Carlo, Monaco. 1,436,530. January 3, 1975; May 19, 1976. — See UK Patent 1,373,8503.

Sucrose derivatives. Tate & Lyle Ltd., of London, England. 1,437,048. March 4, 1974; May 26, 1976. Sucrose is treated with 2,2-dimethoxypropane in N,Ndimethyl formamide in the presence of toluene sulphonic acid, to yield 4,6-O-isopropylidene sucrose. This may be acetylated, e.g. with acetic anhydride in pyridine solution, and the 4,6-O-isopropylidene sucrose hexaacetate isolated by codistillation with toluene and chromatography on a silica gel column, eluting with a 2:1 v/v mixture of ether and light petroleum. The hexaacetate may be hydrolysed, e.g. in 50% acetic acid at 80°C for 10 minutes, to give 1',2,3,3',4'6'-hexa-Oacetyl sucrose. Similarly, the hexabenzoate ester may be prepared as for the hexaacetate but by use of benzoyl chloride, and isolated by pouring the reaction mixture into ice-water. Hydrolysis in aqueous acetic acid-acetone yields the hexa-O-benzoyl sucrose.

Cane harvester. Sugar Cane Growers Cooperative of Florida, of Belle Glade, FL, USA. 1,438,902. January 8, 1974; June 9, 1976.

Beet harvesters. Comhlucht Siuicre Eireann Teo., of Dublin, Ireland. 1,439,439. November 13, 1974; June 16, 1976.

Making levulose with immobilized glucose isomerase. Corning Glass Works, of Corning, NY, USA. 1,440,703. February 15, 1974; June 23, 1976. — Dextrose is converted to levulose by incubating [at 50 - 70°C (60°C] a solution[buffered to pH 7.2 - 8.2 (7.4 - 7.8)] (of < 45% concentration) with an immobilized enzyme composite comprising glucose isomerase (derived from a Streptomyces organism) absorbed within the pores of a porous alumina body having an average pore diameter of 100 - 1000 Angstöms (140-220 A) (4-200-mesh, US Standard Sieve). The incubation is carried out in a flow-through column into which the dextrose solution is introduced continuously.

Isomerizing dextrose to levulose. Standard Brands Inc., of New York, NY, USA. 1,444,692. May 6, 1974; August 4, 1976. — The process of UK Patent 1,379,0574 is modified in that the dextrose solution is passed through at least one bed of cells derived from micro-organisms of the *Arthrobacter* genus (*A.* spp. NRRL B-3726, NRRL B-3728 or ATCC 21748) containing intracellular glucose isomerase.

Beet harvesters. Ransomes Sims & Jefferies Ltd., of Ipswich, Suffolk, England. 1,446,415. November 2, 1972; June 18, 1976.

A process for working up molasses. Süddeutsche Zucker-AG, of Mannheim, Germany. 1,448,524. December 12, 1974; September 8, 1976. - Molasses (of 40-65°Bx) is separated into sugars and non-sugars fractions by liquid distribution chromatography [at 50° - 99°C (85° - 95°)] on two columns of cation exchanger [an olefine material with 3-20% cross-lined divinyl benzene and including sulphonic acid groups) in the Ca++ form whereby 55-75% (60 - 70) of the exchanger is in the first column]. Molasses is supplied [at a linear flow rate of 2 - 6 cm.min;1 (3 - 4 cm.min<sup>-1</sup>) to the first column and this then eluted with deionized water (decarbonized water of pH > 9) until sugar is detected in the eluate. This is then passed into the second column and elution continued until sugar is detected in the eluate from the second column. Water is then passed through the second column but not through the first, and this second column eluate collected. The non-sugars are then separately eluted from the first column (at a linear flow rate of 3 - 12 cm.min-1). The ion exchangers are regenerated with a concentrated (sugar-containing) nonsugars fraction obtained in the process. The first column may be subdivided into two sub-columns, arranged serially.

<sup>&</sup>lt;sup>1</sup> I.S.J., 1978, **80**, 380.

<sup>&</sup>lt;sup>2</sup> ibid., 1978, 81, 28.

<sup>3</sup> ibid., 1978, 80, 58.

<sup>4</sup> ibid., 60.

### TRADE NOTICES

FCB sugar factory in Pakistan. Fives-Cail Babcock, 7 rue Montalivet, 75383 Paris Cedex 08, France.

Total sugar consumption in Pakistan in 1978 was 750,000 tonnes (9-10 kg per caput) while production by the 29 sugar factories amounted to 830,000 tonnes, so that the country was self-sufficient. Consumption is expected to rise to one million tonnes by 1980, however, and to reach 1,500,000 tonnes by 1985. As a step to meeting the needed production capacity, the Deh Bijora sugar factory - the 30th in the country - has been

commissioned.

Deh Bijora has a rated capacity of 2300 tcd and is the second unit of this size supplied by Fives-Cail Babcock to the Sind Sugar Corporation in Pakistan. FCB have supplied the main equipment although an important fraction (13% of the total value) of the equipment has been manufactured by local industry to FCB drawings, particularly the fabricated equipment - vacuum pans, evaporators, juice heaters, etc. The factory produces white sugar using a raw sugar remelt carbonatation process. When operating at full capacity, the factory will have a production capacity of approximately 35,000 tonnes of sugar per annum.

Cane is crushed in a tandem of four 870 mm x 1700 mm (34 in x 67 in) self-setting mills preceded by two sets of knives and a hammer-shredder; the cane mills are driven by one 625 hp and three 550 hp steam turbines. The juice is concentrated in a quadrupleeffect overflow evaporator of 2970 m<sup>2</sup> (32,000 ft<sup>2</sup>) heating surface. The crystallization system is designed for 3-strike operation, and each vacuum pan is fitted

with its own condenser.

Separation of crystal sugar is carried out by means of two FC 1000 continuous centrifugals with 25° baskets for single-curing of A-sugar, two FC-1000 continuous centrifugals with  $30^\circ$  baskets for first curing of B-sugar, one FC-1000 continuous centrifugal with a basket for B-sugar affination, three FC-1000 continuous centrifugals with 34° baskets for first curing of C-sugar and one FC-1000 continuous centrifugal for C-sugar affination. The A-sugar (in the CBA process) or the A- and B-sugar (in the CBCA process) is remelted and the resulting melt liquor limed and carbonatated using flue gases from the boilers. Final white sugar is cured using two fully automatic C 221 centrifugals of 1220 mm x 760 mm (48 in x 30 in) basket size.

#### **PUBLICATIONS RECEIVED**

Steam jet ejector systems. Kotting International Ltd., Anglia Way, Mansfield, Notts., England.

This new booklet on Korting steam jet ejectors for producing vacuum and pumping vapours and non-condensables outlines their advantages over other forms of vacuum pump, e.g. low initial and maintenance costs, greater versatility, etc. It gives layouts of multi-stage systems with inter-condensers, describes the principle of operation and, by means of performance factors, formulae and initial design calculations, guides the engineer in selecting the type of ejector most suitable for his purpose. The Enviro-Clear clarifier/thickener. Enviro-Clear Division, Amstar Corporation, Readington Road and Industrial Parkway, Somerville, NJ 08876, U.S.A.

This booklet, General Catalogue EC-76, describes the latest developments in the Enviro-Clear clarifier which, although developed for beet juice purification, has found application in many other industries. The advantages of the system are listed and its principle and operation are described. Flow capacities for different unit sizes are tabulated and the characteristics of the different types are presented in tables combined with illustrative drawings. Additional information is provided on flow diagrams and control systems, shipping plans and test units.

Cane sugar mill chains. Ewart Chainbelt Co. Ltd., Colombo Street, Derby DE3 3LX, England.

Catalogue No. 650 is a completely revised and up-dated guide to Ewart chains for the cane sugar industry. Printed throughout in English, Spanish, French and German, it provides a combination of technical drawings, graphs, tables and application photographs, assembled as a series of brochures covering metallurgical data and selection factors for conveying and transmission chains, a quick-reference guide to Ewart chains, steel and combination chains, malleable iron chains, slats and aprons, and "Cobra" overlapping apron conveyors, all within a distinctive black and gold cover.

Electrical equipment for the sugar industry. ASEA Industrial Division, S-721 83 Västeras, Sweden.

A new 8-page leaflet in colour illustrates some of the range of equipment manufactured by companies within the ASEA Group and sold to the sugar industry. It incudes steam turbines, high voltage switchgear and circuit breakers, transformers, low voltage switchgear, capacitor banks, constant speed A.C. motors, speed-controlled motor drives, centrifugals, control gear and panels, computer-based control systems, weighing equipment and cables. The leaflet is numbered AX 11-104 E.

Weighing and control equipment. - Enquiries for weighing and batching control equipment worth £1,000,000 were taken by Howe Richardson Scale Co. Ltd., of Nottingham, England, at a recent exhibition, Features which attracted interest on the HRS stand included the "Select-O-Weigh 400" range of scale controllers for batch weighing, the "BVL" pneumatic valve bag weigher, the "EC-B51" load-cell nett bagging weigher and the "Loss-in-Weight" constant rate feeder. At another exhibition, HRS equipment displayed included a range of belt weighers comprising the "Bulktronic" continuous totalizing belt weigher, and the D50 and D60 weighers for totalizing and control of material passing over a conveyor belt.

Dust control in sugar factories. - Dust Control Equipment Ltd. have won orders worth £150,000 for their "Dalamatic" filters for installation at the British Sugar Corporation's factories at Cantley, Felsted, Newark and Peterborough. Over half of the order is for the Peterborough factory where a change is being made from raw sugar to white sugar production. The new filters will collect air-borne sugar dust from the conveyors, elevators, dryers and mechanical handling apparatus where dust loads are particularly heavy. Wet collectors have also been installed at the granulators in Peterborough. British Sugar Corporation has spent several million pounds on DCE equipment in its factories.

Burma sugar project consultancy contract. - Tate & Lyle Technical Services Ltd. has recently signed a contract worth more than £330,000 for consultancy services relating to the Pyinmana Sugar Project. This involves construction of a new 1500 tcd cane sugar factory and rehabilitation of the existing 1500 ted factory, together with development of the associated agricultural and infrastructural works. The total project is expected to cost approximately £37 million and is being financed by the Asian Development Bank and the OPEC Special Fund, TLTS will initially be responsible for the preparation of the preliminary designs, equipment specifications and tender documentation. Subsequently the company will be involved in assisting the Foodstuff Industries Corporation of Burma with the adjudication of tenders, the development of the new and existing cane areas, and the supervision of the construction and rehabilitation works over a period of five years.

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

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#### Sudan sugar imports<sup>1</sup>

	1978	1977 — tonnes —	1976
Argentina	11,305	0	9,421
Brazil	31,250	73,377	0,
China	0	10,328	Ō
Cuba	10,500	0	Ō
Czechoslovakia	23,300	0	0
EEC	72,850	5,000	17,413
Egypt	0	3,195	0
Germany, East	3,900	0	0
Greece	0	2,500	0
India	67,088	32,050	105,092
Korea, South	0	32,400	0
Portugal	0	4,750	0
Other countries	0	0	2
Total	220,193	163,600	131,928
Total, raw value	220,193	177,827	143,400

Central American Sugar Technologists meeting. — The first Congress of ATACA, the Central American Sugar Technologists Association, was held in Guatemala in 1973 and it had been proposed to hold another meeting in Managua, Nicaragua in 1978. This had to be cancelled, however, and the meeting is to take place at the beginning of September in San Salvador, El Salvador.

Brazil sugar production plan 1979/80<sup>2</sup>. - The Instituto do Açucar e do Álcool has set authorized 1979/80 sugar production at 6,600,000 tonnes, tel quel, equivalent to approx. 6,930,000 tonnes, raw value, and down 10,08% from the 7,340,000 tonnes produced in 1978/79. Alcohol production of 3,800,000,000 litres has been authorized for 1979/80 against 2,600,000,000 litres authorized in the previous crop year. The IAA has said that, with internal consumption forecast at 4,680,000 tonnes of sugar, exports would be limited in 1979/80 to 1,920,000 tonnes, in line with Brazil's ISA quota.

Dedini-Toft agreement<sup>3</sup>. - M. Dedini, of Piracicaba, Sao Paulo, has signed a contract with Toft Brothers Industries, of Australia, for the manufacture of equipment for the planting, harvesting and transportation of sugar cane and of equipment related to sugar and alcohol production.

International conference on effluent treatment. - A conference and exhibition, sponsored by the journal Process Biochemistry, will be held at the Mount Royal Hotel, Marble Arch, London W1, on November 6-7, to review the treatment of effluents from the biochemical industries. More than 20 specialists will outline the many new developments in effluent treatment and product recovery from biochemical wastes. They will also be assessing alternative technology for the recovery of saleable by-products from effluents. The programme, which allows for a discussion period on each paper, includes one on effluent treatment in beet sugar manufacture by Dr. R. Pieck of Raffinerie Tirlemontoise S.A., Belgium, and another on effluent treatment options from molasses fermentation by O. M. R. Brown of United Molasses Co. Ltd., England. The exhibition to be held in conjunction with the conference will show equipment and processes for effluent treatment and by-product recovery. Further information may be obtained from the Conference Secretary, Wheatland Journals Ltd., 157 Hagden Lane, Watford WD1 8LW, England.

Sugar development schemes in Sri Lanka<sup>4</sup>. - Two major sugar cane development schemes are to be set up in the Monaragala and Uda Walawe areas. In Monagarala district the multi-million project will cover an area of 19,000 acres. Experts from the World Bank have finished their research study on the project costing Rs 90 million which will be funded by the Bank. The second project at Uda Walawe, costing Rs 52 million, will cover an area of 14,200 acres and will be funded by the Asian Development Bank.

#### Madagascar sugar statistics<sup>5</sup>

19	978	1	977	1976		
_		tonnes,	raw value —			
	72,367 123,214		71,081 116,736		74,378 114,041	
	195.581		187,817		188,419	
	93,896		87,782		85,640	
				_		
0		5,739				
119		0				
0		0				
11,027		10,902				
13,233		11,027		12,271		
	24,379		27,668		31,698	
	77,306		72,367		71,081	
	0 119 0 11,027	123,214 195,581 93,896 0 119 0 11,027 13,233 24,379	72,367 123,214 195,581 93,896 0 5,739 119 0 0 11,027 10,902 13,233 24,379	72,367 71,081 123,214 116,736 195,581 187,817 93,896 87,782 0 5,739 119 0 0 0 11,027 10,902 13,233 24,379 27,668	72,367 71,081 123,214 116,736 195,581 187,817 93,896 87,782  0 5,739 0 119 0 660 0 5,707 11,027 10,902 13,060 11,027 11,027 27,668	

Irrigation projects in Mauritius. - Mauritius is developing three irrigation projects to raise the yield of sugar cane, viz. the Northern Plains Irrigation Project, the Western Coastal Region Irrigation Project and the Small-Scale Irrigation Project. three should permit an increase in the country's sugar crop, since a pilot project at Plaine des Papayes indicated that an increase of about 20 tonnes of cane per acre could be gained.

Jamaica flood damage to cane. — Floods have caused serious damage to cane grown in the western part of the island and caused the premature closing of some of the Jamaican sugar factories in June. A sugar industry spokesman said, however, that cane would be stood-over to the new 1979/80 crop and that, weather permitting, crushing would begin in November instead of the usual December to compensate for the extra cane<sup>6</sup>. Jamaica would meet its 300,000 tonnes export quota, 120,000 tonnes of which is earmarked for the EEC.

Australian bulk sugar terminal opened7. - On July 2 the Australian Dulk sugar terminal opened . — On 301 2 min Australian Prime Minister officially opened the \$A 53,000,000 off-shore Lucinda bulk sugar terminal near Ingham, Queensland, in the presence of more than 250 guests representing all sections of the sugar and transport industries at both Australian and international level. The new deepwater wharf at Lucinda, where ships of up to 40,000 tonnes may be loaded at rates of up to 1420 tonnes.hr 1. has an approach jetty from the shores 5.76 km . has an approach jetty from the shores 5.76 km long, housing the longest over-the-sea raw sugar conveyor in the

Costa Rica sugar production 1977/788. — Raw sugar production in Costa Rica reached 191,340 tonnes in 1977/78, 2% below the record outturn of 1976/77. While both cane area and tonnage crushed were slightly higher than a year earlier, the recovery of sugar per tonne of cane was smaller. The USDA forecasts 1978/79 production at 206,650 tonnes, 8% up on the previous crop.

Paua-New Guinea sugar cane by-products project 9, - Hawker Siddley Canada Ltd. has announced that it has been given approval by the Busu Coffee Co. of Papua-New Guinea to make a study for a proposed sugar cane by-products complex. It said that the complex would include sugar cane separation and fibreboard plants. Buildings, installed equipment and management and consulting fees have been estimated at US \$6,500,000.

Ivory Coast sugar factory 10. - The Zuenoula sugar factory is expected to start operations in December 1979. Construction started in September 1977. The complex has a cane area of 5200 ha of which 4200 ha are irrigated. A sugar production of 8000 tonnes is expected during the first season.

I.S.O. Stat.Bull., 1979, 38, (5), 83.

F.O. Licht, International Sugar Rpt., 1979, 111, 381. Bank of London & S.America Review, 1979, 13, 419.

Standard Chartered Review, May 1979, 23. I.S.O. Stat. Bull., 1979, 38, (5), 60-61.

F.O. Licht, International Sugar Rpt., 1979, 111, 397.

<sup>7</sup> F.O. Licht, International Sugar Rpt., 1979, 111, 258.
8 F.O. Licht, International Sugar Rpt., 1979, 111, 258.
9 S. African Sugar J., 1979, 63, 120.

#### Mexico sugar statistics<sup>1</sup>

	1978	1977	1976
		— tonnes, raw value —	
Initial stocks	233,801	121,261	99,849
Production	3,130,682	2,789,856	2,709,888
	3,364,483	2,911,117	2,809,737
Consumption	2,933,940	2,677,316	2,675,411
Exports	73,711 *	0	13,065
Final stocks	356,832	233,801	121,261
		-	

\* All to USA † 499 tonnes to USA: 12,566 tonnes to EEC.

Europe sugar beet area, 1979. — The third estimate by F. O. Licht GmbH<sup>2</sup> of the areas sown to beets for the 1979/80 campaign has recently been published, very soon after the second<sup>3</sup>. The total area, reduced further to 7,828,000 ha, is now virtually unchanged from 1978, owing to falls in the crop area estimates for Turkey, Spain and France. The contracted area in Turkey - 311,000 ha - seems not to have been reached and the area is now set at 275,000 ha, while the estimate for Spain is reduced by 11,000 ha to 189,000 ha, 41,000 ha or 18% less than in 1978. The beet area in France is now estimated at 510,000 ha, 13,000 ha or 3% below that of 1978. Slight revisions have been made for Belgium-Luxembourg, Ireland and Switzerland but the estimates for other countries of both West and East Europe are unchanged

Yugoslavia sugar industry expansion<sup>4</sup>. - Yugoslavia plans the construction of ten new sugar factories during the current plan period (1976/80). The plants in Bac, Zabal, Pencini, Kovacica and Nova Crna (all in Vojvodina province) have already begun operations or are about to do so. A further five factories are to be built, however, in Bijeljina, Virovitica, Ormoz, Sabac and Pozarevac, by 1980. Because of increased sugar production, Yugoslavia has been self-sufficient in sugar since 1978. With expansion of the beet area to 160,000 ha in 1979 an increase in sugar production is again to be expected. However, the higher production has led to substantial losses for the industry, amounting to 260 million dinars. In 1978 only Senta and Vrbas sugar factories made small profits, two more factories were at the profit threshold, while the remaining nine factories made losses.

Rust disease in Colombia<sup>5</sup>, - The Colombian Government imposed a quarantine on an area near the Venezuelan border after rust disease was discovered on cane in the region. A strain of the disease which had never appeared before in Colombia was found in mid-May in northern Santander province; this strain of Puccinia melanocephala, like other strains of the disease, destroys cane plants. Under the quarantine, no vegetation may be transported outside the area and the affected plants are being destroyed.

Government incentives for bagasse paper production in India<sup>6</sup>. The Union Government has announced a package of incentives, including tax exemption, to facilitate the setting up of bagasse-based projects. Bagasse from sugar factories could produce nearly 2,000,000 tonnes of paper and newsprint and, even if only half of this was produced, it would go a long way to reducing the current shortage of paper. Under the scheme, erection of paper and newsprint plants close to sugar factories would be encouraged, with financial institutions giving priority to extending assistance to such projects. To offset the high costs of boiler replacement and conversion to coal firing, excise duty exemption would be given to paper made with at least 75% bagasse for a period of 3 years, to be reviewed thereafter. The cost of the new boilers or modifications, and transporting and storage costs for coal stocks for the factories would be built into the cost of the paper plant, while the railways would give priority to movement of coal to the factories.

Alcohol from cane in the Philippines 7, - The Philippines Minister for Energy announced that the Bicolandia Sugar Development Co. mill was to be the site of an alcohol manufacturing facility using cane as the raw material<sup>8</sup>. The plant will be built by the state-owned Philippine National Oil Company. A blending programme is planned with a gradual shift in the alcohol:gasoline ratio from 5% in 1980 to 20% by 1989.

India sugar statistics9

	1978		1	977	1976		
	_		<ul><li>tonnes,</li></ul>	raw value -			
Initial stocks		1,849,862		1,339,554		1,237,148	
Production		7,102,694		5,018,798		5,033,400	
		8,952,556		6,358,352		6,270,548	
Exports							
Afghanistan	10,804		0		1,085		
Algeria	0		0		11,390		
China	76,873		0		0		
Djibouti	1,405		0		0		
Egypt	46,999		21,459		83,745		
Indonesia	273,669		106,818		167,571		
Iran	0		0		135,127		
Iraq	0		0		9,763		
Jordan	0		0		11,933		
Kenya	0		5,261		0		
Korea, North	33,278		0		0		
Maldives	2,592		1,139		380		
Nepal	0		0		4,696		
Oman	0		271		0		
Portugal	0		0		13,126		
Rumania	0		0		68,450		
Sevchelles	0		868		0		
Somalia	0		0		22,780		
Sri Lanka	91,999		29,863		13,668		
Sudan	76,278		21,207		114,232		
Tanzania	0		21,044		11,933		
Tunisia	0		0		6,617		
UK	25,714		29,419		29,940		
USA	0		0		152,534		
Yemen, North	11,128		39,052		11,128		
Yemen, South	36,735		0		0		
		687,474	-	276,401		914,907	
Consumption		5,211,940		4,232,089		4,016,087	
Final stocks		3,053,142		1,849,862		1,339,554	

Honduras sugar outlook 10. - The US Department of Agriculture quotes projected sugar production in Honduras in the 1978/79 season at a record 214,500 short tons, raw value, while exports are expected to rise to 94,500 short tons from 25,100 tons shipped from the 1977/78 crop. Raw sugar output in 1977/78 was an estimated 131,400 short tons but, with three new mills expected to start full production in 1978/79, cane crushed is expected to total 2,319,000 tons against 1,460,300 tons in 1977/78 when only three mills out of six were in full production. Domestic consumption is forecast to rise in the period to 118,900 tons from 105,000 tons in 1977/78.

Bagasse paper plant in India 11. - The Tamil Nadu Government has decided to put up a Rs 1320 million plant for the manufacture of 250 tonnes of newsprint and 50 tonnes of writing paper per day using bagasse as the raw material.

Increased Japanese use of high fructose corn syrups 12. - According to Japanese press reports, there has of late been a marked trend among big industrial users to shift away from conventional sugar; in soft drinks, for example, Pepsi-Cola has already switched to HFCS for about half its sugar requirements, while Coca-Cola and the soft drink divisions of Asahi Breweries and Sapporo Breweries are said to be planning to change over in part during 1979. Since HFCS is not subject to the consumption tax on sucrose — more than 8% of the wholesale price — it is nearly 50% cheaper. Certain product drawbacks have previously limited use to small-scale food processors, but recent product quality improvements have increased acceptability to big industrial users and it is thought that its use may increase among confectionery manufacturers.

New Chinese sugar factories 13. - Among new construction projects this year, the New China Agency reports that there will be twelve cane sugar factories of 500 tcd capacity and eleven beet sugar factories with a daily slice of 500 tonnes.

I.S.O. Stat. Bull., 1979, 38, (5), 65

International Sugar Rpt., 1979, 111, 287.

I.S.J., 1979, 81, 194.

F.O. Licht, International Sugar Rpt., 1979, 111, 293.

Public Ledger, June 30, 1979. Maharashtra Sugar, 1979, 4, (7), 66.

Sugar News (Philippines), 1979, 55, 47.

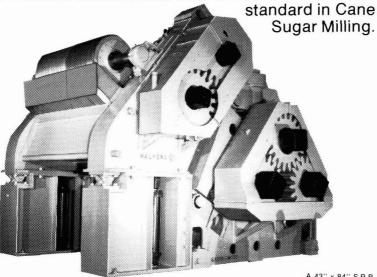
See J. S.J., 1979, 81, 255. J.S.O. Stat. Bull., 1179, 38, (6), 50. Reuters Sugar Rpt., March 12, 1979. Standard Chartered Review, May 1979, 21.

<sup>12</sup> F.O. Licht, International Sugar Rpt., 1979, 111, 383. Westway Newsletter, 1979, (68), 13.

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The factory consists of a Porta Box cane off loading station with cane preparation by knives and heavy duty shredder,  $4\times3$  roller 90 inch FCB self setting mills with conventional boilers and sugar processing equipment. Refined sugar will be produced using the Tate and Lyle Talo Floc system. The factory is designed to handle 4,000 TCD extending to 5,000 TCD by the addition of a diffuser at a later date. First crop operations after commissioning are scheduled to start in November 1979.

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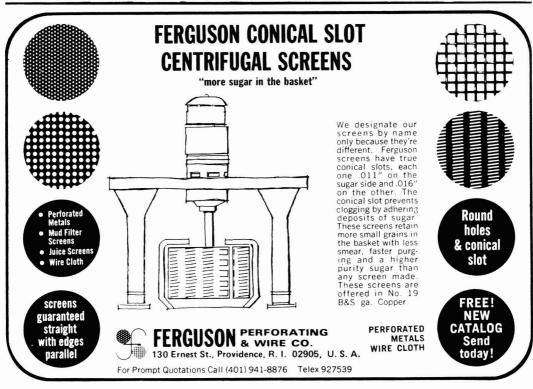
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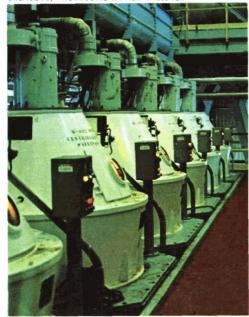
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