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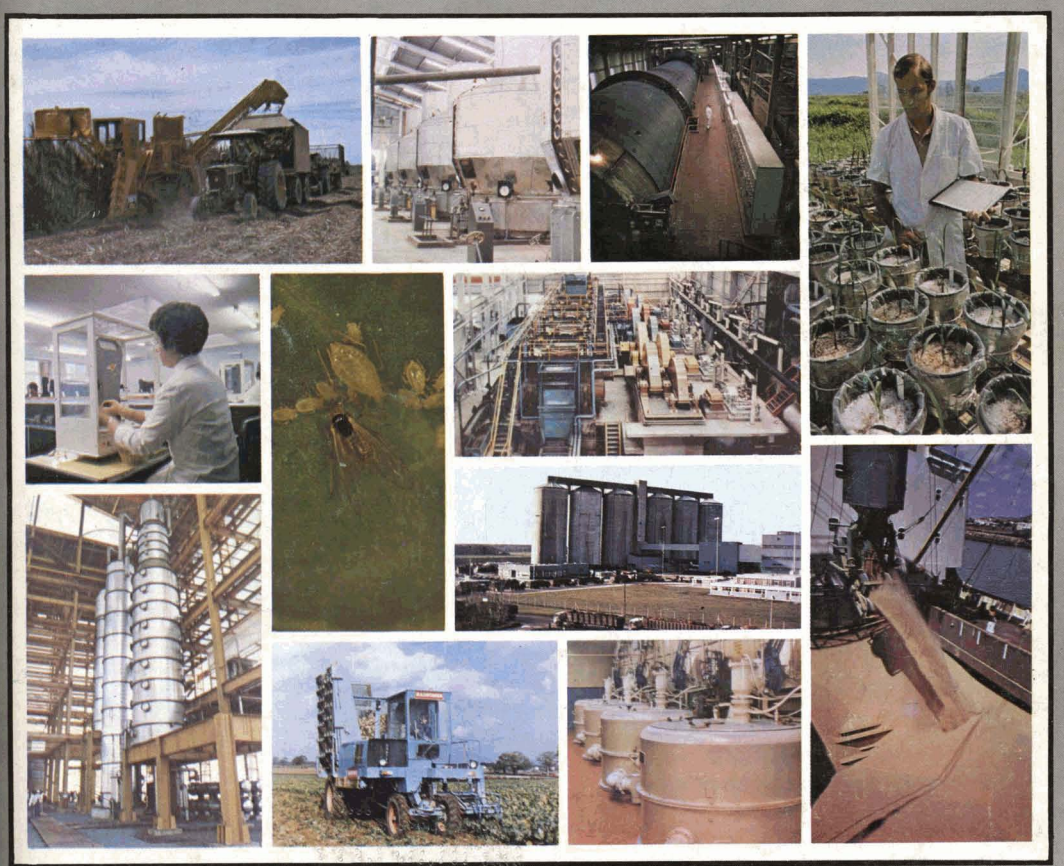
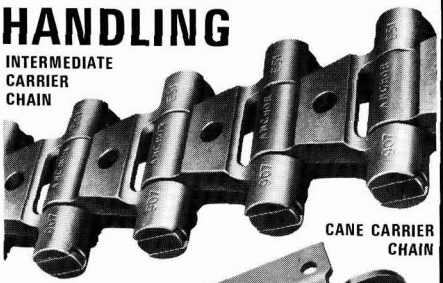


JUNE 1978

RENOLD

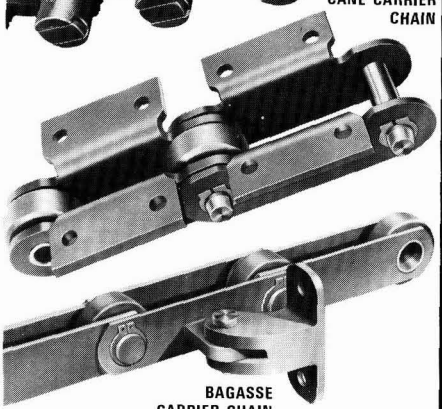
PRODUCTS FOR THE sugar industry

CHAINS FOR MECHANICAL HANDLING



INTERMEDIATE CARRIER CHAIN

CANE CARRIER CHAIN



BAGASSE CARRIER CHAIN

Specialised Renold chains have been supplied to the cane sugar industry since 1920. Over 90 years of precision chain manufacture ensure a product combining high strength with compactness, minimum weight and low cost for long life and trouble-free operation.
Precision roller chains and wheels for power transmission are also available for all applications.

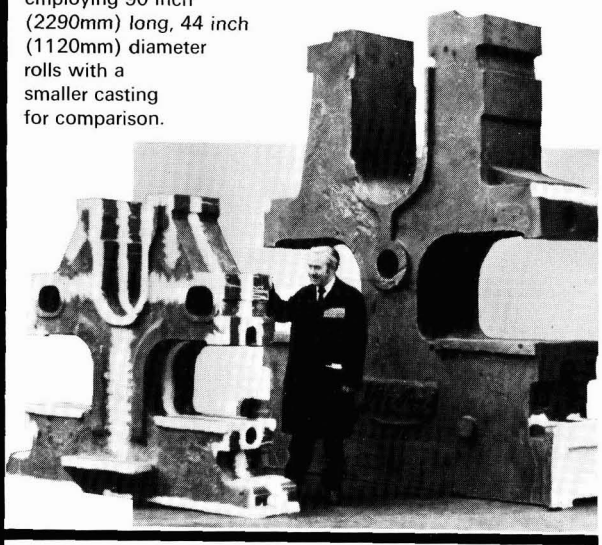
RENOLD LIMITED
SALES DIVISION
MANCHESTER
ENGLAND

Other Renold products include:-
Hydraulic, electrical and mechanically operated variable speed systems.
Couplings, clutches and brakes.
Power transmission ancillaries.

CASTINGS & FORGINGS

Holcroft Castings and Forgings, a Renold subsidiary company, supplies steel, iron and bronze castings and steel forgings.

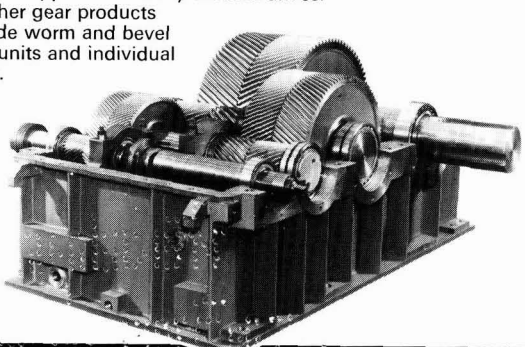
The photograph shows at 13½ tonne headstock casting for a 12 roll tandem employing 90 inch (2290mm) long, 44 inch (1120mm) diameter rolls with a smaller casting for comparison.



POWER TRANSMISSION GEARING

One of three 800hp triple reduction, double helical gear units supplied to the Philippines. Spur gears up to 127mm circular pitch, 760mm face width and 4700mm diameter can be supplied for heavy tandem drives.

Other gear products include worm and bevel gear units and individual gears.



Retention time. How short should it be?

The Dorr-Oliver RapiDorr® 444 is six ways better than so-called "Short Retention Time" clarifiers.

There is no question that the shortest practical retention time is desirable in cane juice clarification. But when the disadvantages of extremely short retention time clarifiers outweigh the advantages, then it is vital to reconsider how short short should be. The Dorr-Oliver RapiDorr 444 clarifier is designed for shorter retention time than other conventional units. And it offers six distinct advantages over what have become known as "Short Retention Time" (SRT) clarifiers.

1 "SRT" clarifiers depend on polyelectrolytes for best results. The RapiDorr 444 does not. Polyelectrolyte additives are very costly for one thing. Not to mention such complications as lack of uniformity of raw material, or the unavailability of polyelectrolytes in some areas and even, in some cases, government restrictions against their use. (Incidentally, if your clarification would be improved by adding polyelectrolytes, you can with the RapiDorr 444 — that's up to you. But remember, this is not necessary to make the machine function efficiently.)

2 "SRT" clarifiers tend to be "nervous" in operation, or extremely delicate. The RapiDorr 444 is far more stable, has more surge or holding capacity and is easier to operate, resulting in better overall performance.

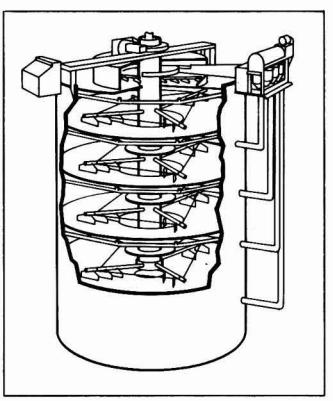
3 The true test of a cane juice clarifier is how well it operates when conditions are tough. When weather is bad, or stale cane produces refractory or hard-to-settle juices, then you need the extra retention time and larger settling areas the RapiDorr 444 provides. And "SRT" clarifiers just don't.

4 "SRT" clarifiers normally require complicated continuous pH, temperature and flow control as well as an extra large flash tank. With the RapiDorr 444 clarifier, you avoid these extra expenses.

5 Mud thickening, mud holding and mud withdrawal capacity are built into the RapiDorr 444. Most "SRT" clarifiers do not have this ability.

6 "SRT" clarifiers can be a mechanical nightmare of pipes, launders, controls, cones, and the like, and difficult to maintain. The simplicity of RapiDorr 444 construction precludes continuous expensive maintenance.

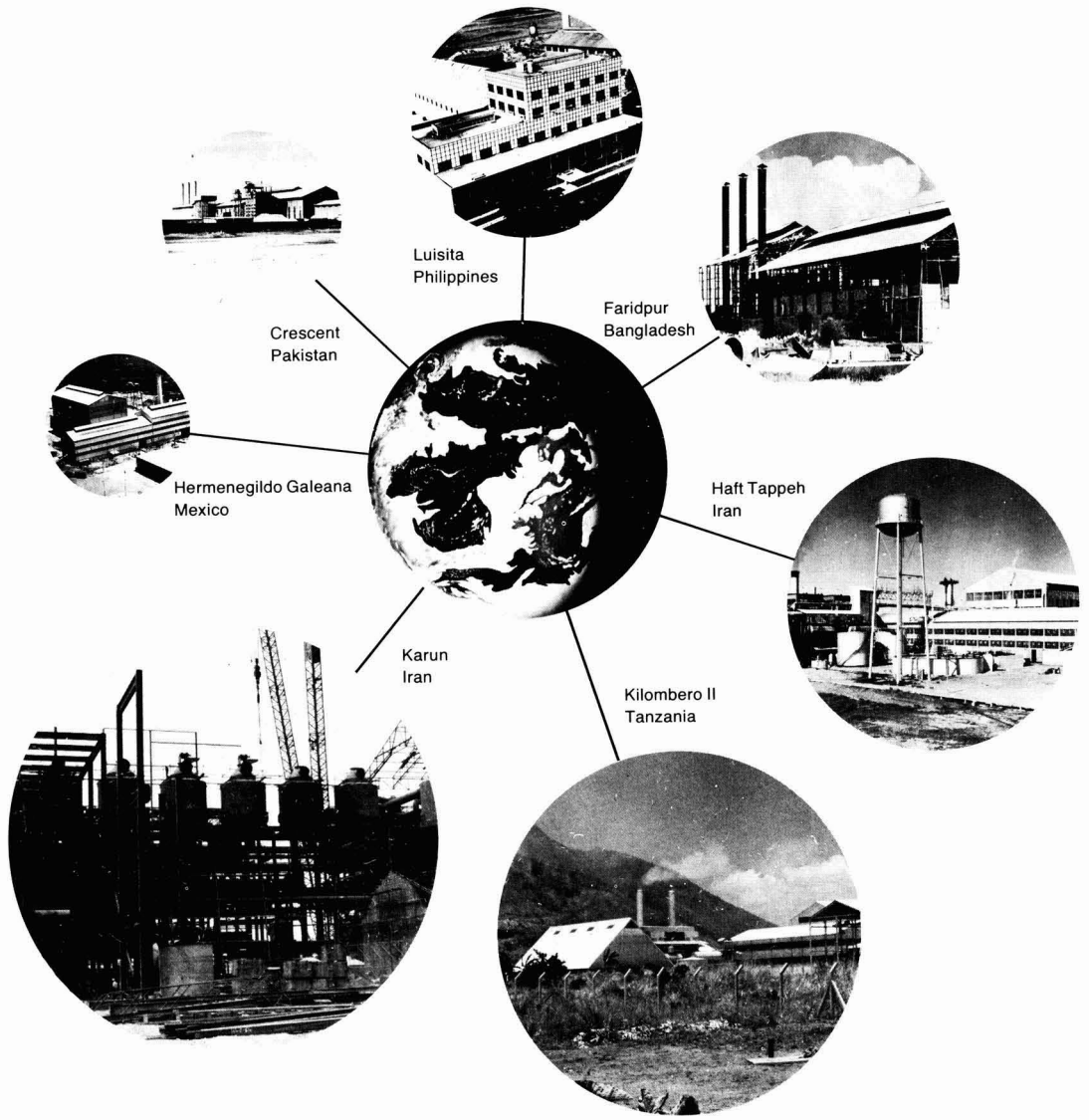
Avoid the risk of getting short changed with short retention clarifiers. Send for complete information on the RapiDorr 444. Write Larry Engel, Dorr-Oliver International Headquarters, Stamford, CT 06904 U.S.A.



DORR-OLIVER

A step ahead in process equipment.

Looking from a satellite



Several SWS-supplied sugar plants can be spotted at a glance looking from a satellite in orbit. Many glances are, however, required to spot them all.

Sugar plants of different lay-out and capacity. Delivered on a fob-contract or on an everything including turnkey contract.

What they all have in common is SWS' attention to detail, and outstanding economic performance through our up-to-date technology.

STORK-WERKSPOOR SUGAR

sugar industry engineers Hengelo (Ov.) The Netherlands P.O.Box 147 Member of Vmf-Stork

How to teach an old centrifugal new tricks

Figure A

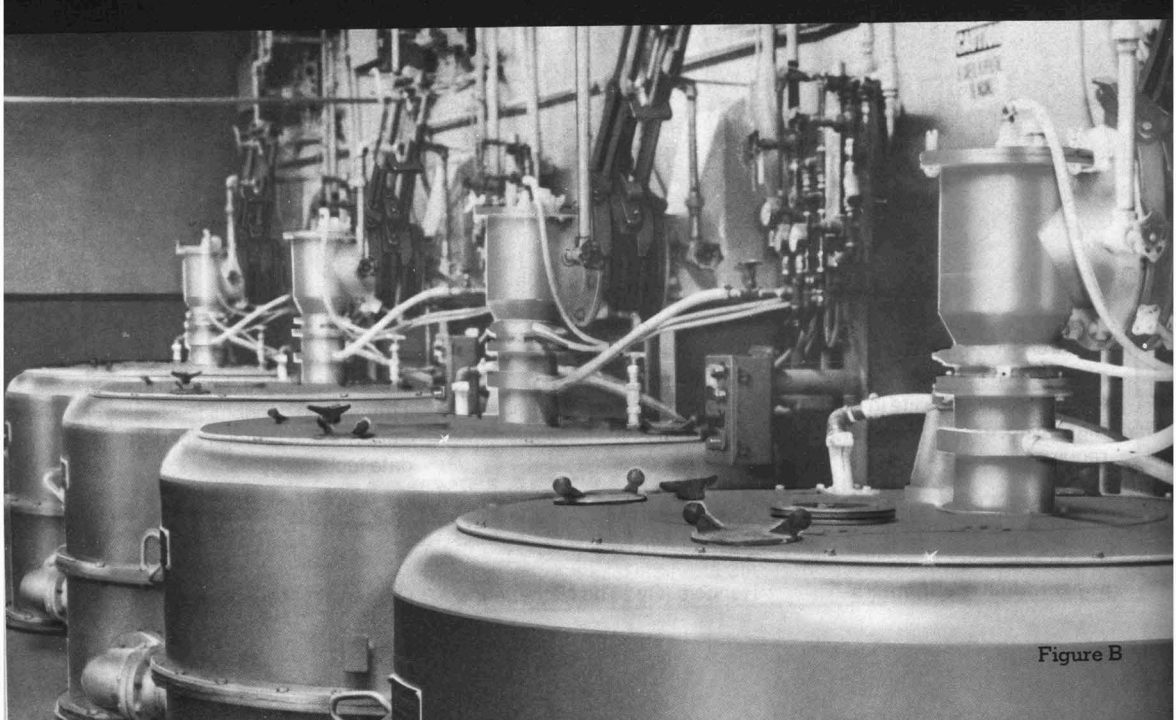


Figure B

Introducing PROJECT-UPDATE

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

We call it "Project-Update."

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

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

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

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

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

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

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

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

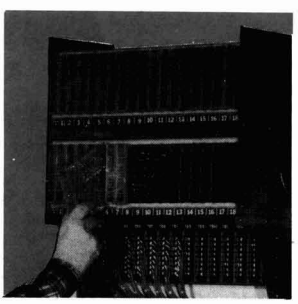


Figure C

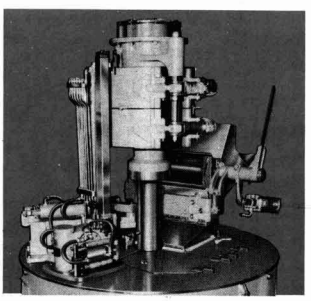


Figure D

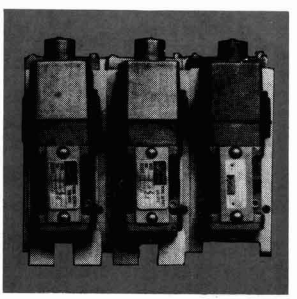


Figure E

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

THE WESTERN STATES MACHINE COMPANY
P.O. Box 327, Hamilton, Ohio 45012
Telephone: (513) 863-4758 Telex: 21-4577

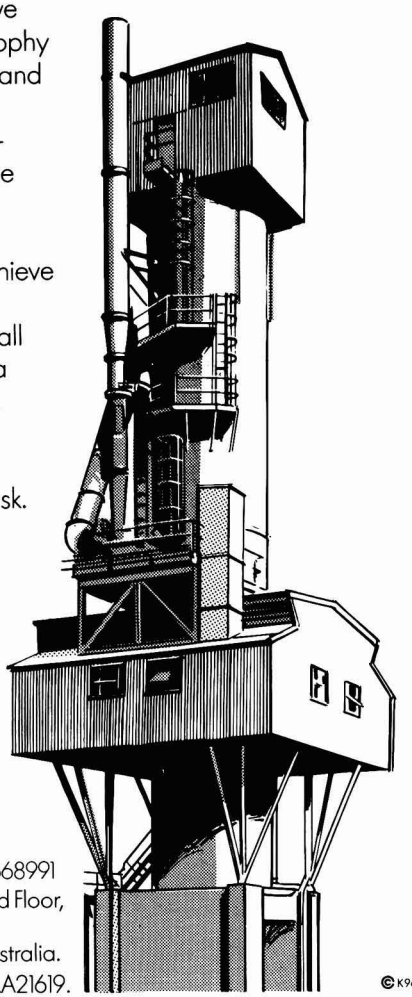
WEST'S PHILOSOPHY

West's didn't invent the vertical shaft lime kiln but for nearly twenty years we have been applying our basic philosophy to the development of the modern oil and gas fired shaft.

We believe in keeping it simple– a straight shaft coupled to a discharge system that gives a regular and even movement of the charge–long flame burning systems using oil or gas to achieve even burning and full penetration– accurate control of lime to fuel rattos, all adding up to reliable operation and a high quality lime product at an economical price.

If you want to know more about West's philosophy–write to us and ask.

West's Pyro Limited– Engineers to the lime industry for Vertical Shaft Kilns, Hydrators and complete process plants.



WEST'S PYRO LTD

Dale House, Tiviot Dale, Stockport,
Cheshire SK1 1SA Tel: 061-477 1844 Telex: 668991
West's Australasia Limited, Suite 1 & 2, Third Floor,
1 Chandos Street, St. Leonards,
New South Wales, Area Code 2065, Australia.
Tel: New South Wales 439-4177. Telex: AA21619.

Sugar in lumps. A

Sugar lumps are at present produced throughout the world by means of a technique perfected and modernised by MACHINES CHAMBON, who today offer entirely automatic lines for the moulding and conditioning of sugar lumps of all sizes.

The CHAMBON plants mould, dry and put into boxes according to type, 12, 24, 55, 80 or 100 tons* of sugar per day.

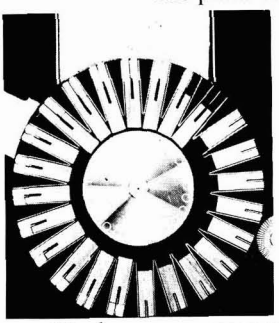
They are strongly built, reliable, completely automatic and only a few people are required to supervise their operation.

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.

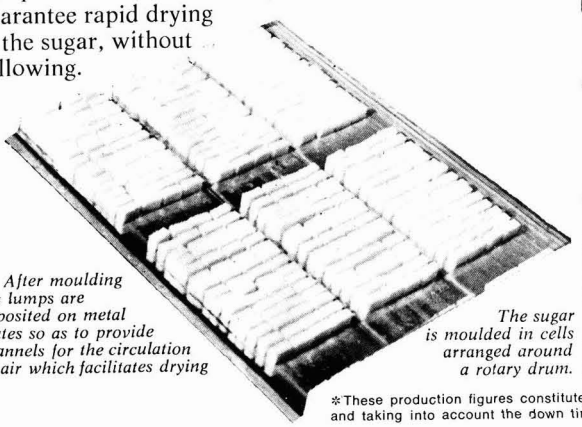
A system of compression by mobile pistons produces lumps perfectly regular in shape and weight and of variable hardness according to the rate of compression.



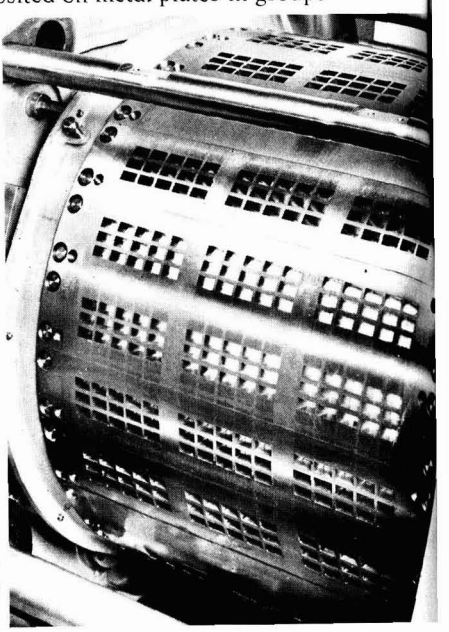
Rapid and perfect drying.

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 of the sugar, without yellowing.



After moulding the lumps are deposited on metal plates so as to provide channels for the circulation of air which facilitates drying



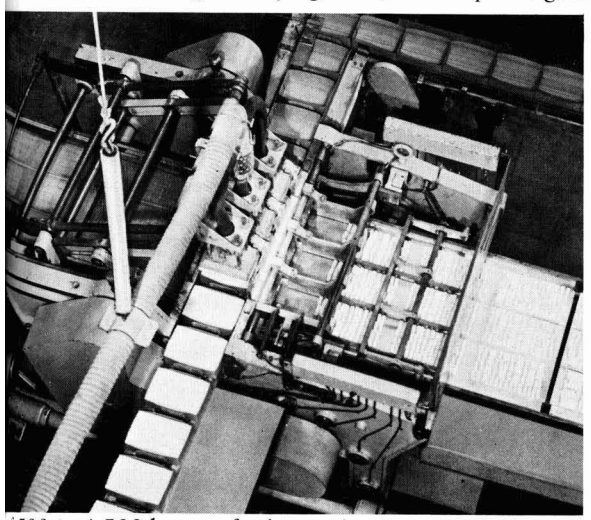
The sugar is moulded in cells arranged around a rotary drum.

*These production figures constitute minimum tonnages guaranteed under normal operating conditio and taking into account the down time for weekly cleaning.

simple product.

Automatic conditioning.

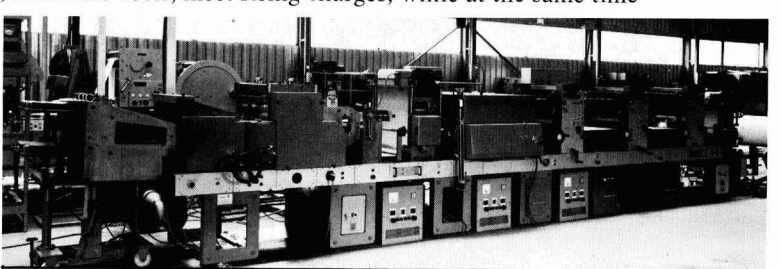
On leaving the drying units, the lumps are gathered and deposited by pneumatic fingers in three successive layers in the boxes, which are formed on a connected machine and automatically supplied to the conditioning line.
The full box is conveyed to the closing machine, which forms and glues the lid of 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.



The boxes are printed and formed in a single operation.

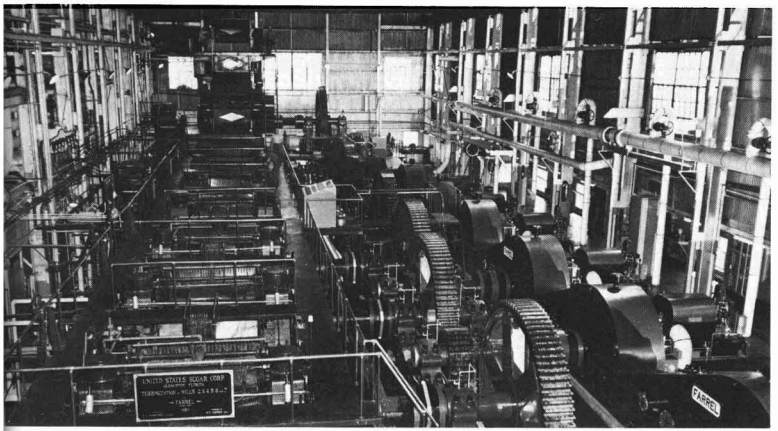
CHAMBON

Bergère/Communication

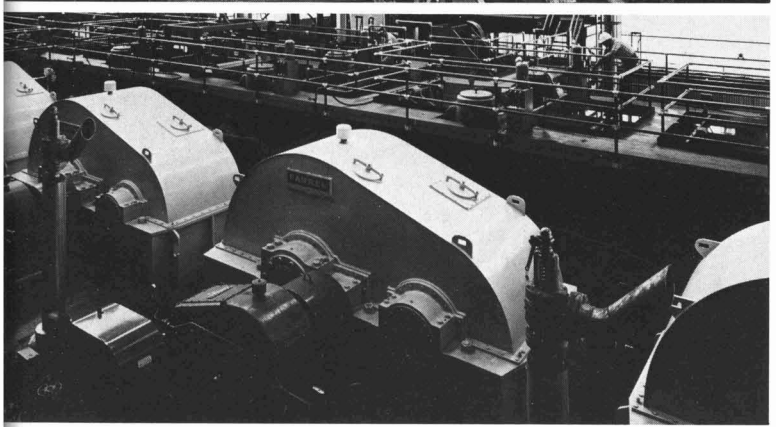
France 6, rue Auguste-Rodin - La Source B.P. 6049 - 45800 Orléans Cédex. Tél. (38) 63.20.74. Télex Chambon 760 763 F
Great Britain Riverside Works, Standish Road Hammersmith - London W.6. 9 AN. Tel. 748.60.86. Telex 261476
U.S.A. 24 North Third Avenue, Highland Park, New Jersey 08904. Tel. (201) 846 8010. Telex 0844445
Brazil Rua Mariz E Barros, 437 Porto Alegre RS. Tel. 243.35.80 - 31.84.21

Do it right with Farrel mill drives.

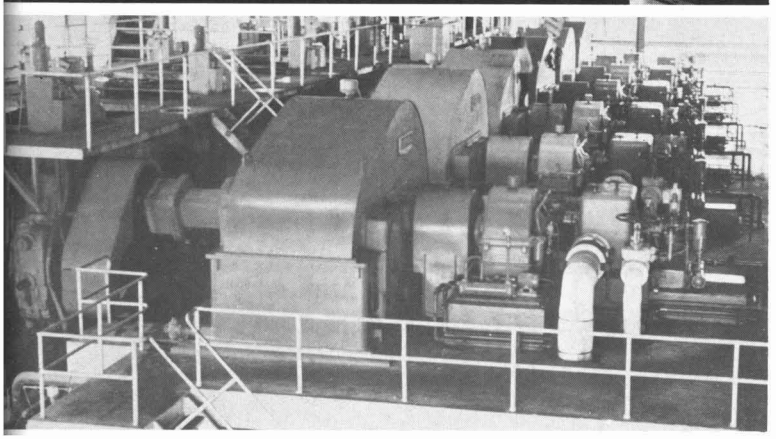
For converting from steam engine to turbine drive — adding capacity — or new construction — Farrel sugar mill drives improve operating efficiency; give you more years of reliable service per dollar of investment.



CONVERSION:
At United States Sugar Corporation, Clewiston, Florida, a mill tandem originally installed in the mid-1920's, was converted from steam engines to individual turbine drives by Farrel. Each turbine drives a Farrel high-speed reducer, intermediate-speed reducer, and the original Farrel low-speed spur gearing.



EXPANSION:
A 15-roll Farrel cane grinding unit with totally enclosed turbine drive was installed in 1974 at Belle Glade, Florida, for the Sugar Cane Growers Cooperative of Florida. This mill complements the original Farrel tandem installed in 1964 and expanded to 7 mills. All 12 individual turbine drives consist of high speed DR-39 and low speed DRB-4571 Farrel reducers. The two tandems have a combined capacity of up to 20,000 short tons of cane per day.



NEW CONSTRUCTION:
An 18-roll Farrel cane grinding unit with totally enclosed turbine drives was selected by Elizalde and Company and was installed at La Carlota/La Castellana, Negros Occidental, Philippines. This 40" x 84" milling tandem is adjacent to the older La Carlota factory and has a capacity exceeding the three tandems of La Carlota. Here also the gearing between turbines and mill rolls is two double reduction units, size DRB-4571 for the slow speed and DR-39 for the high speed.

For more information on how you can improve operating efficiency, write Farrel Company, Ansonia, CT 06401.

FARREL

Better ways to make things better.

An **EMHART** Unit


Sugar cane producers around the world are harvesting greater profits with ETHREL® Plant Growth Regulator. That's because ETHREL Plant Growth Regulator increases the sugar content of the cane by up to 15%.
But ETHREL Plant Growth Regulator does a lot more.
ETHREL improves juice purity. And that means less molasses and better mill efficiency. ETHREL improves the burn, so there's less trash in the field. And flowering can be inhibited to reduce dry, pithy upper internodes.
Timely applications of ETHREL Plant Growth Regulator also mean improved harvest schedules and improved milling operations. More sugar can be obtained earlier in the harvest campaign, and staggered applications can reduce mill load during normal peak periods.
ETHREL also extends the optimum harvest period and that means more sugar per hectare on more hectares.
Ask your supplier for ETHREL Plant Growth Regulator. It can help nature help you do a more efficient job producing sugar. And help you make a lot more profit doing it.
ETHREL Plant Growth Regulator should be used in accordance with label directions and only on those crops registered for its use.
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Subsidiary of Union Carbide Corporation
Ethrel®
Helps nature help you.
ETHREL® helps you get more sucrose from your cane.

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Tel.: (415) 653-2122.

NOTES AND COMMENTS

International Sugar Agreement

The price conditions referred to in Article 41, paragraph 2 of the Agreement were met on 19th April 1978 (i.e. a price below 11·00 cents/lb for 75 consecutive market days) and, as a result, the quota cut of 2·5% envisaged in paragraphs 2 and 4 of the article became operative on the 24th April.

Under paragraph 3 of the article, however, the full cut in quota does not apply to those countries whose average net exports in 1974–76 amounted to at least 60% of their average production in those years, and the quotas in effect of Australia, the Dominican Republic and Thailand (which fall into this category) remain at 85% of Basic Export Tonnages. The refused cut for these countries is shared among the other exporting members in proportion but with a maximum of a further 1% of B.E.T. As the 2·5% cut for the three countries is more than 1% of the B.E.T. of the remaining members it is this maximum which applies and the quotas in effect have thus been reduced to 81·5% of B.E.T. The figures now applying are as follows:

	Basic export tonnages	*Quotas in effect (81·5% of B.E.T)*
	—— *tonnes, raw value* ——	
Argentina	450,000	366,750
Australia	2,350,000	1,997,500*
Bolivia	90,000	73,350
Brazil	2,350,000	1,915,250
Costa Rica	105,000	85,575
Cuba	2,500,000	2,037,500
Dominican Republic	1,100,000	935,000*
Ecuador	80,000	70,000†
Fiji	125,000	101,875
Guatemala	300,000	244,500
Guyana	145,000	118,175
India	825,000	672,375
Jamaica	130,000	105,950
Mauritius	175,000	142,625
Mexico	75,000	70,000†
Mozambique	100,000	81,500
Nicaragua	125,000	101,875
Panama	90,000	73,350
Peru	350,000	285,250
Philippines	1,400,000	1,141,000
El Salvador	145,000	118,175
South Africa	875,000	713,125
Swaziland	105,000	85,575
Thailand	1,200,000	1,020,000*
Trinidad	85,000	70,000†
	15,275,000	12,626,275

It has been reported[1] that the Special Hardship Reserve Committee has recommended the allocation of 70,000 tonnes of additional export entitlements from the special hardship reserves. Although it has not been said which countries would benefit from the allocations, it is assumed that they will go to either Panama or Guyana or both because these are the only two countries to have applied for an allocation. The Hardship Committee is to meet again in late July when it will decide on further allocations from the remaining 130,000 tonnes of the 200,000 tonnes reserve.

World sugar prices

During the month of April there was little movement in the London Daily Prices for raw and white sugar, the LDP moving within a range of £98·50 and £104 per tonne while starting the month at £102 and ending at £101·50. The LDP(W) moved in the range £103–£110, starting the month at £106 and ending at £109 per tonne. There was some easing of the market at the beginning of the month with rumours of sales by the USSR and authorization of sales by India. Talk of renewed purchases by US refiners brought some recovery but the greatest influence was that of purchases of white sugar by Iran towards the end of the month.

US sugar policy

As reported earlier[2], the International Trade Commission announced initially that it had concluded from its hearing that imports of foreign raw sugar were damaging the domestic sugar industry and on the 18th April sent its report to President Carter, recommending that import fees on such sugar should be increased from the present emergency level of 2·71 cents per pound to 3·6 cents per pound but not to exceed 50% ad valorem[3]. The Commission proposed that a limit of 40,000 short tons per annum be placed on imported refined sugar.

Another recommendation was that, if the import fees were not sufficiently high as to permit the domestic price support level of 13·5 cents/lb to be sustained, the President should establish a quantitative limit on sugar imports, with two Commissioners recommending that quotas be introduced if the fee system proved inadequate. (Quotas of 3·1 million tons for 1978 and 4,275,000 tons for subsequent years were recommended.) Quotas would be triggered if, for a period of 20 consecutive calendar days, the simple average price of sugar, as determined by the Secretary of Agriculture and expressed in terms of 96° sugar, should be 1% or more below the price support level. With the exception of one member, the Commission recommended that quotas be allocated on a country-by-country basis.

The Senate Agriculture Committee was meanwhile engaged on drafting sugar legislation which, while retaining the full commitment of the USA to the International Sugar Agreement, would provide a protective mechanism in case the Agreement did not perform as expected. A draft programme was introduced by Senator Frank Church of Idaho[4] and has the aim of achieving a price of about 17 cents/lb, with the President determining the level of domestic consumption and setting a variable fee equal to the difference between the price objective and the prevailing free market price[5]. If the raw sugar price for 20 consecutive market days was 5% or more below the price objective, the President would be able to limit imports, while he could raise quotas if domestic sugar production fell below desired levels. The draft does not specify whether quotas would be on a country-by-country basis or not.

The sugar refining industry is dissatisfied with the proposals and is opposed to the provision to support domestic prices at 17 cents/lb; they are to submit proposals of their own to the President. Various other groups favour floor prices between 14·5 and 17·5 cents/lb, the US Dept. of Agriculture apparently preferring 15·5 cents/lb. If such a proposal became law, with a

*85% of B.E.T. † subject to maximum reduction to 70,000 tonnes.

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (13), 13.
[2] *I.S.J.*, 1978, **80**, 130.
[3] *Lamborn*, 1978, **56**, 64.
[4] *ibid.*, 68.
[5] F.O. Licht, *International Sugar Rpt.*, 1978, **110**, (13), 22.

variable import fee, it would render ineffective the ITC recommendation for a fixed fee of 3·6 cents/lb.

India sugar stocks and sales

Sugar production from the current harvest started slowly but recovered during its first few months so that the end-February total was 3,395,000 tonnes, tel quel, or slightly above the corresponding figure for 1977. It is likely that earlier forecast output of 5,600,000 tonnes, raw value, could well prove pessimistic[1]. The Government reduced the levy on domestically consumed sugar at the end of March as a measure to stimulate consumption but sugar stocks have continued to rise.

At the end of February, stocks at 3,126,000 tonnes were 660,000 tonnes higher than the corresponding figure for 1977, while at the end of April the difference had risen to 1,400,000 tonnes (4·4 *vs.* 3 million tonnes). This mounting stock induced the country to enter the market as a seller in mid-April and the Government-owned State Trading Corporation was authorized to offer up to 300,000 tonnes for shipment from May onwards as part of a 650,000 tonnes target for the period April 1978–March 1979. Initial bids were all rejected as too low, which had a firming effect on the market, although five cargoes were sold later in the month, at $211.50 per tonne f.o.b. and stowed.

India's problem is that current market prices are much lower than her production cost of some $280 per tonne; since exports are controlled by the Government, the loss on exports must be borne by the exchequer.

New York spot price

On the 22nd February the New York Coffee and Sugar Exchange submitted proposals for a new procedure[1] for determining and publishing spot prices to be considered by the US Commodity Futures Trading Commission. The proposal would set spot prices as a differential above or below the settlement price for the nearby futures delivery month then trading. A panel would be selected at random from a group of experts from all major segments of the industry by an Exchange employee and would not be told what opinion other panel members had expressed. The panel members would furnish their opinions to the Exchange before the settlement price for the day was known.

The Commission announced that it received favourably the proposal but deferred action on it until some questions were resolved. The Commission's Vice-Chairman said that the action of the Justice Department, which had caused disbanding of the Exchange's spot price committees[2], had created massive problems in the operation of the International Sugar Agreement and the domestic price support programme mandated by the Farm Bill[3]. The Commission released a copy of a letter from the Assistant Secretary of State for Economic and Business Affairs saying that the Exchange's proposals appeared to be an equitable method of setting a world daily price for sugar that would be acceptable to members of the International Sugar Agreement.

A member of the Commission suggested that the letter supported the claim of urgency in re-establishing the spot prices and suggested that the Secretary of Agriculture be requested to convey his views on the need for the spot price committees to the Commission. The Justice Department, however, wrote to the Commission requesting that no action be taken on the Exchange's proposed rules for the spot price committees and claiming that there appears to be no need for emergency action on the proposal.

Europe beet areas, 1978

First estimates for sugar beet areas for the 1978/79 campaign were published by F. O. Licht KG recently[1]. The figures, with corresponding data for 1977 and 1976, are reproduced below:

	1978	1977	1976
		hectares	
West Europe			
Belgium	107,000	98,000	98,000
Denmark.....	75,000	83,900	83,000
France	527,000	575,000	575,000
Germany, West	410,000	433,477	449,329
Holland	131,000	134,000	138,966
Ireland.....	36,422	35,208	34,400
Italy	260,000	240,000	290,000
UK	206,400	203,000	203,000
Total EEC ...	*1,752,822*	*1,892,585*	*1,871,695*
Austria	45,000	55,977	56,070
Finland	30,000	30,270	27,200
Greece	43,500	44,000	47,200
Spain	218,000	243,457	265,000
Sweden	52,000	53,800	53,500
Switzerland ...	13,000	11,938	11,296
Turkey	275,000	249,566	248,325
Yugoslavia ...	142,578	118,434	100,889
Total West Europe ...	*2,571,900*	*2,610,027*	*2,681,175*
East Europe			
Albania	7,000	7,000	6,000
Bulgaria	78,000	75,000	72,600
Czechoslovakia	217,000	215,000	215,500
Germany, East	272,000	270,700	269,800
Hungary	125,000	113,000	128,386
Poland.....	580,000	532,000	555,000
Rumania	260,000	255,000	234,800
USSR	3,800,000	3,760,000	3,754,000
Total East Europe.....	5,339,000	5,227,700	5,236,086
Total Europe...	7,910,900	7,837,727	7,917,261

As may be seen, the reduction in West Europe will be only marginal (1·6%) while an actual increase is forecast for East Europe. Of course, in many countries sugar output is affected only slightly by low world prices because of price guarantees on the domestic market. In the EEC sugar produced against the A and B quotas enjoys guaranteed prices and it is only the C or over-quota sugar that must be sold on the world market. Four of the Nine produced C-sugar and it is these countries which account for the reduction in EEC beet areas.

In Austria, difficulty in disposing of excess production has led to a 20% fall in beet area, but Turkey and Yugoslavia are expanding areas to provide raw material for their increased production capacity. The East European countries are little affected by world sugar prices and the target figures given show small increases except for Bulgaria and the USSR where expansion programmes are under way. The targets may be revised as the season progresses, furthermore.

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (11), 14.
[2] *Public Ledger*, 21st February 1978.
[3] *I.S.J.*, 1978, **80**, 1.
[4] *Willett & Gray*, 1978, **102**, 68.
[5] *International Sugar Rpt.*, 1978, **110**, (8), 1–5.

Licht has calculated a likely range of production levels on the basis of the highest and lowest yields for each country during the past four years, and also on the average yield. These give outturns of 16,860,000, 12,790,000 and 14,748,000 tonnes, respectively, as against actual production of 16,556,000 tonnes in 1977/78. This indicates a production in 1978/79 probably less than last campaign but nevertheless more than required for consumption, so that Europe is likely to contribute to even higher surplus stocks next year.

World sugar production estimates

F. O. Licht KG recently published[1] their third estimates of world sugar production for 1977/78. So far as beet sugar is concerned, campaigns were ended some time ago and only very small adjustments have been made to the second estimates published earlier[2]. Details of East European crops are less easily forthcoming, however, and Licht now expects an increase of 100,000 tonnes for the East German crop while also reducing their figure for the USSR by 35,000 tonnes. For the whole of Europe, production is now expected to be 315,000 tonnes greater than the earlier forecast and 4,024,000 tonnes higher than 1976/77.

Reductions of 90,000 and 110,000 tonnes have been made in the estimates for Chile and Morocco while US beet sugar output is expected to be higher by 60,000 tonnes. The overall beet sugar production is now set 208,000 tonnes higher, at 36,552,000 tonnes, against 33,396,000 tonnes for 1976/77.

Thailand's expected crop is now set 221,000 lower than earlier, Cuba's 300,000 tonnes and South Africa's 104,000 tonnes lower. The Mexican crop forecast has been raised by 100,000 tonnes and that of Colombia by 75,000 tonnes. Other smaller adjustments bring the estimated cane sugar estimate to 55,897,000 tonnes—a reduction of 360,000 tonnes—and the world total to 92,449,000 tonnes against 87,737,000 tonnes in 1976/77.

South African sugar crop[3]

For the second year in succession, the South African sugar industry has had a record season. Sugar production for the 1977/78 season, which officially ended on the 30th April, was 2,083,867 tonnes, which exceeds the previous season's output by about 42,000 tonnes. The total cane crushed—19,009,030 tonnes—was more than 210,000 tonnes lower than for the previous season.

Comparative cane quality and factory performance data for the two seasons are as follows:

	1977/78	1976/77
Tonnes cane crushed per hour	221·40	211·84
Time efficiency, %	75·89	75·22
Pol % cane	12·83	12·43
Fibre % cane	15·79	15·52
ERC % pol in cane	84·89	84·33
Extraction, %	95·87	95·48
Boiling house recovery, %	88·62	88·99
Overall recovery, %	84·96	84·97
Mixed juice purity, %	84·39	84·47
Final molasses (85°Bx) % cane	3·83	3·60
Final molasses purity, %	38·31	38·23

Sugar factories with the best performance were Amatikulu (212,845 tonnes), Tongaat (211,398 tonnes), Sezela (204,341 tonnes) and Gledhow (157,357 tonnes).

After the big export drive in December, before the introduction ot the new International Sugar Agreement, the South African sugar industry has practically no export sugar in stock, but only sufficient sugar to supply the domestic market until the factories start production again, possibly from the middle of April.

An early estimate of the 1978/79 crop places it in the region once again of two million tonnes and the feeling, at this stage, is that there is not likely to be a cut in growers' quotas. Under the provisions of the International Sugar Agreement, South Africa is limited to exports totalling 680,593 tonnes; domestic sales are likely to be about 1,050,000 tonnes and, with a stockpile of 170,000 tonnes, most of the crop will be absorbed.

It is estimated that the stockpile of 170,000 tonnes will be worth about R 34 million at present prices and this stored sugar will be released only when the price reaches 19 US cents per pound. South Africa's contribution to the fund to finance stockpiles is estimated to be R 2 million a year.

Thailand sugar industry regulation[4]

Concerned about the oversupply of sugar to the world market and consequent low prices, the Thailand Government is reported to have decided to adopt a sugar policy which embraces the following: (1) No permission will be granted for the establishment of new factories during the five years of the Fourth Social and Economic Development Plan; (2) No permission will be granted for the change of location of factories from that already approved; (3) Expansion of factories in locations faced with pollution problems is prohibited; (4) Conditions and working schedules are to be set out so that the expansion or establishment of plants is completed within two years, where permission was granted prior to 1976, and within three years where permission was granted since 1976; (5) No expansion will be granted to factories already having permits for establishment; and (6) For small and low-efficiency factories established independently in the North and North-East, exemption will be granted allowing expansion of production capacity in steps.

More recently a new proposed draft bill has been submitted by the Industry Ministry to the legislative body for debate; it contains drastic changes aimed at controlling the country's sugar trade and calls for establishmen of a National Sugar Institute to be responsible for planning sugar production and distribution within Thailand and exports. The Institute is to be under the supervision of a proposed National Sugar Board which will be a policy-making body. The Board will be empowered to approve or turn down the establishment and expansion of sugar factories; fix sugar export measures and export fees; collect a production fee of 1 baht per kg of sugar produced to provide a Sugar Industrial Assistance Fund; rule on the duration of a sugar production period, quantities of cane crushed and sugar and by-products produced as well as the volume of distribution; set the minimum and maximum sugar production for each mill; control the quality, price and transport of sugar; and collect information on the amounts of sugar held and location of the stockpiles.

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[1] *International Sugar Rpt.*, 1978, **110**, (9), 1–5.
[2] *I.S.J.*, 1978, **80**, 95.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (12), 11–12.
[4] *ibid*, (1), 12.

Petrochemicals versus carbohydrate chemicals—An economic survey

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Introduction

UNTIL the end of the 2nd World War, the main feedstock for the chemical industry was coal, either via coal-tar or via coke and acetylene. Relatively small amounts of chemicals were made from carbohydrates such as molasses; they were mainly ethanol and simple derivatives like acetone or acetic acid. After the war, with the arrival of the petrochemical industry, mineral oil took over and it has now become virtually the only feedstock for the whole of the organic chemical industry. This development was made possible by the then relatively low price of oil, about £7/tonne.

Since the hey-day of the petrochemical industry in the 1960's, the price of oil has gone up by a factor of 8, while inflation during that period increased other prices only four-fold. In effect, oil has therefore doubled in value. It is a diminishing commodity and, as such, is certain to become more and more expensive, in line with the laws of supply and demand. Carbohydrates, on the other hand, are annual crops, less likely to be similarly affected and therefore it can be expected that they will become progressively more attractive as chemical feedstock.

Range of products

(*a*) Petrochemicals. The petrochemical industry is based on steam-crackers in which a fraction of mineral oil, called naphtha, is "cracked" to simpler compounds. The main chemical products (in addition to fuels and petrol) from a cracker comprise hydrogen, methane, ethylene, propylene, butenes and butadiene. Aromatic compounds can be extracted from petrol, and it is therefore possible to synthesize every organic compound from mineral oil, usually by a number of different routes. The wide range of petrochemicals was admirably summarized in R. F. Goldstein & A. L. Waddams' book, "The Petrochemical Industry" and need not be further elaborated.

(*b*) Carbohydrates. Carbohydrates such as sugar are almost as versatile a chemical feedstock as cracked hydrocarbons. While sugar has not yet been "cracked", it can readily be fermented to ethanol. In Fig. 1 the wide range of ethanol derivatives is illustrated, though only about 100 of the more obvious compounds are shown. All these can be synthesized by well known and established methods, and their adoption will depend only on the economic position and not on chemical know-how. In addition to these ethanol derivatives, many other compounds can be produced from sugar directly, (see for instance "Sweets for starters", by A. G. Vlitos, in *Chem. in Britain*, Sept. 1977), but these are not included in Fig. 1.

The four main derivatives of ethanol, i.e. acetaldehyde, acetone, acetic acid and ethylene, are the key products. In Fig. 1, the direct derivatives of ethanol, such as ether, are shown on the left, ethylene derivatives are on the right, those of acetone on the top and acetaldehyde on the bottom when the diagram is in normal position.

It is outside the scope of this article to go into detail regarding either the production routes or use of these products. All those listed can be made by well-established processes; some of these are currently in disuse for economic reasons (e.g. acetone from ethanol). The most significant absence from Fig. 1 is the group including benzene and other aromatics; while aromatization of aliphatics is possible, this is unlikely to be required for a considerable time.

Scale of operation

Production of heavy organic chemicals is capital-intensive and therefore very sensitive to the scale of operation. The largest current petrochemical units produce very approximately about 500,000 tonnes/annum of ethylene, 350,000 $t.a^{-1}$ of propylene, 240,000 $t.a^{-1}$ of C-4 aliphatics and 60,000 $t.a^{-1}$ of hydrogen and methane, i.e. a total of 1,150,000 $t.a^{-1}$ of chemicals. (The other half of the output comprises fuels and gasoline.) In order to compete successfully, carbohydrate chemicals would have to be produced on a comparable scale. If the source of carbohydrate was sugar cane, how much land and crops would this require?

The overall yield of refined ethanol from sucrose is about 82% of theory. The yield of total sucrose per acre is about 4 tonnes; therefore, 0·563 acres are required per tonne of ethanol. For the above scale of operation, i.e. 1,150,000 tonnes of chemicals, an area of 1000 square miles (equivalent in size to the county of Dorset in England) would be required, yielding 2·6 million tonnes of sucrose. It is obvious that such a development would be out of the question for densely populated Western European countries, even if the climate were suitable for the above mentioned carbohydrate rate of growth. (Beet sugar gives a lower yield per acre.)

However, in other parts of the world such developments are not impossible. Cuba, for instance, can grow 6 million tonnes of sugar per year. If half of this were fermented, it would give 1,300,000 tonnes of alcohol, the chemical equivalent of about one 500,000 $t.a^{-1}$ cracker. Brazil in particular, with her 3,300,000 sq. miles (35 times the area of the UK, but less than twice her population), and with a suitable climate, may find the space to satisfy all her chemical and fuel requirements from carbohydrates, and developments on these lines are taking place at the moment.

Large-scale operation

A possible product distribution from an arable area of 1000 square miles is illustrated in Fig. 2. Table I gives the products, the amount of ethanol required per 100 parts of product, and the total ethanol.

An attempt will now be made to equate this output of 1000 square miles and 2,600,000 $t.a^{-1}$ of sucrose with petrochemicals.

Table II gives the ethylene equivalent of the above-mentioned products. (This will give only an approximate equivalent, because some of the products, acetic acid

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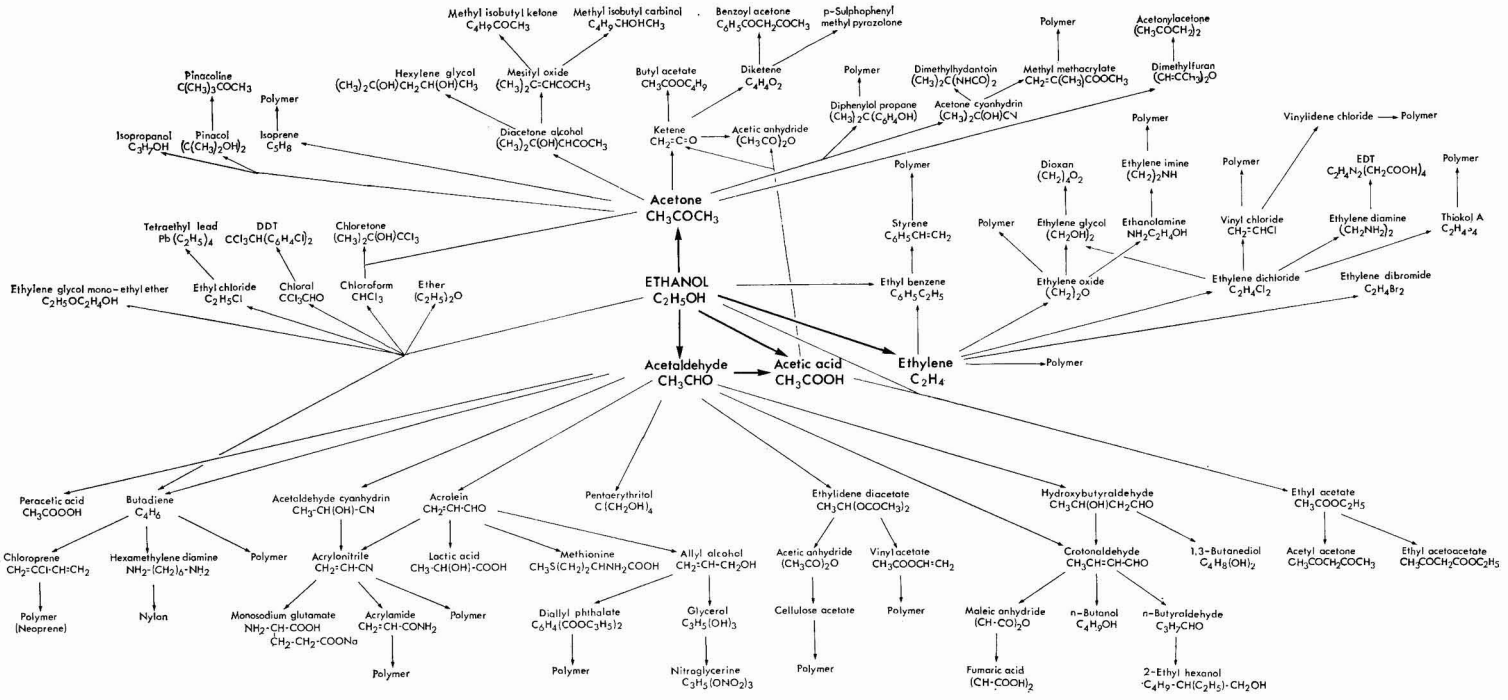

Methyl isobutyl ketone C4H9COCH3
Methyl isobutyl carbinol C4H9CHOHCH3
Benzoyl acetone C6H5COCH2COCH3
p-Sulphophenyl methyl pyrazolone
Polymer
Acetonylacetone (CH3COCH2)2
Pinacoline C(CH3)3COCH3
Hexylene glycol (CH3)2C(OH)CH2CH(OH)CH3
Mesityl oxide (CH3)2C=CHCOCH3
Butyl acetate CH3COOC4H9
Diketene C4H4O2
Polymer
Dimethylhydantoin (CH3)2C(NHCO)2
Methyl methacrylate CH2=C(CH3)COOCH3
Dimethylfuran (CH=CCH3)2O
Polymer
Diphenylol propane (CH3)2C(C6H4OH)
Acetone cyanhydrin (CH3)2C(OH)CN
Isopropanol C3H7OH
Pinacol (C(CH3)2OH)2
Isoprene C5H8
Diacetone alcohol (CH3)2C(OH)CH2COCH3
Ketene CH2=C=O
Acetic anhydride (CH3CO)2O
Polymer
Vinylidene chloride → Polymer
Polymer
Dioxan (CH2)4O2
Ethylene imine (CH2)2NH
Polymer
EDT C2H4N2(CH2COOH)4
Polymer
Acetone CH3COCH3
Styrene C6H5CH=CH2
Polymer
Vinyl chloride CH2=CHCl
Ethylene diamine (CH2NH2)2
Thiokol A C2H4-S4
Tetraethyl lead Pb(C2H5)4
DDT CCl3CH(C6H4Cl)2
Chloretone (CH3)2C(OH)CCl3
Polymer
Ethylene glycol (CH2OH)2
Ethanolamine NH2C2H4OH
Ethylene glycol mono-ethyl ether C2H5OC2H4OH
Ethyl chloride C2H5Cl
Chloral CCl3CHO
Chloroform CHCl3
Ether (C2H5)2O
ETHANOL C2H5OH
Ethyl benzene C6H5C2H5
Ethylene oxide (CH2)2O
Ethylene dichloride C2H4Cl2
Ethylene dibromide C2H4Br2
Acetaldehyde CH3CHO
Acetic acid CH3COOH
Ethylene C2H4
Polymer
Peracetic acid CH3COOOH
Butadiene C4H6
Acetaldehyde cyanhydrin CH3-CH(OH)-CN
Acrolein CH2=CH-CHO
Pentaerythritol C(CH2OH)4
Ethylidene diacetate CH3CH(OCOCH3)2
Hydroxybutyraldehyde CH3CH(OH)CH2CHO
Ethyl acetate CH3COOC2H5
Chloroprene CH2=CCl-CH=CH2
Hexamethylene diamine NH2-(CH2)6-NH2
Polymer
Acrylonitrile CH2=CH-CN
Lactic acid CH3-CH(OH)-COOH
Methionine CH3S(CH2)2CHNH2COOH
Allyl alcohol CH2=CH-CH2OH
Acetic anhydride (CH3CO)2O
Vinyl acetate CH3COOCH=CH2
Crotonaldehyde CH3CH=CH-CHO
1,3-Butanediol C4H8(OH)2
Acetyl acetone CH3COCH2COCH3
Ethyl acetoacetate CH3COCH2COOC2H5
Polymer (Neoprene)
Nylon
Monosodium glutamate NH2-CH-COOH CH2-CH2-COONa
Acrylamide CH2=CH-CONH2
Polymer
Polymer
Diallyl phthalate C6H4(COOC3H5)2
Glycerol C3H5(OH)3
Nitroglycerine C3H5(ONO2)3
Polymer
Cellulose acetate
Polymer
Maleic anhydride (CH-CO)2O
n-Butanol C4H9OH
n-Butyraldehyde C3H7CHO
Fumaric acid (CH-COOH)2
2-Ethyl hexanol C4H9-CH(C2H5)-CH2OH

Fig. 1

for instance, are not usually made from ethylene but by alternative routes.)

This shows that the 2,600,000 tonnes of sucrose are equivalent to 714,000 tonnes of ethylene, or that about 3·6 as much sucrose feedstock would be required as ethylene. Comparing feedstock cost only, and ignoring capital and other charges, ethylene may therefore cost 3·6 times as much as sucrose (as raw juice) for the two feedstocks to break even. This ratio will vary somewhat for different product distributions.

Hence, if ethylene was available at £200/tonne, sucrose (as raw juice) would have to be £55/tonne or less to make it more economical, from a purely feedstock point of view.

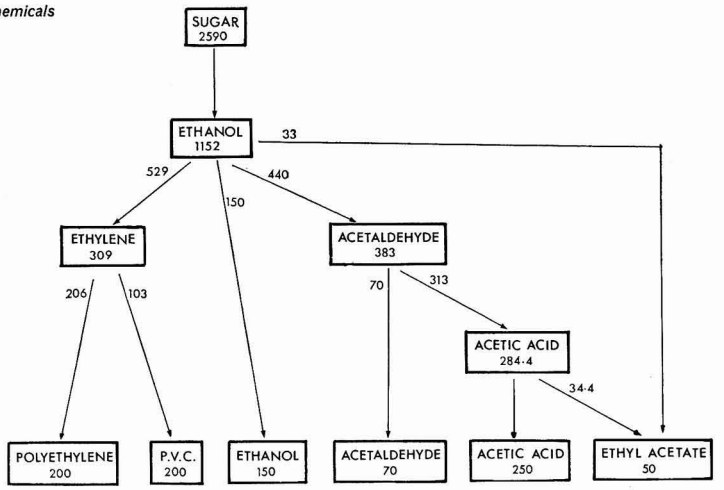


Fig. 2.

Table I. Products from 1000 square miles

Name	Amount, t.a^{-1}	Ethanol required per 100 parts	Total ethanol required, t.a^{-1}
Polyethylene	200,000	176·1	352,200
P.V.C.....	200,000	88	176,000
Acetic acid	250,000	126·5	316,300
Acetaldehyde ...	70,000	115	80,500
Ethyl acetate	50,000	154	77,000
Ethanol	150,000	100	150,000
	920,000		1,152,000

Table II. Ethylene equivalent

Name	Amount, t.a^{-1}	Ethylene equivalent per 100 parts	Total ethylene, t.a^{-1}
Polyethylene	200,000	103	206,000
P.V.C.	200,000	51·5	103,000
Acetic acid	250,000	82	205,000
Acetaldehyde ...	70,000	74·7	52,300
Ethyl acetate	50,000	100·1	50,100
Ethanol	150,000	65	97,500
			714,000

Small-scale operation

Even if the amount of sucrose available is much smaller than for the above scheme, profitable chemical production is still possible. On a small scale, conversion of ethanol to ethylene would not be economical because of the large size of ethylene-user plants, such as polyethylene. However simpler schemes, like that outlined in Fig. 3, are feasible. For this an availability of 100,000 t.a^{-1} of sucrose (as sugar juice) plus another 100,000 t.a^{-1} of molasses is assumed. The yield of ethanol would then be as follows:

From 100,000 tonnes of sucrose	44,400 tonnes
From 100,000 tonnes of molasses	21,600 tonnes
Total ethanol.....	66,000 tonnes
This could be converted to the following products:	
Ethanol	25,000 tonnes
Acetaldehyde	12,000 tonnes
Acetic anhydride	20,000 tonnes
	57,000 tonnes

Acetic anhydride is included because of its use for cellulose acetate production. Cellulose acetate requires cotton linters and many countries have climates suitable for growing both cotton and sugar cane.

The ethylene equivalent of the above 57,000 tonnes of products is about 43,000 tonnes. The sucrose requirements (assuming 50% in molasses) amount to 150,000 tonnes. The feedstock ratio of sucrose to ethylene is therefore 3·5, similar to that of the large-scale scheme.

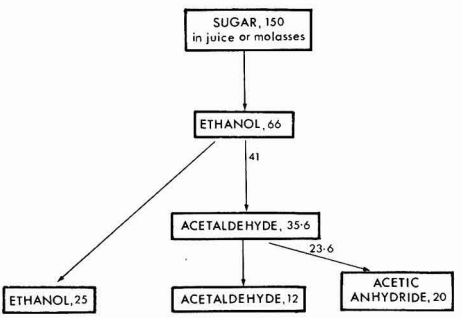


Fig. 3.

Economics of small-scale operation

An attempt has been made to determine the economics of such a scheme, expressed as a percentage return on investment. Naturally, local conditions may introduce wide variations on the data quoted, which refer to a developing country in the sugar belt.

Capital cost. The capital cost of a combined 66,000 t.a^{-1} distillery plus smaller acetaldehyde and acetic anhydride plants will depend very much on the available infra-structure and general facilities such as roads, harbours, housing, etc. If the bulk of these were available, then such a complex might cost £15 million for the plant, £4 million for the offsites, and £2 million for the working capital, making a total investment of some £21 million ($40 million).

Operating costs. These are summarized in Table III and the following comments apply:

Feedstock. This is the main cost item and it is made up of the cost of the raw sugar juice and of molasses. The cost of the raw juice will depend on the cost of land, labour, fertilization, irrigation and handling. No refining or purification of the juice is required. For instance, if the cost of land is £650 per acre, at a yield of 4 tonnes per acre and with money available at 12%, the annual cost of land would be equivalent to £20/tonne sucrose. For this costing, the value of the crude juice (but excluding any profit) is estimated at £60/tonne. The value of 50% molasses is therefore £30/tonne. This agrees well with the £40/tonne quotation of molasses in London, allowing £10/tonne for transport to London.

Steam and other utilities. Part of the steam can be generated by burning bagasse (6·3 tonnes of steam can be made from the bagasse equivalent to 1 tonne of sugar); other fuels are required for the excess demand. The total variable cost amounts to £9·9 million per annum.

Fixed costs. Direct labour requirements are estimated at 15 men/shift (4 shift system) at £2500 per man, plus £50,000 for supervision. Maintenance and overheads are each estimated at £800,000. Depreciation is charged at 10% for the plant and 5% for the offsites.

Total production cost amounts to £13·4 million per year.

Table III. Economics of small-scale operation

Capacity: 57,000 $t.a^{-1}$ of chemicals (excl. by-products)

Capital	*£ million*
Plant	15
Offsites	4
Working capital	2
Total investment	21
Operating cost	*£ million/annum*
Feedstock:	
100,000 tonnes of sucrose as raw juice at £60/tonne	6·0
100,000 tonnes of molasses at £30/tonne	3·0
Total feedstock	9·0
Utilities and chemicals	0·9
Total variables	9·9
Direct labour, 15 man/shift (60 total) plus supervision	0·2
Maintenance	0·8
Overheads	0·8
Depreciation: 10% on plant, 5% on offsides	1·7
Total production cost	13·4
Net income from sales	16·0
Minus production cost	13·4
Margin	2·6
Therefore, return on investment	12%

Income from sales. Table IV quotes typical current international prices for these chemicals, and also gives the total income derived from these sales. The price of ethanol assumed, i.e. £265/tonne, is below the UK price of the cheapest fermentation alcohol which is about £290/tonne. It is also below petrochemical alcohol which is quoted at £270/tonne. The hydrogen by-product from acetaldehyde production is valued at £500/tonne; it can be used for the production of margarine and soaps or for welding. The CO_2 by-product from fermentation and the distillation residue are not given any value, although the former can be used for sugar refining and the latter as cattle-feed.

Return on investment

The net income from sales amounts to £16 million. If the production cost of £13·4 million is deducted, a margin of £2·6 million per year is obtained. This is equivalent to a return of 12% on the investment. This profit margin, calculated for current conditions, is low. However, a project of this type would take at least 4 years to realization, and by that time conditions will have changed, owing to the increasing scarcity value of oil. The implications of this are discussed below.

Table IV. Income from sales

Name	$t.a^{-1}$	*Sales price £/tonne*	*Income £/a*
Ethanol	25,000	265	6,630,000
Acetaldehyde	12,000	275	3,300,000
Acetic anhydride	20,000	320	6,400 000
Hydrogen	500	500	250,000
Gross income from sales			16,580,000
Cost of sales, say			580,000
Net income from sales			16,000,000

Discussion

It has been shown that the above small-scale chemical project at present gives a return in investment of 12%. This is probably not acceptable to commercial investors, who are looking for 25% or more. However, if the inflationary trend over the last 15 years continues, one would expect 42% return in 5 years' time. The compound inflation rate over these past 15 years, including the inflation of the price of sugar, was about 9·5% per year. The inflation rate for petrochemicals feedstock, however, was 15% per year (UK conditions), and the value of chemical products is based directly on the price of the petrochemical feedstock. Assuming that this trend continues for the next 5 years, and that the capital cost of the plant is paid in 3 years, the position in 5 years from now will then be:

Historical investment in plant	£27,600,000
Net income from sales	£32,400,000
Production cost	£20,700,000
Margin	£11,700,000

This gives a return on investment of 42%, and subsequent years are likely to continue to give increased returns. Petrochemicals suffer not only from a higher rate of inflation than carbohydrate chemicals, but they are also subject to the following disadvantages:

(*a*) Crackers give a wide range of products within narrow ratios, irrespective of market demands.

A typical example of such an imbalance was the butadiene supply and demand position. A few years ago, when there was a strong demand for ethylene, the excess butadiene output had to be burned. Lately, ethylene demand has been slack and the butadiene market could not be fully satisfied. With carbohydrates as feedstock, each product can be produced separately, with an output adjustable to demand.

(*b*) The investment required for petrochemical production is very large. To start with, a refinery is needed for the supply of naphtha, or a gas-gathering system if gases are to be cracked. A 500,000 $t.a^{-1}$ ethylene cracker requires about 25% of the output of a typical 10 million tonne refinery. A cracker is, of course, essential and the cost of a 500,000 $t.a^{-1}$ unit is of the order of £150 million. Finally, numerous user plants for the cracker products are needed. A petrochemical complex of this type costs over £500 million. Compared with this investment, distilleries are relatively cheap.

(*c*) The scale of petrochemical production must be large; it is doubtful whether crackers with an output much below 500,000 $t.a^{-1}$ could now be competitive. Distilleries on the other hand can be economical at much smaller capacities and 20,000 $t.a^{-1}$ units are still in operation.

(*d*) The technology of distilleries and ethanol derivatives is relatively simple compared with that of large crackers. The building, commissioning and operation of petrochemical plants require technological competence of a very advanced order.

The above disadvantages of petrochemical production make a chemical industry based on alternative carbohydrates particularly attractive for developing countries. Many developing countries have climates suitable for intense carbohydrate cultivation. Their technical skill will be adequate for the simpler technology of distillation. The amount of investment required will be tens rather than hundreds of millions of pounds. They will not suffer from competition from most industrial countries, which have neither the climate nor the space for growing the large amounts of carbohydrates required, but will have the field for themselves.

Some chemicals, particularly ethanol and acetone can be used as fuel in cars, and their general adoption for this purpose only awaits the right economic conditions. As soon as ethanol is cheaper than petrol (gasoline), then there will be a virtually unlimited market for these carbohydrate derivatives.

Conclusions

It has been shown that carbohydrates via fermentation-ethanol are almost as versatile a chemical feedstock as cracked hydrocarbons. The exceptions are benzene and other aromatics, which could not economically be synthesized for the time being.

The cultivated areas equivalent to the chemical output of one 500,000 $t.a^{-1}$ ethylene cracker is about 1000 square miles, based on sugar cane cultivation. Western European countries and Japan have neither the space nor the climate to make indigenous large-scale production of carbohydrate chemicals a realistic proposition. In other less densely populated and warmer countries such as South America and Africa, carbohydrates will soon become a viable alternative to petrochemicals.

Two schemes were briefly considered: a large scheme, producing over 1 million tonnes of ethanol. On this scale, dehydration of ethanol to ethylene is economical and the products may include P.V.C. and polyethylene. A smaller scheme with 66,000 $t.a^{-1}$ of ethanol, producing simple, direct ethanol derivatives, was cost-estimated. A return of 12% on investment was calculated for current conditions, but if the inflation-trends of the last 15 years continue, one could expect the return to increase to over 40% in 5 years' time.

A chemical industry based on carbohydrates appears to be particularly suitable for developing countries. It requires less investment and less technical skill than petrochemicals, and there would be no competition from most industrial countries.

The potential use of ethanol as a motor-car fuel ensures an almost unlimited market.

Summary

Carbohydrates are almost as versatile a chemical feedstock as cracked hydrocarbons such as ethylene. Countries with adequate arable areas and a suitable climate may soon find that carbohydrates are a more economical raw material for their chemical industry than mineral oil. It is expected that in about 5 years' time, chemical projects based on crops like sugar will be very attractive economically, owing to the ever-increasing scarcity value of oil.

Les produits pétrochimiques par rapport aux produits chimiques à base d'hydrates de carbone. Un aperçu économique

Les hydrates de carbone constituent une source de produits chimiques aux possibilités presque aussi variées que les hydrocarbures de cracking, tels que l'éthylène. Les pays qui disposent de superficies arables suffisantes et un climat approprié, pourraient constater bientôt que les hydrates de carbone constituent une matière première plus économique, pour leur industrie chimique, que l'huile minérale. On s'attend à ce que, d'ici cinq ans environ, des projets chimiques basés sur des produits tels que le sucre, seront économiquement tres attrayants du fait du cout croissant du pétrole.

Petroprodukte und Kohlenhydrate—ein ökonomischer Vergleich

Kohlenhydrate sind ein fast ebenso vielseitiges chemisches Ausgangsprodukt wie gekrackte Kohlenwasserstoffe, z.B. Äthylen. Länder mit genügend anbaufähigen Gebieten und einem geeigneten Klima werden bald feststellen, dass Kohlenhydrate ein wirtschaftlicheres Rohmaterial für ihre chemische Industrie sind als Mineralöl. Man erwartet, dass in ungefähr fünf Jahren chemische Verfahren, die auf natürlichen Ausgangsprodukten wie Zucker basieren, wegen der ständig steigende Ölpreise, wirtschaftlich interessant sein werden.

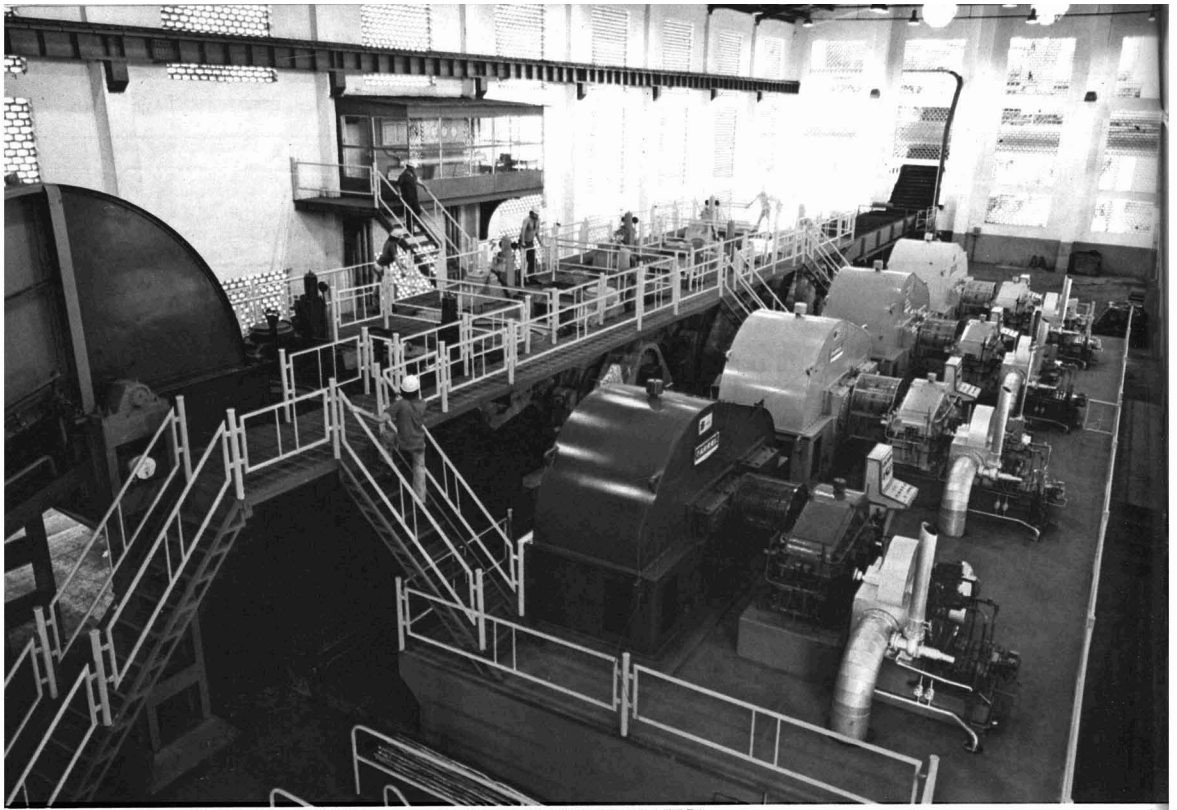
Petroquímicas contra químicas de carbohidratos. Un examen económico

Carbohidratos son una material prima casi tan versátil como hidrocarburos fraccionado por calor, por ejemplo etileno. Paises con adecuadas áreas arables y una clima conveniente pueden descubrir en pocos años que en carbohidratos existe una materia prima más económica para su industrias químicas que petróleo. El autor espera que, en cinco años, proyectos químicos basado en cosechas como azúcar seran económicamente muy atractivo como resulta del costo siempre creciendo de petróleo.

Czechs plan to increase sugar beet production.—Traditionally a sugar exporting country, Czechoslovakia plans to raise production of sugar beet from the 8,270,000 tonnes of 1977/78 to 8,400,000 tonnes next campaign.

Fiji sugar expansion[1].—A programme of expansion is under way in Fiji at a cost of not less than $7,700,000 whereby aggregate crushing capacity of the four factories will be raised from 630 to 800 tonnes of cane per hour. Modernization will also be included, with replacement of out-of-date centrifugals, steam engines, etc. Two major bulk storage and loading installations are also to be built at Malau and Lautoka at an estimated cost of $10 million each.

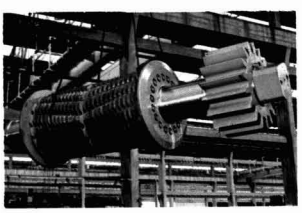
[1] Karan: *Fiji Sugar*, 1978, **3**, (1), 15–17.



Trapiches Zanini-Farrel 42" x 84" - Usina São Martinho - trapiches con 4 molinos - 8000 TCD - 12% FIBRA

Fator

Solamente quien fabrica el mejor trapiche del mundo puede transformar su ingenio en un moderno central azucarero.



En el ramo azucarero, así como en cualquier otro, un buen equipo es de vital importancia para la obtención de un mejor resultado final. Cada pieza, cada equipo influye en el funcionamiento, pero sucede muy a menudo que un buen equipo no puede alcanzar los resultados deseados, debido a una falta de armonía del conjunto en general.

Es por eso que Zanini no solamente fabrica el mejor trapiche del mundo, como también ejecuta proyectos completos para centrales azucareros. La calidad Zanini está siempre presente, para mejor seguridad del central azucarero y mayor tranquilidad del cliente, desde la fabricación del equipo hasta la indispensable asistencia técnica después de la instalación.

Y esta eficiencia es garantizada por el alto nivel tecnológico conseguido

a través de una asociación que reunió en una única fuente, la experiencia, la tradición y el "know-how" de Zanini y Farrel.

Por lo tanto, cuando Ud. piense en trapiches o en un gran proyecto de producción de azúcar, diríjase a aquel que tenga condiciones de suministrar no sólo el mejor equipo, como también la mejor solución para la coordinación global de su proyecto. Diríjase a Zanini.

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

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30" x 60"	37" x 78"	44" x 96"
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Polar lipid composition of sugar cane (*Saccharum officinarum*) leaves

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Introduction

THE leaf lipids, in general, consist of both polar and non-polar components of which galacto- and phospholipids are known to play an outstanding role in the structural organization of the photosynthetic apparatus[1,2]. In view of the importance of these lipids in leaves for photosynthesis, a detailed study on their fractionation and identification in sugar cane, which is one of the most efficient of C-4 plants for the production of carbohydrates, was undertaken.

Materials and methods

Leaves of CoJ 67, a mid-season cane variety, were collected in November 1976 from the crop raised at the farms of the Plant Breeding Department, Punjab Agricultural University, Ludhiana. Ten plants were selected at random. The upper three leaves, together with leaf sheaths, were removed from each plant. Midribs were removed from the green leaves. Requisite amounts of the samples were drawn from thoroughly mixed leaf sheaths (LS), midribs (M) and leaves without midribs (LWM). The leaves were thoroughly washed before use for analysis. Total lipids were extracted by the method of Bligh & Dyer[3]. The separation of whole-leaf polar lipid fractions into various classes and their identification were carried out by the methods described by Sukhija & Bhatia[4]. To confirm the structure, galactolipid fractions were separated from total lipids by a column chromatographic technique followed by acetone precipitation as reported by Sastry & Kates[5] and were analysed for reducing sugar, glycerol and ester contents[6,7].

Results and discussion

The total lipid content of the M, LS and LWM samples is presented in Table I. Since it was found to be maximum in LWM followed by M and LS, it appears that the lipids are associated with the chlorophyll of the leaves; the M and LS samples were not as green as were the LWM. The ratio of polar to non-polar lipids indicated that the amount of polar lipids in LWM was appreciably higher than that in either M or LS. This observation further confirms that the polar lipids are associated with the chloroplast membranes of LWM and M.

Table I. Total lipids and ratio of polar:non-polar lipids of sugar cane leaves*

	Total lipids, %	*Ratio of polar:non-polar*
Leaves without midrib (LWM)	3·2	3·6
Midribs (M)	3·1	2·4
Leaf sheaths (LS)	2·3	1·8

* Each figure is an average of five determinations

The data on fatty acid composition of the polar and non-polar lipid fractions from sugar cane leaves are given in Table II. Palmitic acid (16:0) was the most predominant fatty acid in both polar and non-polar lipid fractions of LWM. Among the unsaturated fatty acids, linoleic acid (18:2) was present in the highest concentration in LWM non-polar lipids. Capric acid (10:0) was observed to be present only in polar and non-polar lipids of M and in non-polar lipids of LWM. It was also found that, in polar and non-polar lipids of LWM, the amounts of total saturated and unsaturated fatty acids were identical.

The lipids extracted from the sugar cane leaves were first separated into polar and non-polar fractions, and the polar fraction further resolved into individual classes by thin-layer chromatography in one direction. The basic solvent system, consisting of 65:30:4 (v/v) chloroform:methanol:7N ammonia, gave reasonably good separation with very little overlapping. The eight spots separated were tentatively identified with a number of spray reagents as phosphatidyl inositol plus sulpholipids; phosphatidic acid; lysolecithin; digalactosyl diglycerides (DGDG); lysophosphatidyl ethanolamine; phosphatidyl choline; monogalactosyl diglycerides (MGDG) and green pigment plus neutral lipids.

The two purified fractions of galactolipids were obtained by silicic acid column chromatography and analysed for reducing sugars, esters and glycerol in order to confirm the identity of MGDG and DGDG. The

[1] Wintermans: *Biochim. Biophys. Acta*, 1960, **44**, 49–54.
[2] Nichols: *ibid.*, 1963, **70**, 417–422.
[3] *Canad. J. Biochem. Physiol.*, 1959, **37**, 911–917.
[4] *Indian J. Biochem.*, 1970, **7**, 271–274.
[5] *Biochemistry*, 1964, **3**, 1271–1280.
[6] Rankonen: *Biochim. Biophys. Acta*, 1961, **53**, 361–362.
[7] *idem ibid.*, 1962, **56**, 367–369.

Table II. Fatty acids in sugar cane leaf lipids*

	Fatty acids†										
	10:0	12:0	14:0	15:0	16:0	16:1	18:0	18:0	18:2	18:3	*Ratio of saturated to unsaturated fatty acids*
	% total acids										
Polar lipids											
Leaves without midrib (LWM)	—	10·9	3·4	—	35·3	—	Traces	10·9	12·6	26·9	1·0
Midribs (M)	9·7	8·2	4·9	4·9	34·9	—	6·5	Traces	12·5	18·8	2·2
Leaf sheaths (LS)	—	16·7	9·8	8·8	41·2	—	Traces	8·8	14·7	Traces	3·2
Non-polar lipids											
Leaves without midrib (LWM)	3·9	4·4	5·2	7·7	27·6	—	Traces	12·9	35·8	2·6	1·0
Midribs (M)	4·4	4·6	6·5	3·9	21·2	10·3	4·7	12·1	18·1	14·2	0·8
Leaf sheath (LS)	—	7·6	8·2	5·9	20·5	4·4	5·7	36·6	4·7	6·3	0·9

* Each figure is an average of five determinations.
† Identified as *a:b* where *a* is the number of C atoms and *b* the number of double bonds.

reducing sugar portion of the galactolipids hydrolysate was examined by paper chromatography[8]; it was observed that only galactose was present. The concentrations of galactose, glycerol and esters were determined for both MGDG and DGDG (Table III). The ratio of sugar:ester:glycerol for MGDG was found to be 1·006:2·040:1·000, which is near to the standard (1:2:1). The corresponding ratio for DGDG was found to be 2·007:2·090:1·000, which is close to that of the standard DGDG (2:2:1). These results showed that both MGDG and DGDG fractions extracted from the cane leaves were pure. Moreover, the results further confirmed the tentatively identified galactolipids.

Table III. Structural analysis of cane leaf galactolipids*

	Sugar μ *mole.cm*$^{-3}$	*Ester* μ *mole.cm*$^{-3}$	*Glycerol* μ *mole.cm*$^{-3}$
MGDG	0·486	0·988	0·483
DGDG	0·532	0·555	0·265

* Each figure is an average of five determinations

Summary

Leaf lipids of CoJ 67 cane variety were studied. Leaves without midribs (LWM) contained the highest amount of lipids followed by midribs (M) and leaf sheath (LS). Analysis of the polar and non-polar lipid fractions showed that palmitic acid was the predominant saturated acid and oleic, linoleic and linolenic acids the main unsaturated acid components. The polar lipids were fractionated by thin-layer chromatography and the fractions tentatively identified. Galactolipids, being the most important functional polar lipids for the chloroplast membrane, were further studied and their structures confirmed as monogalactosyl and digalactosyl diglycerides.

La composition des lipides polaires des feuilles de la canne à sucre (*Saccharum officinarum*)

Les lipides des feuilles de la variété de canne CoJ 67 ont été étudiés. Les feuilles sans nervures contenaient la plus grande quantité de lipides, suivies par les nervures et par les limbes. L'analyse des fractions de lipides polaires et non-polaires ont démontré que l'acide palmitique était l'acide saturé prédominant, tandis que les acides oléique, linoléique et linolénique étaient les principaux composants parmi les acides non saturés. Les lipides polaires ont été fractionnés par chromatographie en couche mince et les fractions identifiées expérimentalement. On a poursuivi l'étude des galactolipides qui sont les lipides polaires fonctionnels les plus importants pour la membrane des chloroplastes, et il a été confirmé que leur structure correspond à des diglycérides monogalactosylique et digalactosylique.

Zusammensetzung von polaren Lipiden aus Zuckerrohrblättern (*Saccharum officinarum*)

Blattlipide der Rohrsorte CoJ 67 wurden untersucht. Blätter ohne Mittelrippen enthielten die meisten Lipide, gefolgt von Mittelrippen und Blattscheiden. Die Analysen der polaren und nicht-polaren Lipidfraktionen zeigten, dass Palmitinsaure die wichtigste gesättigte Säure war, während Oleinsäure, Linolsäure und Linolensäure die wichtigsten ungesättigten Säurekomponenten waren. Die polaren Lipide wurden dünnschichtchromatographisch aufgetrennt und die Fraktionen vorläufig identifiziert. Galactolipide, die für die Chloroplast-Membrane die wichtigsten funktionalen Lipide sind, wurden weiter untersucht und ihre Strukturen als monogalaktosyle und digalaktosyle Diglyceride bestimmt.

Composición en lípidos polares de hojas de caña de azúcar (*Saccharum officinarum*)

Se han estudiado los lípidos de la hoja de la variedad de caña CoJ 67. Hojas sin costillas centrales (LWM) contuvieron las mayores cantidades de lipidos, y entonce las costillas centrales (M) y los estuches de las hojas (LS). Análisis de las fracciones polares y no-polares de los lípidos ha demostrado que ácido palmítico fué el predominante ácido saturado, y que ácido oléico, ácido linoléico y ácido linolenico fueron los principales ácidos no-saturados. Los lípidos polares se han fraccionado por cromatografía a capa delgada y las fracciones identificado provisionalmente. Galactolípidos, siendo los más importante lípidos polares funcionales para la membrana cloroplástica, se han estudiado además y su estructuras confirmado como digliceridos mono- y di-galactosílicos. □

[8] Umemura, Nakamura & Funahashi: *Arch. Biochem. Biophys.*, 1967, **119**, 240-252.

Industrial experiments with a new carbonation system

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Paper presented to Int. Sugar Tech. Staff Conf., Irish Sugar Co. Ltd., 1977

PART II

INDUSTRIAL PLANT

The plant in Genappe (see Figs. 5–8) includes the following equipment:

(1) A liquid CO_2 tank of 50 tonnes capacity installed free of charge by the CO_2 delivery company, plus an evaporator (Fig. 7) capable of producing 1000 kg of pure CO_2 gas per hour; this is heated with water at 80°C (10 $m^3.hr^{-1}$).

(2) A tank for lime storage plus the existing lime kiln.

(3) A constant-head juice tank for feeding the Kenics mixers.

(4) Four Kenics static mixers (Fig. 8) with six elements, of outside diameter 32·39 cm, inside diameter 30·33 cm and total length 294·6 cm. The outside pipe is of mild steel and the internal mixer elements of 304 stainless steel. Working conditions for each unit are: limed juice flow 33–45 $m^3.hr^{-1}$, recycled juice flow 467 $m^3.hr^{-1}$, CO_2 flow 370 $kg.hr^{-1}$, maximum pressure drop 0·36 $kg.cm^{-2}$, speed of linear flow 2·6 $m.sec^{-1}$, maximum inlet pressure 4 $kg.cm^{-2}$.

(5) Four recirculating pumps each of 470 $m^3.hr^{-1}$ capacity and power of 25 hp.

(6) Controls: 3 pH controllers with transmitters and automatic CO_2 inlet valves.

(7) A reception tank for carbonatated juice.

(8) Acid cleaning facilities: a tank of 1 m^3 capacity, a pump and piping.

This installation was designed for carbonatation of 100 $m^3.hr^{-1}$ of limed juice at 12 g CaO/100 cm^3 to an alkalinity of 1 g CaO/100 cm^3. The CaO to be removed is 100,000 × (12 — 1) = 1100 $kg.hr^{-1}$, which requires 1100 × 44/56 = 864 $kg.hr^{-1}$ of pure CO_2 (or 873 $kg.hr^{-1}$ at 99% efficiency).

Running conditions

In practice only two Kenics are operated together while one is being cleaned and the fourth remains as a spare unit. The flow of limed juice is manually set at 75 $m^3.hr^{-1}$, and the pH control takes care of the introduction of CO_2 from the main line (4 $kg.cm^{-2}$). Special care is taken as to the inlet and back pressures (1·2 $kg.cm^{-2}$ *inlet*, 1·5 $kg.cm^{-2}$ outlet).

After some ten days the outlet pressure rises to 2 $kg.cm^{-2}$. The Kenics mixer is isolated and acid washing is applied (10% HCl circulated during 16 hours). No special supervision is needed in this plant and sight glasses are provided to make sure that cleaning is effective. Pressure coming back to normal indicates the end of acid washing. Scale is found only in the mixer and recirculating pipes; no scaling occurs in the outlet pipes.

Working data

The Kenics static mixer works perfectly without any running troubles. Chemical characteristics are the same for normal carbonatation juices and the Kenics juices. Physical characteristics are slightly better for normal carbonatation in respect of filtration rate (30 sec against 45 sec for the filtration of 1000 cm^3). 100% efficiency is achieved for CO_2 utilization.

In Table XI are summarized the working data for both juices after second carbonatation carried out in the laboratory.

Investments and running costs

The installation cost is about 2,000,000 Belgian francs, the price of the Kenics being 500,000 francs. For the Kenics a daily quantity of 14 tonnes of pure CO_2 is used,

Table XI

		Factory 2nd carb. juice	*Laboratory 2nd carb. juice from normal 1st carb.*	*Laboratory 2nd carb. juice from Kenics mixers*
Brix	(A)	15·14	16·75	16·48
	(B)	15·38	17·97	17·85
	(C)	16·05	17·18	17·97
Pol	(A)	13·66	15·23	14·99
	(B)	13·83	16·25	16·11
	(C)	14·53	15·65	16·36
Purity	(A)	90·24	90·90	90·97
	(B)	89·92	90·42	90·27
	(C)	90·53	91·09	91·04
Alkalinity, g CaO/ 100 cm^3	(A)	0·029	0·025	0·029
	(B)	0·032	0·026	0·029
	(C)	0·028	0·030	0·031
pH	(A)	9·40	9·35	9·45
	(B)	9·45	9·35	9·40
	(C)	9·20	9·40	9·45
Lime salts	(A)	0·036	0·035	0·047
	(B)	0·042	0·033	0·027
	(C)	0·027	0·029	0·023
Colour % Brix	(A)		232	239
	(B)		233	221

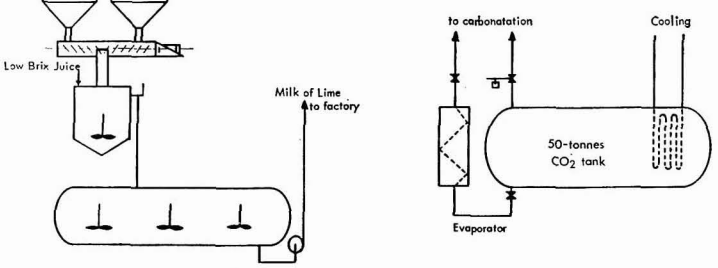

Fig. 5. Lime and pure CO_2 storage

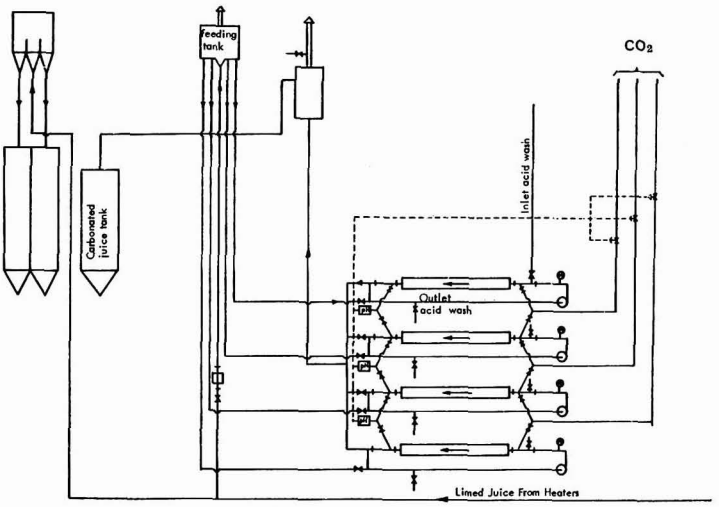

Fig. 6. Kenics carbonatation system

costing 2240 francs per tonne. About 20 tonnes/day of lime is needed, at 1215 francs per tonne. The exact amount of CO_2 used in the Kenics is not easy to establish because some of the bought lime and pure CO_2 had to be used in the normal carbonatation system owing to the fact that the lime kiln was not working too well.

Limestone cost in Belgium is 280 francs per tonne and coke 3445 francs per tonne. For the 1976 campaign Genappe bought 2591·42 tonnes of lime and 837·83 tonnes of pure CO_2.

Second carbonatation trials

One of the four Kenics mixers was also tried for second carbonatation of factory juice but after 24 hours' working it was completely scaled-up; even the filter cloths were scaled. We do not think that a retention tank between the Kenics mixer and filtration would avoid this scaling.

Conclusions

The four Kenics static mixers installed at the Genappe sugar factory have been used successfully for first carbonatation with an efficiency of gas absorption up to 100% when using pure CO_2. Under the working conditions of Genappe and with prices quoted for lime and pure CO_2 the investment for a new lime kiln can be avoided if a factory wants to increase the capacity by up to 2000 tonnes/24 hours. Beyond this increase, for an 80-day campaign, it is more economical to invest in a lime kiln.

Summary

Pilot plant studies are reported on the use of Kenics static mixers for carbonatation of limed juice using both pure carbon dioxide and gas from the factory lime kiln. Almost 100% CO_2 utilization efficiency was achieved with a 6-element mixer which was preferred to an 11-element unit which required more power. An industrial-scale plant was installed at Genappe sugar factory in Belgium and successfully operated for first carbonatation but not for second carbonatation as a result of heavy and rapid scale formation. On a basis of costs for bought lime and pure CO_2 a Kenics mixer installation is economical up to a capacity equivalent to 2000 tonnes of beet per day; above this it is more economical to invest in a new lime kiln.

Essais industriels avec un nouveau système de carbonatation

On présente le compte-rendu d'études en installation pilote sur l'emploi de mélangeurs statiques Kenics pour la carbonatation de jus chaulé à la fois avec de l'anhydride carbonique pur et avec du gaz du four à chaux de l'usine. Un rendement d'utilisation du CO_2 de près de 100% a été atteint avec un mélangeur à 6 éléments, choisi de préférence à une unité à 11 éléments qui absorbait trop de puissance. Une installation a l'échelle industrielle a été montée à la sucrerie de Genappe (Belgique) et exploitée avec succès en première carbonatation, mais pas en deuxième carbonatation par suite de la formation rapide d'une importante incrustation. Sur base du cout d'achat de la chaux et du CO_2 pur, une installation avec mélangeur Kenics est économique jusqu'à une capacité équivalente à 2000 tonnes de betteraves par jour; au-delà il est plus économique d'investir dans un nouveau four à chaux.

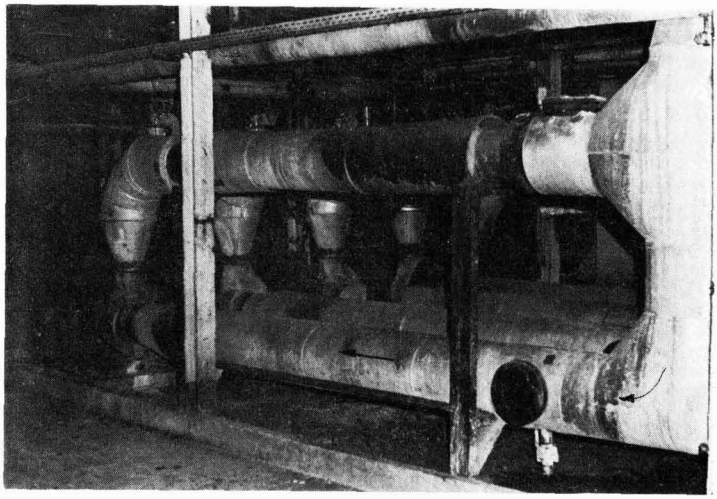

Fig. 7. CO_2 evaporator

Industrielle Versuche mit einem neuen Carbonatationssystem

Mitgeteilt werden Untersuchungen in einer Versuchsanlage über die Anwendung des statischen Mixers

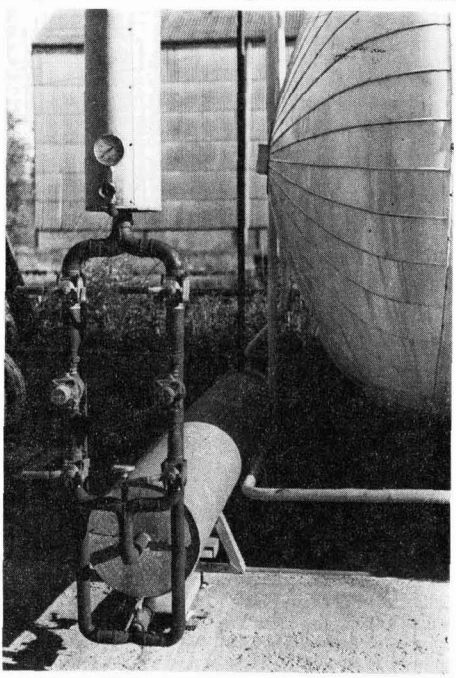

Fig. 8. Static mixer, pump and recirculation pipe

"Kenics" für die Carbonatation von gekalktem Saft mit reinem Kohlendioxid und Kalkofengas. Nahezu 100% CO_2-Ausnutzung erreichte man mit einem 6-Element-Mixer, der einer 11-Element-Einheit vorgezogen wurde, die mehr Energie benötigte. Eine Anlage in industriellem Massstab wurde in der Zuckerfabrik Genappe in Belgien installiert und arbeitete erfolgreich für die 1. Carbonatation aber nicht für die 2. wegen der starken und schnellen Bildung von Steinkrusten. Auf der Kostenbasis von gekauftem Kalk und reinem CO_2 ist die Installation eines Kenics-Mixers bis zu einer Kapazität von 2000 t/d Rüben wirtschaftlich; für eine höhere Kapazität ist es wirtschaftlicher einen neuen Kalkofen aufzustellen.

Ensayos experimentales con una nueva sistema de carbonatación

Estudios con una planta pílota se describen que

usaban mezcladores estaticos tipo Kenics para carbonatación de jugo alcalizado, con dióxido de carbón puro y con gas del horno de cal de una fábrica. Eficiencia de utilización de casi 100% se ha alcanzado por un mezclador de 6 elementos que es preferible a un otro de 11 elementos que requería más fuerza. Una planta de escala industrial se ha instalado en la azucarera de Genappe en la Belgica y operaba con éxito para carbonatación primera pero no para carbonatación segunda como resulta de formación grande y rápida de incrustaciones. Sobre un base de costos para cal y CO_2 pura comprado, una instalación de mezcladores tipo Kenics es económica hasta una capacidad equivalente a 2000 toneladas de remolacha por día; sobre este nivel es más económico invertir en un nuevo horno de cal. □

Inhibition of sugar cane mosaic virus by plant rhizome extracts

By R. D. JOSHI and J. PRAKASH
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Introduction

ACCORDING to recent available data, sugar cane, the major cash crop of India, covers 1,471,000 hectares in Uttar Pradesh, with an annual production of 6,147,900 tonnes[1]. Of different strains of sugar cane mosaic virus, strain A (SCMV-A) is the most prevalent one in the sugar cane crop in this State[2]. Recently this strain was found to cause 31·2% reduction of millable cane[3]. Because of the prevalent and destructive nature of SCMV-A, it was felt essential to search for some agent inhibiting this virus. In the present study we report the effect of extracts of the rhizomes of five plants, viz. *Zingiber officinale* Roscoe, *Allium cepa* L., *A. sativum* L., *Solanum tuberosum* L. and *Curcuma longa* L., on SCMV-A infectivity.

Materials and methods

Extracts of the underground rhizomes were prepared by crushing plant material with distilled water (1 cm^3 per g). The extract thus obtained was centrifuged at 6000 rpm for 20 minutes and stored at 3-4°C for further work. Inoculum was obtained by macerating SCMV-A-infected sugar cane leaves in a meat mincer. Maize (*Zea mays* L.) cv. Ganga 2 was used as a test plant. Inoculum and the extracts were mixed in equal proportions and incubated for 5 minutes before inoculation. Inoculum mixed with distilled water (1:1) served as the control.

Results

Observations on SCMV-A inhibition by different plant extracts are recorded in Table I. The maximum decrease in infectivity was obtained with *Z. officinale* extract, and the following experiments were therefore performed to learn the probable nature of the inhibitory principle in this extract.

(i) *Effect of dilution:* The extract was diluted to 1:10, 1:50, 1:100, 1:1000 and 1:10,000 with distilled water and mixed with the inoculum (1:1). It was observed that dilution of the extract causes a significant reduction in its anti-viral property (Table II).

Table I. Effect of different plant extracts on SCMV-A infectivity

Plant extract	*No. of plants infected out of 25 inoculated*		*% inhibition*
	Control	*Treated*	
Zingiber officinale	20	6	70
Allium cepa	20	15	25
A. sativum	20	12	40
Solanum tuberosum	20	19	5
Curcuma longa	20	9	55

Table II. Effect of dilution on the inhibitory property of the *Z. officinale* extract

Dilution	*No. of plants infected out of 25 inoculated*		*% inhibition*
	Control	*Treated*	
1:10	20	8	60
1:50	20	11	45
1:100.....	20	12	40
1:1000	20	16	20
1:10,000	20	18	10

(ii) *Effect of dialysis:* When the extract was dialysed against running water for 36 hours, the antiviral factor was found to be dialysable, since the dialysed extract showed only 3% inhibition.

(iii) *Effect of desiccation:* A 5-cm^3 aliquot of the extract was kept in a desiccator for 4 days. The dried extract was mixed with distilled water to make up to a volume of 5 cm^3. It was then tested for the inhibitory property. No effect of desiccation on the antiviral property of the extract was observed.

(iv) *Effect of pH:* The pH of the extract was adjusted to 4·5, 5·0, 5·5, 6·0, 6·5, 7·0, 7·5, 8·0 and 8·5 with 0·1N HCl and 0·1N NaOH. After 30 minutes these were brought to the original pH. No appreciable effect of pH on the inhibitory effect of the extract was noticed, since inhibition ranged between 68 and 73%.

(v) *Effect of storage:* The extract was stored in sterilized stoppered glass vials at room temperature (25-28°C) and at 4°C. The inhibitory capacity of the extract was

[1] "U.P. Agriculture in Brief", 5th Edn. (C. S. Azad University of Agriculture and Technology, Kanpur), 1975-76.
[2] Bhargava: *Final Tech. Rpt. P.L.480 Research Project*, p. 203.
[3] Rishi, Bhargava & Joshi: *I.S.J.*, 1977, **79**, 298-299.

tested at intervals of two days. By the 20th day of storage, it was observed that the inhibitory capacity was reduced by 85% when the extract was kept at room temperature, but by only 23% when kept at 4°C. We could not continue this experiment beyond the 20th day, as the stored extract was exhausted.

(vi) *Effect of heat:* A number of 5-cm³ portions of the extract were placed in thin-walled glass tubes. These were immersed in water baths maintained at 60°, 70°, 80°, 90° and 100°C. After 10 minutes' immersion they were cooled quickly and the contents tested for inhibitory capacity. No effect of heat on the inhibitory property of the extract was observed, inhibition ranging from 66% to 70%.

(vii) *Nature of inhibitor:* Proteins were precipitated from the extract by treatment with ethanol and with ammonium sulphate. The protein precipitate obtained by either method was suspended in an equal quantity of distilled water and tested for antiviral activity. No inhibition of SCMV-A was demonstrated by the protein suspension.

(viii) *Effect of pre-inoculation application of the extract:* One group of 25 maize seedlings was treated with the extract, while another group of 25 maize seedlings was treated with distilled water. Both sets were inoculated with the virus at various intervals, viz. 2, 4, 8, 16, 24 and 32 hr after application of the extract. Inhibitory activity of the extract increased with increasing time from pre-inoculation application, and a maximum of 72% inhibition was obtained when the extract was applied 16 hr prior to inoculation (Table III).

(ix) *Effect of post-inoculation application of the extract:* Maize seedlings were inoculated with the virus and half treated with the extract, while the other half was treated with distilled water, in sets of 25 seedlings 2, 4, 8, 16, 24 and 32 hr after virus inoculation. A maximum of 78% inhibition was obtained when the extract was applied 8 hr after inoculation. Beyond this period, the inhibitory property of the extract decreased with increasing post-inoculation interval (Table III).

Table III. Effect of pre- and post-inoculation application of the extract on SCMV-A infectivity

	— % *Inhibition* —	
Time, hr	*Pre-inoculation*	*Post-inoculation*
2	23	53
4	41	62
8	48	78
16	72	70
24	65	37
32	50	31

Discussion

A number of higher plants are known to contain viral inhibitors of non-proteinaceous nature[4,5,6,7]. In the present investigation, *Z. officinale* extract was found to inhibit SCMV-A infectivity to the extent of 70%. The inhibitory property of the extract decreased on dilution with water. No change in inhibitory capacity of the extract was observed on adjustment of the pH in the range 4·5–8·5 for 30 minutes. The inhibitory principle was stable to desiccation for a period of 4 days. It was not affected by heat up to 100°C and was dialysable. When proteins in the extract were precipitated with $(NH_4)_2SO_4$ and ethanol, they showed no inhibiting activity. The exact chemical nature and mode of action of the SCMV-inhibitor in *Z. officinale* extract is not clear from these experiments. The maximum inhibitory effect of the extract was obtained when it was applied 8 hr after virus inoculation, although the next best result was achieved by application 16 hr before inoculation. This suggests that the extract exerts its maximum effect during the early stage of virus infection.

Summary

The effects of extracts of rhizomes of five plants on the infectivity of Strain A of the sugar cane mosaic virus were studied. *Zingiber officinale* caused an average 70% inhibition of the virus (the effect fell with water dilution of the extract), while the next best was *Curcuma longa* extract (55% inhibition), followed by *Allium sativum* (40%), *A. cepa* (25%) and *Solanum tuberosum* (5%). The maximum effect (78% inhibition) was obtained when the *Z. officinale* extract was applied 8 hours after inoculation of the maize indicator plants with the virus.

L'inhibition du virus de la mosaique de la canne à sucre par des extraits de rhizomes de plantes

L'effet d'extraits de rhizomes de cinq plantes sur l'effet infectant de la souche A du virus de la mosaique de la canne à sucre a été étudié. *Zingiber officinale* assura une inhibition du virus de 70% en moyenne (l'effet diminuait avec la dilution de l'extrait à l'eau), le second en efficacité étant l'extrait de *Curcuma longa* (55% d'inhibition), suivi de *Allium sativum* (40%), *A. cepa* (25%) et *Solanum tuberosum* (5%). L'effet maximum (78% d'inhibition) a été obtenu lorsque l'extrait de *Z. officinale* était appliqué 8 heures après l'inoculation par le virus des plantes de mais utilisées comme indicatrices.

Inhibition des Zuckerrohr-Mosaikvirus durch Extrakte aus Pflanzenwurzeln

Untersucht wurden die Auswirkungen der Wurzelextrakte von fünf Pflanzen auf die Infektionsfähigkeit des Stammes A des Zuckerrohr-Mosaikvirus. *Zingiber officinale* verursachte durchschnittlich 70% Inhibition des Virus (der Effekt verringerte sich mit der Verdünnung des Extrakts mit Wasser), der nächstbeste war *Curcuma longa*-Extrakt (55% Inhibition), gefolgt von *Allium sativum* (40%), *A. cepa* (25%) und *Solanum tuberosum* (5%). Den maximalen Effekt (78% Inhibition) erhielt man, wenn der *Z. officinale*-Extrakt 8 Stunden nach Impfung der Mais-Indikatorpflanzen mit dem Virus angewendet wurde.

Inhibición del virus de mosaico de caña de azúcar por extractos de la rizoma de varias plantas

Los efectos de extractos de las rizomas de cinco plantas sobre la infectividad de Raza A del virus de mosaico de caña de azúcar han sido estudiado. *Zingiber officinale* causó un promedio de 70% inhibición del virus (el efecto disminió con dilución acuosa del extracto), lo mejor después de eso estuvo extracto de *Curcuma longa* (55% inhibición), y en seguida, extractos de *Allium sativum* (40%), *A. cepa* (25%) y *Solanum tuberosum* (5%). El efecto máximo (78% inhibición) se obtuvo cuando el extracto de *Z. officinale* se applicó 8 horas después de inoculación de las plantas indicadores (maíz) con el virus.

[4] Cheo & Linder: *Virology*, 1964, **24**, 414–435.
[5] Verma, Chaudhuri & Khan: *Biol. Plantarum*, 1969, **11**, 384–387.
[6] Gupta & Chaudhuri: *Ann. Phytopath. Soc. Japan*, 1971, **37**, 124–127.
[7] Moftuoglu & Nienhaus: *Phytopath. Z.*, 1976, **85**, 49–64.

SUGAR CANE AGRONOMY

Evaluation of advances in matology studies of sugar cane in the Argentine Republic. R. A. Arevalo. *Misc. Fac. Agron. Zootecn. Univ. Nac. Tucumán,* 1976, (56), 35 pp (*Spanish*).—The study presented of matology (the science of weed control) in sugar cane is classified into three epochs: 1565–1915, when weed control was totally manual with primitive tools, although with increasing use of animal power for cultivation towards the end of the period; 1915–1960, when mechanization increased and use of chemicals was adopted; and 1960 to the present, a period marked by progressive diminution in the use of hand labour. The author surveys the literature on the study of weed botany, ecology, the importance of specific weeds, and control of groups of weeds; the phytotoxicity of herbicides to cane and the study of residual effects, problems arising in the use of herbicides in sugar cane; cane cultivation systems and methods of application of herbicides. A table shows the amounts of herbicides (a total of 28 chemicals) used in Argentina in 1975. The bibliography includes 62 references.

Fertilization of ratoons of three sugar cane varieties (*Saccharum* spp.) cultivated in structured red soil in the state of São Paulo. E. Zambello, J. Orlando, J. T. Colletti and A. J. Rossetto. *Brasil Açuc.,* 1977, **89,** 123–129 (*Portuguese*).—An incomplete factorial design trial was used to study fertilizer effects on three cane varieties on the red soil of Usina Da Barra in São Paulo. It involved three replicates of 21 treatments, with six levels of N (0, 50, 100, 150, 200 and 400 kg.ha^{-1}), the same number and levels of P_2O_5, and six levels of K_2O (0, 75, 150, 225, 300 and 600 kg.ha^{-1}). The three varieties were CB 41-76, CB 46-47 and CB 47-355. Responses to N were obtained with all three varieties, but there was a reduction in sucrose yield with the highest level, and economical rates were estimated at 159, 166 and 167 kg.ha^{-1} for the three varieties. No response was observed to K or P, and no significant difference in reducing sugars % was found as a response to fertilizer.

Sucrose in cane varieties for milling periods, topographies and areas of Pernambuco. S. Krutman and E. R. Braga. *Brasil Açuc.,* 1977, **89,** 144–159 (*Portuguese*).—A detailed account is given of trials using a total of 19 cane varieties in different areas and under various conditions in the state of Pernambuco, and recommendations are made to maximize production, *viz.* use of specified varieties and harvesting times.

The effect of organic material on the physical-chemical properties of soil and cane yield in red soils. S. C. Yang and Y. C. Wang. *Rpt. Taiwan Sugar Research Inst.,* 1977, (76), 1–12 (*Chinese*).—Application of 20 tonnes.ha^{-1} of sawdust was found to improve yields of plant cane (10% higher cane yield and 11% higher sugar yield), the improvement continuing in first ratoons but thereafter declining. The organic matter significantly increased phosphorus availability in red soils and also increased those of potassium and silica; but it reduced available iron, manganese and aluminium.

Comparative studies on the extraction of available phosphorus in soils of sugar cane fields. I. J. Fang and C. C. Wang. *Rpt. Taiwan Sugar Research Inst.,* 1977, (76), 29–51 (*Chinese*).—Experiments are recorded which were intended to study the influence of various forms of soil phosphate and cane yield, using pot tests, experimental field trials and commercial field trials. Statistically significant responses were obtained from P fertilization of six different soil types in various cane growing areas. Soil P was extracted using a number of extractants and statistical analyses carried out on the P level and cane yield data. A regression equation was developed which related cane yield to the amount of soil P extractable with Bray No. 1 solution in 1:50 dilution, the extractant which gave best correlation.

Nitrogen fertilization in four varieties of plant cane in Ortho dark red latosol soil. J. Orlando, E. Zambello and J. A. G. C. Sousa. *Brasil Açuc.,* 1977, **89,** 176–184 (*Portuguese*).—A trial on Ortho dark red latosol examined the effect of two levels of N fertilizer against zero application as control, with the same level of P and K for each trial (and a further control without any N-P-K addition). Four varieties were employed. The addition of P and K alone gave an increase in cane yield at 18 months, but the additional application of N did not produce a significant response. Leaf samples taken at intervals between 4 and 10 months were analysed and row- and inter-row soil samples were also taken at 8 months. No response was observed in respect of pol % cane or reducing sugars % juice for any variety or level or time of N application.

Economic considerations on delayed sugar cane harvesting. F. A. Fogliata, R. E. Torres and C. A. Gargiulo. *La Ind. Azuc.,* 1977, **84,** 146–155 (*Spanish*). Studies were made on cane and sugar yields from cane harvested at intervals from the same blocks at intervals of two weeks between mid-October and mid-December 1975, as well as the economic values per 100 metres of row. Both agronomic and economic considerations showed that the reduced yields and recoveries after 15th November made this the limiting date to which harvesting might be delayed.

Promising prospects for the cane agro-industry in the state of Paraná. L. R. Graça and L. G. C. Carvalho. *Brasil Açuc.,* 1977, **89,** 300–305 (*Portuguese*).—The Paraná sugar industry is small, with only four sugar factories, estimated to produce a total of 5,460,350 60-kg bags of sugar in the 1976/77 crop. However, agricultural productivity is high, cane yield (plant cane plus 3 ratoon crops) averaging 84·95 tonnes.ha^{-1} in 1970/71–1975/76, or 21 tonnes.ha^{-1} greater than the average for São Paulo. Recovery in the sugar factories in kg sugar per tonne of cane is somewhat lower than in São Paulo, but the difference is steadily diminishing, and production of sugar per hectare is higher. Current and planned production of alcohol are discussed and data tabulated, and it is concluded that the state offers great opportunity for production of sugar and alcohol but that varieties more

tolerant of cold conditions need to be provided, as well as means to reduce the substantial fall in yield between plant and ratoon crops, and improvement in factory performance to give better recovery.

Influences of varieties and soil on the foliar contents of macronutrients in 16 varieties of sugar cane (*Saccharum* spp.) cultivated in large groups of soils. J. Orlando and H. P. Haag. *Brasil Açuc.*, 1977, **89**, 308-326 (*Portuguese*).—A randomized block design was used to study varietal effects and those of four soils on the macronutrient (N, P, K, Ca, Mg and S) contents of cane leaves. Sixteen varieties were planted and grown under the same conditions of fertilization, tillage, sanitation and source, and samples of 20 leaves per plot were taken at 4 months of age, the central 20 cm portion of each +3 leaf being analysed after removal of the midrib. The results showed that there was a varietal effect which was independent of the soil type and *vice versa*. The higher nutrient levels did not always correspond to the highest yields of sugar per hectare, and it is difficult to establish critical nutrient levels from foliar diagnosis and to establish general critical levels, since those for one variety will not apply to another.

Effect of neem cake blended (with) urea on yield and net return from sugar cane. R. K. Sharma, R. A. Sharma and S. R. Sharma. *Cane Grower's Bull.*, 1977, **4**, (1), 7-8.—Neem cake, an inexpensive vegetable product which had been found to increase nitrogen fertilizer utilization efficiency with other crops, was blended with urea (80 kg neem cake and 250 kg N per hectare) and the effect of treated and untreated urea compared at the same N level. There was an increase in yield from 893·51 to 1003·69 quintals.ha^{-1} as a result of the neem cake, while at lower N levels (125 and 185 kg.ha^{-1}) use of higher proportions of neem cake also produced increased cane yields but by smaller amounts.

Agronomic researches on sugar cane in non-factory areas of Uttar Pradesh (1956-75)—a review. S. K. Ojha, R. Singh and B. N. Dixit. *Cane Grower's Bull.*, 1977, **4**, (1), 15-18.—Almost 60% of the cane grown in the state is used for the production of gur and khandsari non-centrifugal sugars, but until 1965 little attention was paid to agronomy in the non-factory areas. In that year an Agronomy (Gur) section was set up at the Shahjahanpur sugar cane research station, and a survey is presented of the results of the section's work in regard to varietal studies, cultural procedures (including seed material, planting, spacing, fertilization, irrigation and ratooning) as well as juice clarification and gur storage.

Critical time of irrigation and nitrogen fertilization under water deficit condition—Review of work done at Sugarcane Research Institute, Pusa. P. K. Bose and K. Thakur. *Indian Sugar*, 1977, **26**, 809-811.—Cane cultivation in North Bihar has spread to areas of low rainfall, and studies have been made to learn the level at which irrigation should be applied from limited water resources in order to make the best use of these while ensuring adequate crop growth and productivity. On a basis of soil moisture availability, the appropriate level is 50%; this involves irrigation of spring-planted cane within 45-60 days of planting and once or twice more at the same interval. In unirrigated cane, and at lower levels of fertilization, nitrogen should be applied either all at planting or half at planting and half at earthing-up. For heavy application of N the fertilizer should be applied one-third at planting, one-third at tillering and the remainder at earthing-up.

Studies on the use of foliar analysis as an index of nitrogen requirements of sugar cane in Tarai, U.P. D. Nath, M. S. Gangwar and R. S. Sachan. *Indian Sugar*, 1977, **26**, 813-816.—Foliar nitrogen levels were found to decrease significantly with age of the cane while a significant relationship was found between leaf nitrogen and sheath moisture at 180 days, the latter also being significantly and positively correlated with cane yield. A yield prediction formula was calculated which related yield to the two measurements and a nitrogen index derived from the age of the crop and the sheath moisture content.

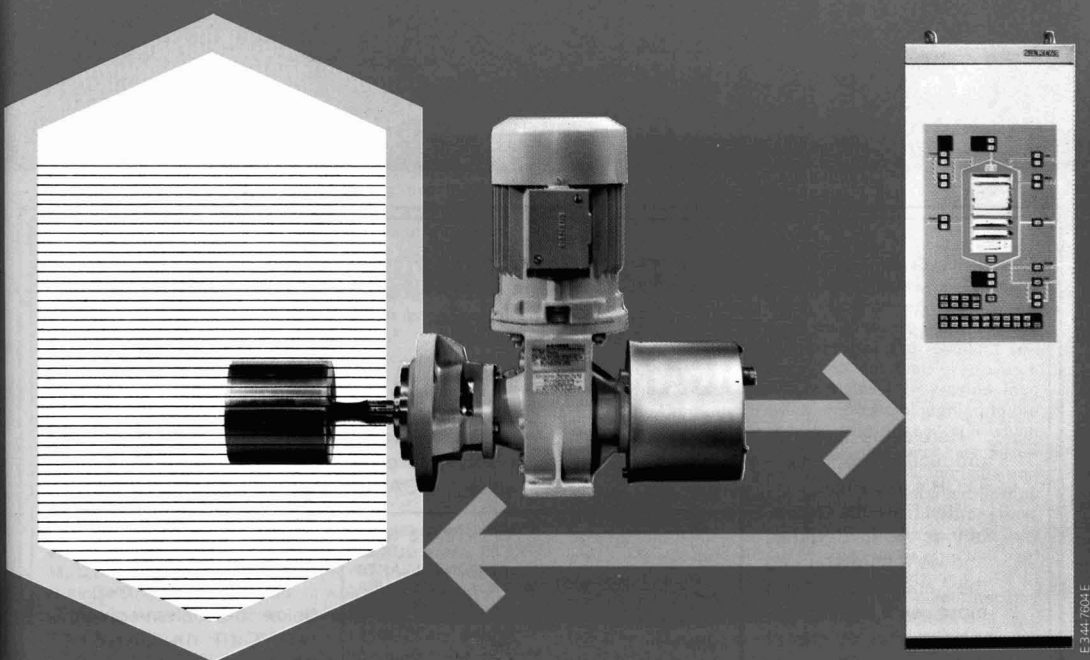
Ripening in sugar cane with "Polaris", "Cetrimide" and "Hyamine 1622". A. Kumar and R. Narasimhan. *Indian Sugar*, 1977, **26**, 817-820.—Field plots of cane planted and grown under uniform conditions were treated with three ripeners at two levels and compared with control plots over a period. Yield and height of the cane was unaffected but pol increased with all three chemicals at five weeks after foliar application, and increased further by six weeks, the effect thereafter falling so that by eight weeks the pol was sometimes less than the control value.

Effect of foliar treatment with GA (gibberellic acid) and IAA (indole acetic acid) on organic, inorganic constituents and on the rate of photosynthesis in sugar cane variety Co 740. J. D. Nimbalkar and G. R. Naik. *Maharashtra Sugar*, 1977, **2**, (9), 9-15.—Application of GA to 3 months-old cane raised the moisture content by comparison with untreated controls (e.g. from 68·57 to 72·78%) while reducing the total sugars by a third (from 0·64 to 0·44%) but increasing the reducing sugars content (from 0·30 to 0·38%). On the other hand, IAA hardly affected the moisture content and raised the reducing sugars to 0·33% but also raised the non-reducing sugars from 0·34 to 0·48%. Of inorganic constituents, Mg, Si and P were increased by IAA while Mn was reduced; GA reduced the K and P contents while increasing the Ca, Si and P contents. GA reduced the total chlorophyll in the cane leaves while IAA increased it; both slightly reduced the ratio of chlorophyll *a* to chlorophyll *b*.

Effect of nitrogen doses on sugar cane plant and ratoon crops and gur production. K. M. Bhardwaj, M. Singh, R. P. Rastogi and R. K. Sharma. *Sugar News* (India), 1977, **8**, (12), 7-10.—Trials during 1973-76 to determine the optimum dosage of N fertilizer showed that 100 kg.ha^{-1} gave a yield of 51·38 tonnes.ha^{-1} of plant cane and 6·39 tonnes.ha^{-1} of sugar while 150 kg.ha^{-1} of N increased the cane yield to 53·83 tonnes.ha^{-1} but, because of the reduced juice quality, sugar yield was only 6·05 tonnes.ha^{-1}. With 200 kg.ha^{-1} of N, cane yield was 53·44 tonnes.ha^{-1} and sugar yield 6·01 tonnes.ha^{-1}. Application of 100, 150 and 200 kg.ha^{-1} of N to each of the plant cane treatments raised the yields of both cane and sugar, the greatest yields of sugar (5·51 tonnes.ha^{-1}) being obtained when 200 kg was applied to ratoons after 150 kg.ha^{-1} to plant cane. This was not significantly greater than the yield (5·44 tonnes.ha^{-1}) with 150 kg.ha^{-1} N applied to each crop, and this is the recommended dosage. Differences in gur quality were negligible.

SIEMENS

Better control of the sugar boiling process



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SUGAR BEET AGRONOMY

The position of sugar beet agriculture and processing in Austria. I. Vitai, J. Beres, G. Eliás and I. Voit. *Cukoripar*, 1977, **30**, 82-87 (*Hungarian*).—A brief illustrated survey is presented of beet agriculture, processing and research in Austria.

Influence of various moisture regimes, level of nitrogen and varieties on sugar beet (*Beta vulgaris* L.) production. I. Yields. N. L. Bhatia and H. C. Sharma. *Indian Sugar*, 1977, **26**, 825-829.—Irrigation × nitrogen trials are reported for two beet varieties at Hissar in India. Scheduling irrigation at pan evaporation levels corresponding to 50% depletion of available soil moisture for a total of 12 irrigations proved sufficient to raise a good crop of sugar beet, while application of 120 kg N per ha to soil which already contained 225 kg available N per ha was also adequate. Both varieties (Maribo "Resistapol" and "Magnapoly") gave good economical yields of roots and sugar.

Estimation of sugar beet crop results on the basis of meteorological data. P. Bozó. *Cukoripar*, 1977, **30**, 127-134 (*Hungarian*).—It had earlier been shown that beet yield was affected not only by rainfall but also by transpiration. For prediction of crop yield per unit area, the relative hydrothermal index (*RHI*) has been introduced; *RHI* is given by $(E\text{-}P) / E$, where E is the evaporative capacity of the air (mm) and P is the total rainfall (mm). Comparison of predicted values obtained using the *RHI* with values obtained on the basis of conventional meteorological parameters (temperature, rainfall and sunshine) showed that the *RHI* method is more accurate; of 120 predictions made for 1971-76, 79% had an error of less than 20%, and 38% had a discrepancy of less than 10% by contrast with the true figures. Critical values of *RHI* are calculated for July onwards—above these values a fall in crop yield is to be expected.

Describing the sugar beet ripening process with the aid of the Markov chain. J. Gerse. *Cukoripar*, 1977, **30**, 142-148 (*Hungarian*).—The author defines the Markov chain (a stochastic process x_t in which the value of x or of time parameter t is discontinuous) and explains, on the basis of ripening experiments in 1968-75 and values of sugar content and beet and white sugar yield, how that statistical approach can be used to describe the pattern of changes in the values of the parameters. The method developed for prediction of yield is described. It is emphasized that the sugar concentration in the growing beet can only be increased overall by making basic changes in agricultural practices.

Trends in labour economy in sugar beet and sugar cane agriculture. K. Baumgarten. *Zeitsch. Zuckerind.*, 1977, **102**, 596-601 (*German*).—Starting from the fact that the costs of producing beet and cane sugar are very much governed by the labour costs of producing the raw material, the author shows how the pressure of high and increasing wages has caused a fundamental change in beet agriculture in industrialized countries over the last 30 years. By comparison, substantial changeover to mechanization has taken place only during the last 10-15 years in the cane agricultures of developing countries, leading to drastic changes in practices in exporting countries having large farms and increasing wage bills. The labour economies of beet and cane cultivation in the industrialized countries are compared, showing which economic criteria are significant for the development of mechanization and for agricultural productivity. It is stated that, since cane agriculture generally demands greater labour input than does beet agriculture and is thus more vulnerable to wage demands, beet sugar becomes increasingly competitive.

First year results of the sugar beet trials in the Natal Midlands. N. G. Inman-Bamber. *S. African Sugar J.*, 1977, **61**, 389-395.—The first year results from a 3-year study are reported. Beet was sown at four locations at intervals between October and March. The highest sugar yields (8-15 tonnes.ha^{-1}) were obtained at a location at an elevation of 1660 m while the lowest (7-11 tonnes.ha^{-1}) were found at the lowest elevation (1070 m). Root rot and root knot nematode infection occurred to some extent, but the main problem was Cercospora leaf spot which was of greatest incidence at the lowest elevation and *vice-versa*. November plantings were most affected compared with those of early October, late December and January. Beet planted after January did not give roots of harvestable size. Sugar content remained low during summer and autumn but root weight increased; root weight became stable as the sugar started to accumulate, reaching a peak of 17-20% in August.

Erosion—a risk to soil fertility. W. C. von Kessel. *Die Zuckerrübe*, 1977, **26**, (5), 8-10 (*German*).—The processes that take place when rainwater or melted snow runs off a field, particularly on a slope, are described and factors governing the extent of the resultant soil erosion indicated. It is pointed out that, even where only a small amount of soil is removed by erosion, loss of humus, Ca, K and P will result from ploughing to the same depth as before, cutting into "dead" soil which is low in humus and nutrients; this becomes mixed with the residual top soil, diluting the components and thereby necessitating application of mineral fertilizer as well as organic manure and green manure and/or straw. In addition, mixing of the dead soil with top soil may prevent beet emergence or may cause the emerged beet to die as a result of very low pH values and loss of buffering capacity in the seedbed. The plants become highly vulnerable to the effects of herbicides and less tolerant of salts, particularly those in N fertilizers. Woody and stunted beets may also result. Considerable damage can be caused by a storm breaking over sloping fields after use of a mechanical hoe; beets may be washed out of the soil or simply torn away. Soil may be washed away to be dumped in layers on top of a seedbed lower down; although perhaps only a few mm thick, such layers may prevent beet emergence. Irrigation channels and drainage ditches may become blocked with soil which is carried from beet fields; the resultant swollen streams may carry off bridges and flood the fields, perhaps even causing traffic accidents on adjacent highways. Wind erosion of beet fields, particularly when coupled with the effects of frost on winter-

ploughed soil, may cause scattering of soil particles; both wind speed and turbulence play a role in this. Soils of varying particle sizes may be less affected than those having a uniform particle size. Surfaces carrying uneven furrows are less vulnerable than levelled-out surfaces. It is stressed that wind damage will occur only where there is a dry surface, even only a few mm thick. The wind may create dust storms which can act on growing beet like a sand blast. Means of avoiding water and wind erosion are examined.

Soil preparation for sugar beet. E. Ruhm. *Die Zuckerrübe,* 1977, **26,** (5), 16-18 (*German*).—Stubble tillage and ploughing are of equal importance in creating optimum conditions for root growth and weed control. Apart from choice of equipment and the way it is used, the number of passes plays a decisive role in stubble tillage. It is recommended to leave an 8-10 day interval between the first and second stubble tillage; the second pass will destroy germinated seed and at the same time create ideal conditions for germination of the remaining seed. Subsequent tillage will normally be to a greater depth, but should not exceed half of the ploughing depth, since, with extremely porous soil, this would create difficulties for the plough. The number of stubble tillage passes will depend on local conditions, weed density, soil moisture content and amount of straw to be incorporated. Straw incorporation and mixing with soil is an essential part of stubble tillage, but a share plough is not suitable, since it does not give uniform mixing, so that beet emergence and growth will suffer. The most important task of ploughing is the creation of a friable soil following the mechanical, climatic and biological processes taking place at the time of stubble tillage. It is advisable, particularly on heavy clay soils, to plough in the autumn when the soil moisture is still 60-75% of the effective field capacity; this will provide a friable soil which will settle rapidly. Tests have shown that excessively deep ploughing adversely affects beet emergence, and it is recommended to plough to a depth which is 80% of the previous depth for a given soil type. Good ploughing will provide only slight undulation in the field and thus obviate the need for levelling of the winter furrows before seedbed preparation. Excessive undulation will have a deleterious effect on drilling. On the other hand, levelling is of advantage before winter or drilling, particularly where ploughing has been carried out at other than an optimum soil moisture content. Tests have shown about 15% greater beet emergence in a levelled field than in an unlevelled control plot.

Thoughts on the new beet harvest campaign of 1977. S. Gramse. *Die Zuckerrübe,* 1977, **26,** (5), 20-22 (*German*).—It is stated that the beet from more than 90% of the area in West Germany is harvested by a single-row machines despite forecasts that such harvesters would become obsolete within a few years; in practice, their capacity is often more than double the expected level, whereas that of six-row machines often falls to 50% of the expected or rated level when the speed falls drastically, e.g. below 3-4 km.hr^{-1}. However, there is need to reduce the losses incurred with single-row harvester operation and to improve their performance under poor field conditions. The six-row machine is economically advantageous on a large area (e.g. 300 ha) and is the only means of raising the work capacity per man, particularly where the farmer has limited time available for harvesting. The question of deterioration in the quality of beet stands and consequent harvesting is briefly examined, and causes unconnected with weather are listed. Means of reducing harvesting losses are also listed. Experience has shown that, while under normal conditions (uniform, well-established stand of beet without gaps and a minimum spacing of 15 cm) single-row machines can perform well at speeds of 7-10 km.hr^{-1} or even greater without losses, under adverse conditions a marked deterioration in harvested beet quality can occur at speeds above 7 km.hr^{-1}. It is suggested that the topper and flail will be of great importance in future, since, even where beets are too close together and there are gaps and a high proportion of doubles, there will be need for high-quality harvesting with a minimum of losses.

Control of rhizomatous weeds. Anon. *Die Zuckerrübe,* 1977, **26,** (5), 26 (*German*).—Even drought has not markedly reduced the incidence of couch grass (*Agropyron repens*), coltsfoot (*Tussilago farfara*) or creeping thistle (*Cirsium arvense*) in recent years. While couch grass can be controlled with "Nata", following one of two procedures which are described in detail, "Roundup" is effective against all three weeds mentioned and its use is not restricted by weather conditions. It is best applied after the grain harvest and removal of stubble, when the couch grass is 10-20 cm high and has at least 3 leaves; in the case of the other two weeds, spraying can be carried out as soon as sufficient leaf material has formed. The application rate is 5 litres.ha^{-1} a.i. in 400 litres of water.

Timing and application of post-emergence herbicides. W. E. Bray. *British Sugar Beet Rèv.,* 1977, **45,** (3), 7-8.—Many beet fields in the UK were affected by application of post-emergence herbicides in May and June of 1977. Since the margin between crop safety and adequate weed control is often extremely narrow, the author stresses the need for great care in the timing and method of application of such herbicides. The crop must be in a sufficiently healthy condition to withstand treatment, while satisfactory coverage of the weeds is necessary in order to ensure optimum control with contact herbicides. Because of differences between chemicals as regards requirements for adequate coverage, manufacturers' instructions must be strictly followed. A table gives the minimum beet growth stage and permitted pre-drilling/pre-emergence herbicides which the post-emergence treatment may follow in the case of various herbicides and herbicide mixtures. "Betanal E" is the most widely used post-emergence herbicide in the UK, but there are several possible causes of reduction in its selectivity. Of the total beet area in the UK, 25% was estimated to contain beet which had been injured to some degree, most of the damage being caused by post-emergence sprays. Quite often, three or more of the following factors were involved: physical damage to leaf by wind, frost, insects, etc.; high temperature and/or light intensity; the effect of soil-acting pre-emergence herbicides; and deficiency of micro-nutrients (especially Mn) or lime. With a fall in selectivity of "Betanal E", mixtures containing it become even more injurious to beet than does the product alone. It is therefore important to choose a post-emergence treatment based only on weed and beet growth stage—the use of a safer treatment should be considered where otherwise damage could occur.

CANE SUGAR MANUFACTURE

Corrosion resistant fibreglass reinforced plastic (FRP) pipes and tanks for the sugar industry. A. R. Zayco. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 374-375.—Advantages of reinforced plastic pipes and tanks are discussed briefly. They include stability, corrosion resistance, ease of maintenance, durability and lightness.

La Carlota—water pollution control. E. G. Nillos. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 376-380.—The system at La Carlota involves the individual treatment where required (e.g. neutralization) of liquid effluents which are then collected in a treatment pond from which the waste water is pumped to a reservoir from which it is withdrawn for irrigation of the cane fields.

An equitable system of sugar and molasses distribution. J. B. Santos. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 394-402.—Instead of molasses being received by the grower on a basis only of the pol of his cane, a more equitable system is proposed whereby molasses distribution is made on the non-sugar in juice, i.e. the difference between Brix and pol, which is responsible for molasses formation.

Equitable sugar and molasses distribution. L. Valera and M. Oliveros. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 403-412.—It is proposed that an equation $M = (100\text{-}J) \times 0{\cdot}4 + K$ be used in the Deere formula for available sugar (used in calculating the planter:miller distribution) where M is final molasses purity, J is first expressed juice purity, and K is a constant (28·57 according to unpublished work by Balagso). This gives a more equitable distribution than where M is considered a constant value.

Development of the Bernard Lodge sugar factory. L. A. D. Chin. *J.A.S.T.J.*, 1974, **35**, 16-20.—In January 1974 the Bernard Lodge factory was acquired from United Brands Co., of the US, by Jamaican interests including the Government to the extent of 10%. The plans of the new owners are discussed; they include enlargement from 170 to 200 t.c.h. capacity, expansion of cane supply, developing of new product lines including 2-lb and 5-lb brown sugar packs and liquid refined sugar, confectionery, invert sugars, fructose, glucose and lactic acid, and development of products from bagasse and molasses.

Evaporator control at New Yarmouth factory. J. J. Zwaardemaker. *J.A.S.T.J.*, 1974, **35**, 98-101.—Evaporator performance is often less efficient than believed, and automation can improve matters and remove a bottleneck. It is preferable for automation to be effected in one operation whereby instruments and controls are compatible and of the same sensitivity. At New Yarmouth, however, level controls were provided some time before introduction of syrup Brix control, and an account is given of the problems involved and their solution.

Flocculation processes in sugar manufacture. M. C. Bennett. *J.A.S.T.J.*, 1974, **35**, 101-109.—Particles suspended in untreated cane juice are all negatively charged and so repel each other, and have a layer of strongly hydrated material surrounding them which acts as a cushion to prevent close approach of particles to each other. This provides stability which is overcome in flocculation by neutralization of the negative charge by acid or positively charged organic or inorganic materials, by reduction of the degree of hydration by boiling or addition of cationic surfactants, or by introduction of a bridging mechanism, the commonest being the calcium phosphate precipitate in normal clarification. The newer mechanism employs long-chain organic compounds, particularly polyacrylamides, and these are particularly effective where a primary flocculation has already been achieved. The structure and action of the polyacrylamides is described and their applications in sugar manufacture summarized.

Evaluation and analysis of factory lost time. P. B. Nurse. *J.A.S.T.J.*, 1974, **35**, 110-115.—Analysis of sugar factory performances over the period 1969-1973 showed an average total lost time of 38·98%, comprising 12·97% for factory stoppages, 9·81% through field stoppages, 5·81% for week-end stops, 3·85% through rain, 3·42% predetermined stops, 2·74% labour stoppages, 0·08% transportation stops and 0·30% from other causes. The losses in efficiency because of lost time and the gains which could be achieved by raising it, so shortening the crop, are discussed and proposals made for efforts to raise efficiency to at least 75%. Areas where attention is needed to achieve this level are employee motivation and training, and proper scheduling of cane deliveries to avoid the supply of stale cane, reduced deliveries over week-ends, and concentration of deliveries over a short daily period. A change is required in negotiation procedure with trade unions so as to ensure that they take place out of crop and thus avoid in-crop stoppages.

Recirculation of non-sugars. J. R. McFarlane. *J.A.S.T.J.*, 1974, **35**, 120-139.—For a typical Jamaican sugar factory boiling an *AB*-strike, and *B*- and *C*-strikes, non-sugars recirculation increases with decreasing *C*-sugar purity. Moreover, while the quantity of *AB*-massecuite is reduced by a little more than the increase in the quantity of *B*- and *C*-massecuite, the rates of boiling of *B*- and *C*-massecuites are much lower than that of *A*-massecuite and the total pan time is substantially higher, with consequent sucrose destruction. Thus, as high a *C*-sugar purity as possible, consistent with minimum final molasses purity, should be aimed for. Calculations are indicated for different boiling systems and purities of massecuites, molasses and sugar in order to realise increases in effective capacity within the system.

Fifty-second annual review of the milling season in Southern Africa (1976-1977). J. P. Lamusse. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 72-91. Cane varietal data and milling statistics are tabulated

and summarized, with reports mainly from South African sugar factories but also from Mozambique, Swaziland and Malawi.

Prediction of season average pol % cane for a mill. R. G. Hoekstra and S. M. Baker. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 92-96.—The relative cane payment system requires an estimate of the seasonal average pol % cane for the mill, and adjustments are required when the true value becomes known; it is best for the estimate to be as close to the true figure as possible. A system was developed and has been applied for the five Hulett sugar factories; it involves, first, development of a pre-season estimate before crushing begins, based on the weighted sum of the double exponentially smoothed value of previous seasons' averages and, second, development of a within-season prediction based on the weighted sum of the pre-season estimate, the average pol % cane value to date during the season, and the difference between the latest month's pol % and the average pol % cane to date. The relative weightings of these threec omponents change during the season.

Evaluation of screen modifications on a continuous centrifugal. P. A. Prince and M. R. G. Montocchio. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 101-106.—Comparative trials were made with a battery of BMA K850 continuous centrifugals, one of which was provided with a special Veco screen having an open area approximately 14% greater than the standard screen, a woven stainless steel mesh also being provided to give greater support. Capacity was increased by some 25% and over 50% in some trials. The same amount of water was used as with the standard screen but, because of the greater throughput, dilution of the molasses was reduced. The screen was expected to have the same life as a standard screen. Molasses purity was equal to or possibly lower than when using the standard screen. Screen washing on a standard machine appeared to reduce molasses purity, e.g. from 38·9 to 38·3 on average, while cold water (at 40°C) for washing gave a slightly lower sugar purity than when using hot water (80°C) while also reducing molasses flow and increasing its purity.

A preliminary report on a continuous *C*-pan. W. S. Graham and D. J. Radford. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 107-111.—A 64 m^3 Fives-Cail Babcock continuous pan was installed at Tongaat for *C*-sugar boiling and is described in detail. In operation it achieved as good exhaustion as a batch pan but capacity was well below its rated throughput. Lowering the steam traps, installing baffles to give better steam distribution in the calandria headers and installing condensate drains and incondensable gas vents on the upper compartments of the headers were all found to have little effect on pan performance. However, steam jiggers, provided with crosspieces having 13×5 mm holes and fitted to each compartment, distributed steam more uniformly and brought an appreciable improvement in capacity. The molasses feed inlets were fitted with distribution pipes, bringing the feed nearer the centre of the pan and distributing it over a wider area; steam pipes were also connected so as to feed a molasses/steam mixture. An automatic air bleed was fitted to maintain a constant vacuum (and so constant temperature) when the steam was shut off. Controllers were used to govern feeding to individual compartments. Subsequently, throughput was increased to 9-12 tonnes.hr^{-1}, against 8·2 tonnes.hr^{-1} before modification, while steady-state conditions could be obtained, giving consistent results with very little operator attention. Scaling was not a serious problem and manual cleaning by brushing should be adequate.

Monitoring of entrainment by vapour sampling and the use of a flame photometer. T. B. Dale and J. P. Lamusse. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 116-118.—A description is given of a system of sampling and condensing of vapour which is then analysed for potassium using a flame photometer in order to give a measure of the sugar entrained. An example is given of its use to detect and locate excessive sugar loss at Gledhow.

Experiment planning and the use of factorial designs. G. R. E. Lionnet and S. M. Baker. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 125-128.—The paper provides a set of procedures considered essential for efficient planning of experiments and highlights the advantages of designing the experiments to answer questions rather than obtaining a series of experimental data, the analysis of which must then be worked out. An example is given of a factorial design for experiments to determine the most important factors affecting exhaustion of *C*-massecuite.

An evaluation of "Visc-Aid" treatment at Darnall mill. C. van Lier. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 129-132.—A series of trials were made alternately using and not using "Visc-Aid", a chemical intended to reduce massecuite viscosity and so improve exhaustion, etc. Measurements were made of the exhaustion of *A*-, *B*- and *C*-massecuites as well as massecuite Brix and viscosity and pan boiling times. Mean values were obtained for the treatment periods and for the control periods, and the statistical significance of variations in the parameters was measured using the *t*-test. Variation in the reducing sugars:ash ratio made it difficult to determine how much of the improvement in massecuite exhaustion and overall purity drop was due to the "Visc-Aid"; however, since all the changes were favourable, it is believed that "Visc-Aid" contributed. Changes in massecuite Brix could not be achieved because of difficulty in striking the pan, so that the effect of "Visc-Aid" could not be judged. Attempts were made to measure massecuite viscosity, but the results were inconsistent. Pan boiling times were reduced by 5%.

Air pollution control—practical experience at Tongaat. B. St. C. Moor. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 133-136.—Experience at Tongaat factory with six high-efficiency wet-type flue gas scrubbers is described, the scrubbers being of three different types operating on both bagasse and mixed-fuel bagasse/coal boilers. Aspects covered include pollution control equipment selection, operation and performance; materials of construction; wet and dry fans; smuts dewatering and conveying, and disposal of the smuts. Several of Tongaat's solutions to problems in these areas are considered to be applicable in other factories.

BEET SUGAR MANUFACTURE

Study of heat losses in Larissa sugar factory. S. Papastergiou. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (29), 309-327 (*Greek*).—The mass, enthalpy and exergy balances have been established for the boilers, steam turbines, diffusion, juice purification, evaporation, pan boiling and drying stations at Larissa sugar factory in order to investigate and calculate energy losses. A quick method of calculating optimum insulation thickness is proposed, and the inadequacy at the purification and evaporator stations after extension is established. Modifications are proposed for reduction of heat losses.

Processing of factory waste by reverse osmosis. T. H. Henscheid, A. Matheson and K. Schoenrock. *Sugar J.*, 1977, **39**, (12), 20-24.—Steffen waste and ion exchange waste were treated by single- and double-stage ultrafiltration and reverse osmosis and also by passage through a Dow cartridge filter. The ultrafiltration used one or two cells fitted with membranes of $2\frac{1}{2}$ in^2 area and pressure up to 100 psi, while up to 900 psi was used for the reverse osmosis. Flow rate of feed solution was 300-600 cm^3.min^{-1}, decreasing as the feed concentration increased. The product was recycled until the concentration of either product or permeate reached a target value. Factors affecting reverse osmosis were studied, including pressures, feed concentration, pH and temperature, the effects being recorded in graph form. pH is critical to preserve membrane life and should be in the range 4·0-8·0. Higher temperatures (up to 50°C) increase permeation rate through reduced viscosity. Two-stage reverse osmosis raised the concentration of Steffen filtrate from 3·99 RDS (% refractometric dry solids) to 6·22 and then 9·35, while the permeates were of 0·33 and 0·56 RDS, respectively. A two-stage unit could thus replace four stages of the seven-stage evaporator currently used to bring the filtrate to 55-60 RDS. The permeate, if sent through a second cell, gives a second permeate which is suitable as a high-quality water for recycling to process. High-pressure ultrafiltration tests with a UMO5 membrane showed that this retained 99% of the colour and 13% of the ash in the feed (a decolorizing resin regenerant liquor after use). Thus, 1400 cm^3 of feed of 5·34 RDS, 61·59% ash on RDS and 1068 colour units gave 1115 cm^3 of permeate of 3·10% RDS, 86·01% ash on RDS and 50 colour, with a concentrate remaining of 285 cm^3 containing 8·28% RDS, 47·73% ash on RDS and 2115 colour units. There was, however, selective permeation of ash, monovalent ions passing easier than polyvalent ions. Combined treatment of Steffen filtrate by ultrafiltration with UM2 and UMO5 membranes and reverse osmosis with a RO89 membrane gave three fractions: colourless water permeate (53% on feed) of 0·35 RDS, a brine (30% on feed) of 6·3% RDS containing about 50% ash on RDS, and the concentrates from the two ultrafiltration units, totalling 17% on feed and containing 19% of the ash and most of the original colour. The last can be added to the pulp while the brine is usable for decolorizing resin regeneration and water returned to process.

Study on treatment of press water with organic flocculants. J. Hašek, J. Smolík, L. Fassatiová and M. Štenglová. *Listy Cukr.*, 1977, **93**, 104-113 (*Czech*).—Full details are given of tests on treatment of press water and model pectin and albumin solutions with "Orthosan MB" and "Syntefix" cation-active flocculants. Tables and graphs indicate the effects of both flocculants in terms of colloid coagulation, colour and mud reduction as well as coagulation and reduction of micro-organisms. While "Syntefix" was better in terms of colloid coagulation and hence filtrability of the water, "Orthosan MB" was better as a disinfectant at high concentrations (up to 10 g.litre^{-1}), although its bacteriostatic properties were not as good as those of other disinfectants in normal commercial use. "Syntefix" (which is preferred to "Orthosan MB" as a coagulant and is relatively cheap when used in small but adequate quantities) is very slightly toxic and dissolves at 80°C.

A sectioned direct flow carbonatation vessel. L. P. Reva, V. M. Logvin and V. V. Tikhii. *Sakhar. Prom.*, 1977, (7), 8-11 (*Russian*).—Details are given of a vertical, cylindrical carbonatation vessel which is divided into five compartments from top to bottom by inclined baffles; the bottom of each compartment is provided with an annular bubbler. Weir boxes connected to pipes maintain the level of the bubbling layer in the compartments and transfer the juice from one compartment to the next; exhausted CO_2 from the space above the juice passes through another pipe to the bubbler in the next compartment. Untreated juice is pumped into the top compartment and, after gassing, leaves at the opposite end so as to avoid passing through fresh, incoming juice. Connexion of the weir box to the space above the juice level by means of a pipe section prevents occurrence of a syphon effect which could create juice level fluctuations in the compartment. Tests on a pilot plant of about 1 m^3 effective volume (equivalent to the processing of 200 tonnes of beet per day), which was operated in parallel with an existing carbonatation vessel showed that while juice from both vessels was of optimum alkalinity (pH_{20} 10·9), that from the experimental model adsorbed 72·9% of the CO_2 compared with only 48·8% in the factory vessel, the latter being considered inadequate for normal treatment of juice. Filtrability of the 1st carbonatation juice was the same in both cases, while the settling properties were better in the case of the factory vessel. The 2nd carbonatation juice properties were, for the factory and experimental vessels, respectively: 91·2 and 90·0 purity, 31·6° and 41·4°St colour per 100°Bx and 0·049% and 0·055% lime salts content (as CaO). Foam formation in the model vessel was very slight, although there was a small amount of deposit on the walls and internal elements of the top compartment in the model vessel which, however, did not affect gassing.

The "price" of water at a sugar factory. A. P. Parkhomets, N. A. Zan'ko, V. I. Sergienko and A. F. Gonchar. *Sakhar. Prom.*, 1977, (7), 12-15 (*Russian*).—The authors discuss the proportion of beet processing costs represented by the costs in the water and effluent sector. Typical costs at a new Soviet sugar factory show that the price of 1 m^3 of fresh water may be only 7% of the costs of treating lowest-grade (Class III) effluent with

mechanical aerators. Nevertheless, it is pointed out that there is still lack of constant monitoring of the losses represented by the water sector costs. Typical costs in Czechoslovakia, East Germany and the USA are indicated, and details are given of factors to be taken into consideration in establishing an annual balance of fresh water and effluent treatment costs. A sample balance is presented.

The effect of pH on sugar solution composition in the presence of sodium sulphite. A. P. Kozyavkin, N. I. Odorod'ko and L. D. Bobrovnik. *Sakhar. Prom.*, 1977, (7), 15-17 (*Russian*).—With the aim of establishing optimum sulphitation conditions whereby losses in boiling resulting from a drop in pH will be minimum, low-grade sugar solutions of 65°Bx were treated with 0·1% sodium sulphite (on weight of sugar) to pH values in the range 5·2-9·0 and held at 80°C for 6 hours; colour, viscosity, pH, lime salts, colloids and free SO_2 were determined before and after treatment. The pH fell with temperature rise more slowly as a result of sulphitation than without treatment. With increase in pH from 5·2 to 7·8, the lime salts and colloid contents fell, after which they started to rise, while minimum viscosity and colour occurred at pH 7·6-7·8. The lowest SO_2 content was observed at pH 7·8-7·9. It has been found that at pH 7·8 $CaSO_3$ formation is considerable and its electrokinetic potential is maximum. Under these conditions, colouring matter is adsorbed to a maximum extent by the positive-charge $CaSO_3$ which then settles out. Hence, maintenance of massecuite at pH 7·6-7·9 is recommended.

Production of hypochlorites from regeneration effluents from chemical purification of boiler feedwater. A. B. Khanin and G. I. Belozerova. *Sakhar. Prom.*, 1977, (7), 17-21 (*Russian*).—Tests were conducted on electrolysis of regeneration effluent from ion exchange treatment of boiler feedwater (where NaCl is used as regenerant) to obtain sodium hypochlorite for use as disinfectant in treatment of e.g. flume-wash water. Regeneration effluents from three sugar factories were used; addition of NaCl to the effluents from two of the factories and raising of the hardness salt concentration yielded more chlorine at reduced electricity consumption. Tabulated data include the concentrations of Ca and Mg chloride deposited on the cathode as well as the active chlorine yield. Results indicated the suitability of the method; siting of electrolysis plant near the boiler feedwater treatment plant is recommended.

Suggestions from efficiency experts at sugar factories in the Cherkass group. A. P. Parkhod'ko. *Sakhar. Prom.*, 1977, (7), 32-33 (*Russian*).—Modifications carried out at various factories in the USSR are briefly described. They include improvements to the plate-type clutches linking the electric motors to the centrifugal pumps used with turbo-gas compressors, filters and crystallizers; use of a rake-type conveyor to feed massecuite to centrifugals; installation of a steam jacket to raise the temperature in tower diffusers; and means of closing the distance between steam jets and beet slicer knives for cleaning purposes.

Use of the heat energy from compressed re-heat steam. A. F. Deryavko. *Sakhar. Prom.*, 1977, (7), 35-36 (*Russian*).—The author complains that insufficient use is made in Soviet sugar factories of the heat from re-heat steam such as pan and evaporator vapour, condensate and condenser water. Descriptions are given of schemes for utilization of compressed vapour and flash steam for pan steaming-out, pulp drying, and syrup, molasses and raw juice heating. It is pointed out that evaporator performance is thereby also improved.

Heat exchange intensity in high-temperature juice evaporation. L. P. Maiorova, V. V. Maiorov and A. R. Sapronov. *Sakhar. Prom.*, 1977, (7), 45-50 (*Russian*). Results are given of statistical evaluation of experimental data on heat exchange rate during heating of sugar solutions in the temperature range 127-147°C, and equations are derived for calculation of the heat transfer coefficient for solutions of 9-21°Bx subjected to forced circulation and for juice heating within the temperature range 100-150°C.

Electro-magnetic treatment of sugar solutions. S. I. Nedzvedskii, B. F. Kolesnikov, V. A. Maksyutov, P. P. Pavlov and V. A. Kolesnikov. *Sakhar. Prom.*, 1977, (7), 50-52 (*Russian*).—Tests are reported in which 1st carbonatation juice was subjected to electro-magnetic treatment as a means of preventing scale formation in the juice heater. A description is given of the vertical, cylindrical test unit, in which exposure of the juice to a field of $2{\cdot}8\times10^5$ amp.m^{-1} permitted maintenance of a practically constant heat exchange coefficient in the heater, by comparison with a 40% fall from September to December when the juice was not treated. Moreover, the lime salts in the treated juice was reduced by 3-9% after filtration by comparison with the untreated juice; this was attributed to easy separation of the calcium carbonate in a finely dispersed form which failed to adhere to the heating surface while the juice was constantly moving. Juice Brix, colour, pH and sugar content were practically unchanged by the treatment.

Further tests on improving the quality of thin juices without alkalinity reserve by partial anion exchange. F. Perschak. *Zucker*, 1977, **30**, 332-338 (*German*). Reference is made to the anion exchange treatment of thin juice to adjust the alkalinity by replacing the anions with hydroxyl ions without the need for alkali addition[1]. While addition of the treated juice in place of NaOH or soda before 2nd carbonatation was found to give a sufficient alkalinity reserve and hence a thin juice of reduced hardness and high thermostability, a major disadvantage was found to be the considerable volume of juice involved and the consequent increase in equipment and pipeline requirements. However, in a private communication, Pieck has suggested treating not thin juice but a portion of filtered, cooled 1st carbonatation juice by the ion exchange method and subjecting the effluent plus the remaining untreated 1st carbonatation juice to 2nd carbonatation. Tests were carried out in which 1st carbonatation juice was treated with MP 600 resin in OH^- form; 228 cycles were completed in the experimental plant, which comprised a 1 m high glass column through which juice was passed at a specific load of 7·5 vol. per vol. of resin, cycle duration being 120 min and regeneration with 4% NaOH at the rate of 1500 meq.litre^{-1} taking 185 min. Resin volume in the

[1] Schneider & Perschak: *I.S.J.*, 1975, **77**, 245.

column was 5·2 litres. Quality of water used for sweetening-off and back-washing was found to affect juice decolorization; agitation of the resin particles with air after sweetening-off was found to be necessary so as to permit removal of turbidity, particularly $CaCO_3$, during subsequent back-washing. When filtered 1st carbonatation juice was mixed with 30% by volume of ion exchange-treated juice from the same initial batch and subjected to 2nd carbonatation, the purity after 215 cycles was raised from 91·24 (that of 1st carbonatation juice) to 91·75, the colour reduced by 23·47% (from 2347 to 1796 ICUMSA units at 420 nm) and the hardness reduced from 39·2° to 20·0°. The high-organic fraction of the regeneration effluent was analysed and found to have a gravimetric dry solids content of 6·36%, COD of 16,682 mg.litre^{-1}, pH of 12·5, alkalinity of 583 meq NaOH per litre, and a sulphate ash content of 90·4% on dry solids. Of the 2·24% N (on dry solids) found, 64% was in the form of pyrrolidone carboxylic acid. The question of possible recovery of e.g. glutamic acid from the fraction should be examined, it is thought. Optimum colour desorption and leachability as well as salt splitting capacity of the resin were obtained by percolation of sulphuric acid through the resin followed by NaCl treatment and subsequent regeneration. The author calculates that a full-scale unit would incorporate five resin columns, each containing 1·39 m^3 resin, based on 10 equivalents of anions to be exchanged per tonne of processed beet and an effective resin utilization of 400 equivalents per m^3. An equation is given for calculation of the molasses reduction possible with the ion exchange process.

Beet washing and supply. J. N. Doucerain. *Zucker*, 1977, **30**, 339-344 (*German*).—See *I.S.J.*, 1976, **78**, 215.

Treatment of beet tails and trash. V. Fakler. *Zucker*, 1977, **30**, 344-348 (*German*).—The author briefly describes a Köllmann & Gruhn plant for treatment of beet tails and trash, and gives details of trash shredders. It is pointed out that, while conventional treatment of trash has involved the use of shredders, the more modern approach is pressing, and details are given of a double-screw press of 20 tonnes.hr^{-1} capacity. At Lage sugar factory, the dry solids content of pressed trash was measured twice daily over a 3-week period in 1975, and averaged 19·4% and 19·3% at 0800 and 1700 hours, respectively, ranging from 17·0% to 22·2%. The motor is rated at 37 kW. Although there is need to dispose of water emanating from the pressed trash, the amount is only 4–6 m^3.hr^{-1} and should offer no difficulties.

Treatment of (beet) tails and trash. G. Gerlach. *Zucker*, 1977, **30**, 348-351 (*German*).—Bammann & Schreiber equipment for separation of stones, trash and beet tails is described with the aid of illustrations. While tails are usually processed together with whole beets, trash disposal has taken on a new significance now that there is reduced interest on the part of farmers in buying the material. However, mixing trash in with dry pulp has overcome the problem and increased the fodder yield, as indicated by results from Brühl sugar factory.

Possible means of using computer techniques for process control in sugar manufacture. G. Šturc, A. Wallner and S. Ondrejička. *Listy Cukr.*, 1977, **93**, 127-130 (*Czech*).—The approach of the Sugar Research Institute in Bratislava (in collaboration with Juhocukor) to the official plan for introducing complete process control in the sugar industry, based on computer techniques, is explained. The aim, under the five-year plan, is for complete factory control from beet pile to sugar silo.

Two silos each of 70,000 tonnes white sugar capacity with packaging and despatch station for 1000 tonnes.hr^{-1} at Connantre sugar factory, France. M. Laraignou and J. Saguez. *Zeitsch. Zuckerind.*, 1977, **102**, 446-449 (*German*).—Details are given of the two concrete silos built at Connantre by Ostenfeld Ingénierie. Each silo consists of (i) a sub-structure in the form of a giant "cellar", in which 104 columns 3·5 m high support the silo floor, (ii) two storage rooms—an inner cylindrical one of 20 m diameter and an outer annular room (the overall diameter of the silo being 47·5 m), and (iii) a superstructure comprising a domed roof and carrying the sugar feeding equipment. The overall height of the vertical section of the silo is 54 m. Between the two silos is a square-sectioned concrete elevator tower which is linked to the sub- and superstructures of each silo. Feeding rate of the sugar is normally 90 tonnes.hr^{-1}, with a maximum at peak times of 110 tonnes. hr^{-1}. The sugar is fed by belt conveyor to the central elevator tower at a point 22 m above its base, whence it is transferred via a batch weigher and bucket elevator to an inclined belt conveyor which carries it to a mobile, swivelling conveyor; this feeds the sugar through one of a number of ports as required. Monitoring of the process is by means of closed-circuit television. Sugar is discharged through 137 ports into the "cellar" and passes via various conveyors to the batch weigher in the elevator tower, from which it is sent by belt conveyor to the packaging and despatch section. All conveyors are systematically dedusted by suction hose. Air of 30% moisture content and a temperature of 25°C is circulated through the stored sugar by means of a fan of 15,000 m^3.hr^{-1} capacity at a pressure of 0·2 bar.

Enzyme applications in the sucrose industries. J. Obara, S. Hashimoto and H. Suzuki. *Sugar Tech. Rev.*, 1977, **4**, 209-258.—The use of α-amylase, dextranase and α-galactosidase (melibiase) in the sugar industry has been studied. The first has been used industrially for hydrolysis of starch in cane juice or syrup, but dextranase has not been used on an industrial scale for hydrolysis of dextran. α-Galactosidase has been used since 1968 for hydrolysis of raffinose in beet thick juice to give galactose and sucrose and thus increase recovery of sugar. A mould, *Mortierella vinacea* var. *raffinoseutilizer*, has been found suitable as a source of the enzyme since it does not produce appreciable amounts of invertase as well, and the enzyme is contained in mycelial pellets which may be used similarly to immobilized enzyme preparations. Beet final molasses is continuously adjusted to 30°Bx, pH 5-5·2 and 50°C and fed into a continuous reactor where it is in contact with the enzyme pellets for 1½–2½ hr; it may then be separated, cooled and sent to a calcium saccharate process. According to data from the Hokkaido Sugar Co. Ltd., 30 kg of pellets will hydrolyse 1 tonne of raffinose during 100 days, 60% of the raffinose in the molasses feed being hydrolysed. Alternatively, an intermediate molasses may be treated at 50°Bx, 50-55°C and pH 5·2 over 2-3 hr. (See also McGinnis: *I.S.J.*, 1976, **78**, 121.)

LABORATORY STUDIES

Monosaccharides by hydrolysis of the colloidal fraction in the manufacture of sugar. M. Darias, I. Valentin and C. Hernández. *ATAC*, 1977, **36**, (1), 55-65 (Spanish).—Colloidal fractions in cane sugar products (raw and clear juice, syrup, massecuites, sugars and molasses) were separated on "Sephadex G50" and their hydrolysates subjected to one-dimensional chromatography on paper using a 4:1:5 butanol:acetic acid:water solvent and employing as standards known monosaccharides, and hydrolysates of known polysaccharides. The results are recorded and confirm the findings of previous workers reported in the literature.

Testing for commercial ripeness of sugar beet on the basis of sugar content and the potassium: sodium ratio. P. Staticescu, A. Costache and A. Stroia. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (4), 35-39 (*Rumanian*).—Tests are reported in which the sugar content of two varieties of beet was determined polarimetrically and the K_2O and Na_2O contents measured by flame photometry. The results showed that the potassium:sodium ratio rose with sugar content throughout the growing period and by mid-October was numerically almost identical with the sugar content. Hence, the ratio is considered a valuable guide to commercial ripeness and can easily be found from conductimetric ash measurements using regression equations which are presented.

Enzyme-catalysed synthesis of sucrose from starch. L. G. Butler, R. G. Squires and S. J. Kelly. *Sugar y Azúcar*, 1977, **72**, (4), 31-32.—A study is reported on the enzymatic conversion of starch-based dextrose or a dextrose-fructose mixture (similar to high fructose corn syrup solids) into sucrose. Examination of some enzymes from *Aspergillus* spp. showed that they would add a fructosyl moiety from β-methyl fructoside (formed by enzymatic synthesis or acid catalysis in a 40% methanol solution) to sucrose or other sugars but not dextrose. On the other hand, sucrose phosphorylase from *Leuconostoc mesenteroides* has been shown[1] to synthesize sucrose from levulose and α-D-dextrose 1-phosphate which is obtainable from starch under the action of starch phosphorylase[2]. Research is needed to develop a synthesis to industrial utility.

Changes in sugar beet during its storage. I. K. Moorad. *Zeitsch. Zuckerind.*, 1977, **102**, 375-377 (*German*). Beets from the same source were stored at +6°, —6°, —15°, —30° and —40°C for 40-220 days, after which they were analysed and the changes in composition noted. Since little change was found at —30°C, and the results were almost the same as found earlier at —24°C, —30°C was regarded as the optimum lower limit. On the other hand, at temperatures experienced in storage in many areas of Northern Europe, viz. between —6° and +6°C, there were marked changes in composition. The trends are indicated by graphs showing the total N and acid contents, lactic acid, raffinose, levulose, dextrose, sucrose, calcium, sodium, potassium, ash, amido- and ammonia N, non-precipitable N, noxious N and amino-N contents as well as dry solids, thermophilic and mesophilic bacteria, marc content and slicing resistance.

"Epol"—a new high-sensitivity reagent for detecting sugar in boiler feedwater. K. Wagnerowski. *Gaz. Cukr.*, 1977, **85**, 101-105 (*Polish*).—"Epol" is a fine powder obtained from "Epidian 5" epoxy resin by hardening with triethylenetetramine, the resin itself being formed by condensation of a diene with epichlorhydrin in alkaline medium. When 2·5 cm^3 of a concentrated sulphuric acid solution containing 0·5-0·6 $mg.cm^{-3}$ of the powder is mixed with 1 cm^3 of boiler feedwater in a test tube, the presence of sugar is indicated after about 30 sec by the formation of a colour which ranges from pink through red to reddish-violet according to sugar concentration. In tests with distilled water and condensate to which known quantities of sugar had been added, "Epol" gave a clearer indication than did alpha-naphthol, e.g. distinct pink coloration in the presence of 5 $\mu g.cm^{-3}$ sugar, while alpha-naphthol gave the same colour definition only at 50 $\mu g.cm^{-3}$ sugar. The presence of ammonia in condensate had no effect on the indicating properties of "Epol", which was also less sensitive to the presence of nitric acid than was alpha-naphthol. On the other hand, unlike anthrone, "Epol" proved to be highly sensitive to formaldehyde; alpha-naphthol is not adversely affected by up to 50 $\mu g.cm^{-3}$ formaldehyde. Photocolorimetric measurement of the colour change in the presence of sugar showed that maximum absorption of 99% was obtained at 560 nm with "Epol", by comparison with a maximum of 72% at 630 nm with anthrone and 60% at 510 nm with camphor. The use of "Epol" is protected by a patent.

Tests on adaptation of a method of gas chromatography to determination of sucrose. A. Ostaniewicz, K. Wesolowska, S. J. Kubacki and A. Borys. *Gaz. Cukr.*, 1977, **85**, 110-112 (*Polish*).—A gas-liquid chromatographic method is described, in which the carbohydrates are converted to their trimethylsilyl derivatives by means of a 10:2:1 pyridine:hexamethyldisilizane:trimethylchlorosilane mixture, and separated in a 4-mm diameter glass column coated with OV-101. Argon at a flow rate of 40 $cm^3.min^{-1}$ serves as carrier gas; hydrogen and air flow rates are, respectively, 40 and 740 $cm^3.min^{-1}$. Column temperature is 225°C and injection volume 0·005 cm^3. A flame ionization detector is used at 250°C. Tests were conducted on sucrose determination in pure solution and in the presence of invert sugar and raffinose. A 4:1 ethanol:water mixture containing 20 mg sucrose per 100 cm^3 was used as standard solution. Comparison was made with polarimetric measurements on an "alcohol acetate digestion". From the results it is concluded that the method does not lend itself to factory control, and that there is need for improvement in order to reduce the analytical errors which occurred. It is also recommended to examine the possibility of using a trehalose internal standard as in the method of Mahoney & Lucas[3], and to concentrate on quantitative and qualitative de-

[1] Hazzid *et al*: *J. Amer. Chem. Soc.*, 1944, **66**, 1416.
[2] Hanes: *Proc. Royal Soc.*, 1940, **129B**, 174; McCready & Hazzid: *Methods Enzymol.*, 1957, **3**, 137.
[3] *I.S.J.*, 1971, **73**, 291-294.

termination of non-sugars in digestion solutions and thereby establish a method for sucrose determination in beet.

Separation by gel filtration of raw sugar colour compounds. M. Muro, L. González, C. S. Freyre, I. Ramos and L. Marimón. *Centro Azúcar,* 1974, **1,** (3), 3-19 (*Spanish*).—Three grades of raw sugar (low pol, deteriorated and very deteriorated) were affined with water to remove the molasses film, and the affination liquor centrifuged to remove solid matter before U.V. spectroscopy. The first two grades had continuous spectra, and only the third showed a peak at 285 nm and a minimum at 245 nm. Use of gel filtration by means of "Sephadex G-10", "Sephadex G-25" and "Sephadex G-75" permitted fractionation of the colour bodies, and the U.V. spectra of these are reproduced. A colourless low molecular weight component from the third grade sugar was separated by gel filtration and could be detected by U.V., infra-red and nuclear magnetic resonance spectroscopy by means of which it was identified as 5-hydroxymethyl furfural.

Characteristics of colorant groups and their separation by means of ion exchange resins. C. Silverio, C. S. Freyre, M. Muro, A. Kosiavkin, M. Novo and J. M. Meana. *Centro Azúcar,* 1974, **1,** (3), 21-36 (*Spanish*). Caramels, melanoidins and reducing sugars alkaline degradation products were prepared separately and their U.V. spectra obtained. The solutions were subjected to paper chromatographic analysis and separation on ion exchange resins of three different types, indicating the possibility of using these techniques for identification of colour bodies present in a solution.

Study on the deterioration of sugar. I. M. Muro, A. Kosiavkin, J. A. García, L. González and I. Machado. *Centro Azúcar,* 1974, **1,** (3), 37-84. **II.** M. Muro, C. Silverio, T. Velunza, I. Machado and J. Meana. *ibid.,* 85-94 (*Spanish*).

I. Changes are recorded which took place in the pol, reducing sugars content, sucrose content, pH, colour and organic acids content of seven grades of raw sugar (between low pol of 96·84 and high pol of 98·30) held for up to five months at storage temperatures of 30°, 40° and 50°C and at 70 R.H. The results are recorded in graph and tabular form.

II. 700-tonne quantities of high-pol sugar, standard pol sugar and the latter washed in the centrifugals with 3% Na_2CO_3 solution were held in storage for 4 months at 35°C and the changes which occurred in pol, pH, colour, sucrose content, moisture and microbial population are tabulated. The effects on the first two types of sugar were comparable to those which occurred in the experiments reported in Part I, while the Na_2CO_3 rinse only appeared to have a germicidal action on the micro-organisms present; these are not considered to have a decisive effect on the deterioration of the sugar, however.

Separation of caramelization products by chromatographic methods. L. González C. and G. Peralta M. *Centro Azúcar,* 1974, **1,** (3), 95-119 (*Spanish*).—Caramelization products were subjected to various techniques for their separation, the consecutive separation method using dextran gel and different eluants showing clearly the presence of caramelan as well as a number of yellow colorants. Gel separation and U.V. spectroscopy showed that the caramelan was of molecular weight up to 50,000 while that of caramelen was between 50,000 and 200,000, with an ill-defined border between the two fractions. Substances of M.W. above 200,000 known as caramelin were not identified. The darker coloured materials, when subjected to electrophoresis, migrated to the positive electrode, being anionic, while the yellow colorants migrated to the negative electrode, being cationic. Compounds of M.W. less than 5000 were separated by paper chromatography and included sucrose, dextrose, levulose, an unidentified compound of R_f less than sucrose and another of R_f greater than levulose, and 5-hydroxymethyl furfural. The caramel contained 89% of compounds of M.W. less than 5000, 8% between 5000 and 50,000, 1% between 50,000 and 100,000, and 2% between 100,000 and 200,000.

Action of micro-organisms on the molasses film that surrounds sugar crystals. Formation of organic acids. M. T. Hernández and N. Rey. *Centro Azúcar,* 1974, **1,** (3), 121-136 (*Spanish*).—Micro-organisms present in raw sugar were isolated and characterized as to genus and pure cultures prepared. These were then cultivated in *A*-molasses of 74°Bx and dilutions down to 10°Bx, and incubated at optimum temperature throughout the time needed for maximum development. The organic acids content of the cultures was measured by titration before and after incubation, and the acids produced identified by paper chromatography. Acid formation was not detected with undiluted molasses but occurred with the more dilute solutions; it is concluded, therefore, that acid formation by micro-organisms is not a hazard in raw sugar storage unless the molasses film is diluted by the ingress of atmospheric moisture.

Influence of micro-organisms in the deterioration of bulk sugar. M. T. Hernández and N. Herrera. *Centro Azúcar,* 1974, **1,** (3), 137-146 (*Spanish*).—A study of the deterioration, under conditions of 0·41% moisture and 37° or 45°C, of raw sugars having high and low microbial populations, showed that the reactions occurring were of a chemical nature and were not influenced by the microbiological status.

The molar weight of non-sugars in molasses. P. Kadlec and E. Šárka. *Listy Cukr.,*1977, **93,** 131-135 (*Czech*). The molar weight *M* of molasses non-sugars was calculated on the basis of an average molasses composition and using values for individual non-sugars taken from the literature. The value found was 0·11262 $kg.mol^{-1}$. However, since the mean molar weight of non-sugars affects the BPE of sugar solutions, the value was also established from ebulliometric data and found to vary within the range 0·10005–0·16675 $kg.mol^{-1}$, with a mean value of 0·13340 $kg.mol^{-1}$. The importance of the molar weight of non-sugars in defining the physico-chemical properties of sugar solutions is indicated.

Automatic proportioning balances for weighing of fluids. F. Hruška and R. Štengl. *Listy Cukr.,* 1977, **93,** 136-138 (*Czech*).—A brief survey is presented of automatic proportioning balances as used in sugar factory laboratories, including Reyers & Zoon and Vietzke models. Mention is also made of a Czechoslovakian balance, introduced into factories in 1976-77 for 1:1

dilution of massecuite samples, which operated well throughout the campaign.

Characterization and inhibition of invertases in sugar cane juice. E. J. del Rosario and V. Santisopasri. *Phytochemistry*, 1977, **16**, (4), 443-445; through *S.I.A.*, 1977, **39**, Abs. 77-956.—Invertases were separated from filtered crusher juice from three cane varieties by $(NH_4)_2SO_4$ precipitation followed by chromatography on "Sephadex G-200". The fractions obtained contained an acid invertase with molecular weight of 380,000 and a carbohydrate content of 23·5%, and a neutral invertase of 66,000 M.W. and carbohydrate content of 22%. For the acid invertase, Km was 2·8 mM and V_{max} was 2·7 μmol sucrose hydrolysed/hr per mg protein; the corresponding values for the neutral invertase were 0·32 mM and 2·8 μmol. Inhibition of both invertases by either lauryl sulphate or metasilicate was not competitive.

The effect of sodium silicate on the preservation of sucrose in crude cane juice. R. Samaniego and R. J. C. Espino. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 94-111.—Samples of raw juice were treated with 0, 2, 4, 6, 8 and 10 micromoles of sodium silicate per cm^3 of juice and held at 20, 26 and 40°C, analyses for Brix, pH and pol being made at intervals up to 14 hours. It was found that the rate of inversion and fall in pH were reduced by the silicate while the effect of temperature was significant. There was little difference in effect between 6, 8 and 10 μmoles of silicate. Juice treated with 6 μmoles may be preserved for up to 11 hours at 28°C, so that silicate might be useful in the event of a factory breakdown or interrupted cane deliveries.

A comparative study on the polarization readings of light, medium and dark coloured sugars using the automatic polarimeter and conventional saccharimeter. E. G. Que and C. Morales. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 213-216.—Polarizations of a series of 50 light, 50 medium and 50 dark samples of raw sugar were measured using a Schmidt + Haensch conventional saccharimeter and a "Sucromat" automatic polarimeter, and the results used to derive three equations relating the former's measurements to the latter's.

A comparative study on the effect of wet and dry lead clarification on polarization of raw sugar using an automatic polarimeter. F. G. Salcedo, T. B. Sanglap and A. A. Fermin. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 217-224.—Three analysts, working simultaneously and independently, determined the polarization of 240 raw sugar samples using an automatic polarimeter and clarifying with wet lead and dry lead. The results were subjected to statistical analysis, and it is concluded that the clarification technique did not significantly affect the polarimeter readings.

Brix-sugar relationship and the unfermentable reducing substances in molasses. T. P. Mariño, M. M. Lachica, B. O. Santiago, W. Chinte and A. Guerrero. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 225-232.—Analysis of molasses for sucrose, reducing sugars and unfermentables content requires laboratory time, personnel and investment, while Brix measurement can be done readily by unskilled workers. Measurements were therefore made, using nine molasses samples, to relate Brix to sucrose, reducing sugars, unfermentables and total sugars. Equations are derived for the four relationships, and it is considered that Brix gives a good direct correlation with each.

Correlated sugar and final molasses distribution tables. C. T. Cabanilla. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 384-393.—The derivation which uses the Deere *s-j-m* formula for available sugar and calculations involved are explained in the preparation of a table of molasses:raw sugar ratios (kg:kg, gal:picul and kg:picul) which result from different apparent purities of first expressed juice. The table is to be used in calculating the entitlement of the grower in respect of the cane he has supplied and can be advised quickly after receipt of the cane and sampling.

Sucrose control at Monymusk factory. P. O. Skinner. *J.A.S.T.J.*, 1974, **35**, 88-92.—The use of pol for chemical control in a sugar factory is convenient and accurate enough for most products and intermediates. However, because of optically active materials present, it can give very different figures by comparison with sucrose analyses in final molasses. Undetermined losses may also be very much reduced when a sucrose balance is drawn up instead of a pol balance. At Caymanas, a partial sucrose control is employed at intervals; this showed that, whereas apparent purity appeared satisfactory, the true purity was almost 10 units higher than that expected from the formulae of Tate & Lyle, Douwes Dekker and the Queensland Sugar Research Institute. Although this may be partly due to their inapplicability to Caymanas conditions, poor molasses exhaustion is also likely to be partially responsible. It is recommended that pol-sucrose relationships be investigated by factories and a more complete analysis on final molasses be made in order to provide a suitable molasses exhaustion formula.

Determination of sucrose in cane juice by the borax method. S. Z. Qadri. *J.A.S.T.J.*, 1974, **35**, 93-97.—The López Hernández method[1] of nullifying the optical activity of dextrose and levulose (but not sucrose) by addition of borax solution was examined using pure solutions and by measurements on 70 samples of juice from West Indian sources, the latter being compared with true sucrose measured by the Clerget and Munson & Walker method. The results confirmed the applicability of the method.

The pol balance for mud % cane and juice. S. Qadri and J. Jaddoo. *J.A.S.T.J.*, 1974, **35**, 140-142.—The undetermined loss figure in chemical control of a cane sugar factory is in error to the extent that the pol in bagacillo, already included in the bagasse pol figure, is counted again in the pol in filter cake because the bagacillo is separated and used as filter aid. A study was made at Bybrook factory in which the bagacillo quantity and pol were measured, while the clarifier mud was filtered without bagacillo and then analysed. A new balance was made up and the undetermined loss error shown to be 0·06% on pol in cane.

[1] *I.S.J.*, 1963, **65**, 72-73, 107-109.

BY-PRODUCTS

Pre-pilot screening of some Philsugin yeast isolates. R. A. Bihis, L. R. Aventino, E. C. Dumangas and P. A. Ordas. *Proc. 23rd Conv. Philippines Sugar Tech.*, 1975, 129-145.—Tabulated data are given of comparative studies made to determine the best of more than 50 available yeast isolates in terms of alcohol production and resistance to bacterial infection in unsterilized worts. The five most promising isolates were identified.

Development, isolation and screening tests of yeast isolates obtained by enrichment culture technique. N. I. Chinjen, A. O. Garan, L. G. Gomez and C. T. Sarabia. *Proc. 23rd Ann. Conv. Philippines Sugar Tech.*, 1975, 146-152.—Alcohol production performance in the Philippines is poor and it is considered that the most important factor is the use of poor and/or inefficient yeast strains. New strains need to be developed which are resistant to high ambient temperature (able to ferment efficiently at 40°C), resistant to acid (of optimum pH 4 to minimize contamination and reduce factory sterilization requirements), resistant to alcohol (and so able to work efficiently at an alcohol content of 10% in the beer), and of good flocculating ability to facilitate separation and recovery, and to give a cleaner beer feed to the distilling columns. An account is given of trials on isolates from a number of sources, using the enrichment culture technique, and tests at distilleries of Lambanog yeast (isolated from fermenting coconut sap) which showed that it gave good alcohol yields, but low dry matter recovery, except when contaminated by bacteria.

Fungal protein production from cane trash, bagasse and pith. R. Samaniego and J. D. Layoso. *Proc. 25th Ann. Conv. Philippines Sugar Tech.*, 1975, 274-284.—A non-toxic, non-pathogenic cellulolytic fungus *Trichoderma viride* NRLL 3653 was grown on bagasse, pith and cane trash, individually and in combination. In surface fermentation of untreated cellulosic samples, the yields were 44·86%, 47·82% and 52·63%, respectively. In combination, the highest yield (60·11%) was given by a 1:2 ratio of bagasse to trash. Submerged fermentation of bagasse gave a higher yield than surface fermentation. Crude protein in the biomass was estimated from the N content as 65·41%.

The utilization of sugar beet tops. M. Nuttall and R. W. Clare. *British Sugar Beet Rev.*, 1977, **45,** (2), 7-10. A 1976 survey showed that 17% of tops were field fed to animals, 6% collected for feeding, 1% used for drying or silage feed, with 76% ploughed-in. The fertilizer value of the tops is recognized and the fact that many beet farms do not have livestock to consume them but collect them using a modern leaf or leaf-plus-crown harvester; ensilage can give suitable fodder, as shown by trials at Morley, and this has a production cost of £3-£5 per tonne as against a feed value of £10 a tonne.

Farmers praise the value of sugar factory lime. D. Charlesworth. *British Sugar Beet Rev.*, 1977, **45,** (2), 29-30.—Benefits gained by three UK farmers in application of filter cake for correction of soil acidity are described.

Grazing heifers on sugar beet tops. B. Draper. *British Sugar Beet Rev.*, 1977, **45,** (2), 33, 44.—An account is given of the successful feeding of cattle with beet tops combined with barley straw and urea.

Laboratory study of mechanical pulping of sugar cane bagasse. R. Imamura and K. Murakami. *Memoirs of the College of Agriculture* (Kyoto University), *Wood Sci. Tech. Series,* 1974, (2), 53-65; through *S.I.A.*, 1977, **39,** Abs. 77-783.—Bagasse which had been cut into 1-in lengths and screened was passed through a laboratory disc refiner of the circulating type. In the 1st stage of refining, in which the plate clearance was 2·1-0·2 mm, the vascular bundles were separated from the pith; in the 2nd stage, with plate clearance 0·12-0·07 mm, the bundles were ground into individual fibres, while the pith was torn into fragments which are considered to act as a filler in the paper sheets. The tensile strength of bagasse paper was rather low, but could be increased by including about 30% chemical pulp, so that it came within the desirable range for newsprint. The density could be increased to the required range by calendering. Opacity, oil absorbency and ink transfer were satisfactory, but the brightness was low, and the sheets showed a tendency to "two-sidedness".

A conceptual report on the production of sucrochemicals from sugar cane juice. A. Diokno. *Crystallizer,* 1977, **2,** (2), 10, 21-22.—Cane juice can be fermented directly to give ethanol, citric acid, acetone plus butanol, baker's yeast and fodder yeast, while ethanol can be converted via ethylene to a large range of other chemicals. It is suggested that this should be considered in the Philippines, with bagasse being used either as fuel or as raw material for board or paper, and ethanol also considered for use as a fuel.

Amyl alcohol from fusel oil. E. V. Carandang. *Crystallizer,* 1977, **2,** (2), 11, 20-21.—The literature on the constitution of fusel oil (46·8% amyl alcohol is quoted) and its separation during the alcohol purification process in a distillery is surveyed. Although in the USA amyl alcohol recovered from fusel oil is now replaced by an organic synthesis product based on petrochemcals, it is considered that its extraction could be economical in the Philippines.

Butanol from molasses. C. Saludo, B. de Jesus, C. Lim, E. Quidilla and E. Siman. *Crystallizer,* 1977, **2,** (2), 11, 21-22.—Details are given of a process whereby molasses or other sugar-containing raw material is fermented using *Clostridium saccharobutylacetonicum* in the presence of degraded protein or ammonia as nitrogen source, at a pH of 5·7-6·7 (maintained by addition of $CaCO_3$), in a closed vessel held at a sterile CO_2 pressure of 15 psi and at a temperature of 87°F for 18-24 hours. Uses of butanol are discussed, and brief reference is made to the economics of the process.

PATENTS

UNITED KINGDOM

Manufacture of dextrose isomerase and conversion of dextrose to levulose. L. Givaudan & Cie. S.A., of Vernier-Geneve, Switzerland. **1,410,579.** 21st February 1974; 22nd October 1975.—A dextrose-containing solution is inoculated with a culture of *Streptomyces glaucescens* (*S. glaucescens* ETH 22794) or a dextrose isomerase isolated from such a culture (on a nutrient medium containing xylose or a polysaccharide degradable to xylose by the micro-organism) and levulose isolated from the incubation mixture.

Recovery of sugar from beet molasses by ion exclusion. Pfeifer & Langen, of Köln, Germany. **1,411,455.** 28th June 1973; 22nd October 1975.—See US Patent 3,884,714[1].

UNITED STATES

Solidified molasses-soya protein food product. E. F. Glabe, P. W. Anderson and S. Laftsidis, *assrs.* Food Technology Inc., of Chicago, IL, USA. **3,893,842.** 1st July 1974; 8th July 1975.—The dehydrated molasses comprises essentially 40-60 parts by weight of molasses solids, 0-60 parts of partially gelatinized starch having a gelatinization temperature of at least 150°F, 0·25-40 parts (0·25-34·75 parts, the balance of 35 parts being wheat starch) of at least partly defatted soya protein flour having a protein content of at least 45% by weight, at least 20% on total protein of water-soluble protein, and at least 50% more water-soluble protein than fat, 0·5-4·0 parts of water, 0-1 part of emulsifier and 0-1 part of anti-humectant.

Protecting stored sugar beets. W. R. Akeson, of Longmont, CO, USA. **3,894,161.** 18th October 1972; 8th July 1975.—Piled beets are protected by covering down to 5 feet from the ground with a number of mats at least 8 days after the pile is formed and after the ambient temperature has fallen to 40-50°F, and covering the remainder of the pile to ground level when the temperature falls to below 40°F. The mats are formed of woven strips of polypropylene (or other synthetic polymeric film material) with rigid blocks attached to the upper and lower ends, the mats being arranged so that their lengths are generally parallel to the fall line of the pile sides, with adjacent mats overlapping. The upper and lower ends of the mats are secured by passing stakes through the rigid blocks into the pile, the mats being wrapped around the blocks at the overlap before the stakes are passed through them.

Animal fodder supplement. P. S. Backlund, of Anaheim, CA, USA, *assr.* Union Oil Co., of California. **3,895,117.** 5th July 1973; 15th July 1975.—The supplement is a liquid, stable, aqueous emulsion of solid fat and (80-85°Bx) molasses containing at least 15% (20-40%) w/w of fat and prepared by melting the fat at 100-200°F, mixing it with 0·01-0·5% of an oil-in-water surface-active agent in the absence of water, blending the resultant mixture into molasses of 70-85°Bx (containing 8-20% of urea or biuret on total emulsion weight) and adding up to 15% of water on the total emulsion weight, sufficient to give a viscosity of <3000 cp (<1000 cp) at 70°F. Sufficient phosphoric acid or $(NH_4)H_2PO_4$ is added to adjust the pH to 3·5-5·0 (4-4·75) and 0·005-0·25% of edible gum or alkyl cellulose.

Ripening of sugar cane. L. G. Nickell, of Honolulu, HI, USA, *assr.* Hawaiian Sugar Planters Association. (*A*) **3,897,239.** (*B*) **3,897,240.** 28th March 1974; 29th July 1975.

(*A*) The sucrose yield of cane is increased by applying, directly to the plant, a suitable amount of a (water-soluble or water-insoluble) penicillin (penicillin G, penicillin V) (as an aqueous solution or suspension spray) 2-10 weeks before harvest (using 5-20 gal.acre^{-1}) [the spray containing 0·1-2% of a (non-ionic) surface-active agent].

(*B*) The sucrose yield of 18-24 months-old cane is increased by applying a suitable amount of bacitracin, directly to the plants, 2-10 weeks before harvesting, in the form of (5-20 gal.acre^{-1} of) a liquid composition having water as the carrier and including 0·1-2·0% of a (non-ionic) surface-active compound.

Increasing sugar content in cane. R. Bosshard, J. C. Muller and E. Ebert, *assrs.* Ciba-Geigy Corp., of Ardsley, NY, USA. **3,898,071.** 17th January 1974; 5th August 1975.—To increase the sugar content, cane plants are treated with a growth-regulating amount of 2-(β-dimethylamino-ethoxy)-4-(3′,4′-dichlorophenyl)-thiazole hydrochloride.

Method of controlling vacuum pan operation. S. Komiyama, I. Matsubara and M. Shiraishi, *assrs.* Hitachi Ltd., of Japan. **3,899,386.** 29th December 1972; 12th August 1975.—(After feeding with syrup to a level-controlled amount, followed by seeding) Batchwise boiling of a massecuite is controlled by (*a*) measuring the inter-crystal gap or supersaturation (determined by B.P.E.) (or the crystal content or massecuite consistency) and controlling the supply of pan feed liquor on the basis of this parameter, (*b*) measuring at least one other parameter indicative of the progress of boiling (average crystal diameter, massecuite level), comparing the inter-crystal gap and the other parameter and comparing these with previously-developed programmes, automatically preferentially selecting one or other programme to control the pan feed, and controlling the feed on the basis of the difference between the preferred parameter and its value according to the programme. When the difference exceeds a predetermined level, the progress of the programme is suspended and resumed when the difference reaches that predetermined level.

[1] *I.S.J.*, 1978, **80**, 156.

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TRADE NOTICES

Cane sugar laboratory applications of Whatman filter papers. Whatman Ltd., Springfield Mill, Maidstone, Kent, England.

Whatman sugar assay filter papers, Grades 91, 92 and 93, are designed to give clear filtrates of batch samples in the shortest possible time for expressed juice pol and Brix determination. They are available in all diameters up to 50 cm and in virtually any sheet or reel size, and can be supplied in pre-pleated form. Grade 91 is a general-purpose paper having a creped surface to give increased loading capacity; Grade 93 is a smooth-surfaced version of Grade 91, while Grade 92 is a retentive creped-surface paper suitable for more demanding tasks—it is heavier and has greater wet strength and retention than Grades 91 and 93. Other Whatman papers for use in the sugar factory laboratory are the Grade 1 general-purpose paper for pol determination in cane, trash and boiler feed water, for insoluble solids determination in juices and for Ca and K determination. Grade 5 is the most retentive filter paper of the qualitative range and is used for P determination in sugar and boiler feedwater, as well as raw sugar colour determination and starch determination in sugar. Grade 6 is widely used in boiler feedwater analysis. The papers in the 40 series are of very low ash content (<0·01%) and are particularly suitable for soil analysis and effluent P determination. Grade 42 is the most retentive, and is thus suitable for very fine precipitates such as barium sulphate, and is sometimes used for fine filtration before refractometric Brix measurement. Grades 50, 52 and 54 are of greater wet strength and chemical resistance than the routine ashless papers; Grade 54, a very fast paper, is useful under pressure for raw sugar filtrability determination. Five grades of glass microfibre papers are available from Whatman—GF/A is a general-purpose grade particularly suitable for soil and effluent analysis. Full details of Whatman filter papers and samples of Grades 91, 92 and 93 are available from the manufacturers.

Diaphragm pumps. Chem-Tech International, P.O. Box 98, Lawrence, MA 01843, USA.

Chem-Tech International announce the availability of the Series 100 light-weight, heavy-duty and fully-adjustable positive-displacement diaphragm pump, which is manufactured in five models ranging from 3 to 30 gal. day^{-1} at a continuous rating of 100 psi.

PUBLICATIONS RECEIVED

Hand cranes. Herbert Morris Ltd., P.O. Box 7, North Rd., Loughborough, Leics., England LE11 1RL.

A new 10-page brochure gives details of the current range of Morris single- and double-girder hand cranes which are available in capacities from 1 to 20 tonnes and spans of up to 18 m.

The cranes are intended for use where infrequent use would make an electric crane uneconomical. The hand crane has a fine degree of control, so that it is highly suitable for applications where accurate placing of loads is required.

Water-tube boilers for Somalia.—NEI International Combustion Ltd. have been awarded a contract for the manufacture and supply of two water-tube, bagasse-fired boilers for a factory being built by Fletcher and Stewart Ltd. as part of the Juba sugar project in southern Somalia. The factory is planned to produce direct-consumption white sugar, although provision is made for the manufacture of refined sugar and for the erection of a distillery to produce potable and industrial alcohol.

Tate & Lyle Engineering contracts.—Tate & Lyle Engineering Ltd. has been awarded a number of major international contracts, including one for the supply of a sugar refinery to the Philippines. The refinery, one of three being ordered by the Philippine Sugar Commission to meet increasing local demand, will be located adjacent to a new raw sugar factory at Bukidnon, in the centre of the island of Mindanao, and will have a daily capacity of 550 tons of sugar. Another important contract has been won by Farrow Irrigation Ltd., a subsidiary of TLE, and covers the supply of effluent treatment plant to six Venezuelan sugar factories, as well as design and supervision services, civil engineering work, local fabrication and installation.

Cane mills for Mexico.—Industria del Hierro, Mexican licensee of the Farrel Co., is to supply milling tandems of Farrel design to six new government-owned sugar factories located in southern Mexico. The six tandems will each comprise six individually-driven, 3-roller mills of 41×84 in rollers. Parts of the totally enclosed gearing were manufactured at the Farrel plant in Ansonia, Connecticut. Each factory will have a crushing capacity of 6000 t.c.d. with possible expansion to 8000 t.c.d. by addition of a seventh 3-roller mill to each tandem.

Spiral heat exchangers.—The British Sugar Corporation is installing Alfa-Laval spiral heat exchangers in their Bury St. Edmunds factory to operate alongside existing BSC shell-and-tube heat exchangers in the heating of juice.

Pettit trailers and tillage equipment.—F. W. Pettit Division of the Geest Industrial Group Ltd. recently held a demonstration at their Moulton, Spalding, works of their range of trailers and tillage to celebrate 50 years of the Company's existence. A wide range of general farm and other trailers is included with capacities from 3¾ to 12 tonnes and with hydraulic lifting and tipping both rear only and 3-way. 4- and 6-tonne units are available with scissors-type high-lift tipping. The bodies may be a combination of steel and hardwood or steel alone. A new range is being introduced of all-steel monocoque trailers, with current models of 6 and 10 tonnes capacity; these are a type which is becoming very popular on the Continent for transport of sugar beets. Also demonstrated were the Pettit range of multiplex, heavy-duty and other disc harrows as well as multiple disc ploughs both mounted and semi-mounted, reversible and non-reversible. For the cane grower, Pettit produce under licence the Greatbatch coupling which provides free movement in three planes and so permits haulage over very rough terrain with great stability and absence of vertical jack-knifing. The design of the coupling places the payload weight on the driving and braking wheels which gives both better traction and better fuel economy.

Hitachi sugar factories for the Philippines[1].—Sugar plants for the Bukidnon Sugar Milling Company and the United Planters Sugar Milling Company were completed in December 1976 and May 1977, respectively. Both facilities are of 4000 t.c.d. capacity and feature Hitachi-designed cane mills, heat exchangers and crystallizers. A new plant under construction in the northern part of Luzon for the Cagayan Sugar Corporation is also of 4000 t.c.d. capacity but will have a 250 tonnes/day refined sugar section; a trial run was scheduled for late 1977.

[1] *Hitachi Zosen News*, 1977, **20**, (97), 27.

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

West Indies sugar statistics[1]

	1977		1976	
		tonnes, raw value		
Initial stocks		59,071		40,596
Imports		13,957		172
Production:				
Barbados	123,604		106,486	
Guyana	253,127		342,770	
Jamaica	297,174		367,908	
St. Kitts	42,794		36,460	
Trinidad	178,004		205,010	
		894,703		1,058,634
		967,731		1,099,402
Exports:				
Algeria	5,673		44,364	
Canada	78,355		47,631	
China	856		9,779	
Ireland	41,866		59,749	
Portugal	11,530		0	
UK	443,041		431,826	
USA.....	147,244		227,328	
Other countries	600		1,450	
	729,165		822,127	
Local consumption	197,691		217,689	
Adjustment	12,191		515	
		939,047		1,040,331
Final stocks		28,684		59,071

EEC sugar quota cut for Surinam[2].—Surinam's sugar supply quota for the EEC under preferential terms has been cut to 3199 tonnes because its full quota was not delivered in the 1976/77 marketing year. Surinam is one of the ACP countries associated with the EEC under the Lomé Convention.

Record East Germany beet harvest[3].—There was a record sugar beet harvest in East Germany in 1977 of 8·4 million tonnes which compares with the post-war low of 5·1 million tonnes in 1976. The largest previous beet crop was recorded in 1972 and amounted to 7·2 million tonnes.

Canada beet sugar campaign, 1977/78[4].—From a total area of 63,059 acres, 127,790 tonnes of sugar were produced in the 1977/78 campaign, as against 149,600 tonnes of sugar produced from beet grown on an area of 79,000 acres in 1976/77.

Brazil sugar expansion[5].—Sugar production in the state of Ceará is to be increased to 2·9 million bags of 60-kg each. In order to attain this, four new sugar factories are to be built, in Uruburetama, Baturité, in the Ibiapaba Mountains and in the Cariri Valley.

Hungary beet sugar crop, 1977/78[6].—The 1977 sugar beet crop in Hungary, grown on 113,000 hectares, amounted to 4·107 million tonnes, according to the official news agency MTI. This was below expectations but exceeded the 1976 production of 3,925,000 tonnes, grown on 128,400 ha, by some 4·45%. Sugar content in 1977 was satisfactory, at 14·97%, 1% higher than the previous year. The sugar beet area declined from 128,400 hectares in 1976 to 122,000 hectares in 1977. Sugar production was 448,000 tonnes, white value, 21·74% up on the 367,990 tonnes of 1976/77. As a consequence it will not be necessary, as in 1976, to import sugar in the crop year ending August 1978.

Argentina 1977 sugar crop.—A total of 15,085,098 tonnes of cane were crushed by the 25 Argentine sugar factories, and 1,579,770 tonnes of sugar produced, tel quel, of which about two-thirds was white sugar. Three factories—La Florida, La Trinidad and Santa Rosa—all in Tucumán, are to be sold by public tender[7].

New Iran sugar factory.—The Karun sugar factory started its first trial run in March and is to process 20,000 tons of cane per day. Production is expected to reach 100,000 tons of refined sugar next year, providing 10% of domestic consumption. It is one of the largest sugar factories in the world and was built by Stork-Werkspoor Sugar B.V., as main contractors, in about 2½ years.

High fructose corn syrup plant in Hungary[1].—A factory for the production of high fructose corn syrup (HFCS) with a daily output of 210 tons is to be erected in Hungary. As reported, Miles Laboratories Inc.have signed an agreement for the setting-up of this plant worth US $40 million. Miles Laboratories are to supply the necessary enzymes, while its subsidiary company Mi-Car International Inc. is to grant the licence for the HFCS technology. Apart from Miles Laboratories, several other firms will participate in the project including the Vogelbusch company of Vienna, who will supply an alcohol plant.

Hawaii sugar production[9].—Sugar production in Hawaii in 1977 totalled 1,033,739 short tons, raw value, as against 1,050,457 tons in 1976 and 1,107,199 tons in 1975. The 1977 crop was the lowest for more than ten years.

Tanzania sugar production increase[10].—The Mahonda sugar factory in Zanzibar, built with Chinese aid in 1973, is reported to have produced 6054 tons of sugar in 1976/77. This was originally estimated at the level of Zanzibar's demand but now seems inadequate. The factory has a 3000-acre plantation and a further 1000-acre estate is to be started. Attention is to be given to raising yields in the existing plantation whereby sugar production from the combined estates will be 9000–10,000 tons per year.

New sugar factory for India[11].—A sugar factory is to be installed along the Zira-Talwandibhai road in Ferozepore district of the Punjab. It will crush 1250 t.c.d.

Paraguay withdrawal from GEPLACEA[12].—Paraguay is the first country to withdraw from GEPLACEA, the organization of sugar producing and exporting countries of Latin America and the Caribbean.

Cane breeding in India[13].—The Sugarcane Breeding Institute at Coimbatore has developed three short-duration varieties—Co 7704, CoA 67-1 and CoA 7001—which ripen after a short growing season, the first having a high sugar content in only eight months. Varieties bred at the Institute occupy 2,700,000 hectares in India and are also grown in other countries. The low yields in India, however, result largely from lack of irrigation and from attack by pests and diseases. One of the most important diseases is red rot, endemic in eastern Uttar Pradesh and northern Bihar, and a breeding programme for resistance to this disease is under way.

New Polish sugar factories.—A new sugar factory, which will be the largest in the country, is under construction at Ropczyce. It will have a daily slicing capacity 2000 tonnes higher than the current largest factories at Lapy and Krasnystaw (i.e. 6000 tonnes)[14]. With the introduction of juice storage for post-campaign processing, the factory will operate for six months of the year instead of three, and it is expected to begin operation in October 1978. Another factory of the same capacity is to be built at Glinojeck but will operate normally during a 3-months campaign[15].

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[1] C. Czarnikow Ltd., *Sugar Review*, 1978, (1384), 74.
[2] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (13), 15.
[3] *Reuters Sugar Rpt.*, 12th January 1978.
[4] C. Czarnikow Ltd., *Sugar Review*, 1978, (1375), 31.
[5] *Zuckerind.*, 1978, **103,** 160.
[6] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (3), 8; (4), 10; (5), 13.
[7] *Bank of London & S. America Rev.*, 1978, **12,** 135.
[8] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (13), 19.
[9] *Lamborn*, 1978, **56,** 20.
[10] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (4), 14.
[11] *Indian Sugar*, 1977, **27,** 431.
[12] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (3), 12.
[13] *Indian Sugar*, 1977, **27,** 430.
[14] *Westway Newsletter*, 1978, (52), 15.
[15] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (9), 12.

Holland sugar imports and exports[1]

	1977	1976
	—— *tonnes, tel quel* ——	
Imports		
Belgium	60,142	*
Finland	2,500	0
France	251	219
Germany, West	4,069	3,111
Guyana	198	152
Surinam	2,187	300
Taiwan	0	1,971
Other countries	639	153
	69,986	5,906
Exports		
Bahrein	10,751	0
Belgium/Luxembourg	6,506	*
Denmark	38	3,327
Germany, West	1,933	1,161
Iran	1,005	16
Iraq	12,001	0
Israel	4,059	10,536
Jordan	8	5,721
Kuwait	2,000	0
Lebanon	15,175	2,030
Malta	1,857	6,410
Mauritania	1,170	0
Morocco	550	11,000
Nigeria	33,020	21,004
Oman	2,500	0
Saudi Arabia	4,815	5,010
Sudan	4,583	0
Surinam	2,500	600
Switzerland	0	2,000
Tanzania	2,001	0
Tunisia	11,050	0
USSR	30,551	0
United Arab Emirates	1,000	0
UK	20,963	2,010
Yemen, North	21,551	0
Yemen, South	0	6,000
Zaire	2	5,000
Other countries	3,066	2,028
	194,655	83,853

*Statistics for 1976 do not include movement of sugar with Belgium/Luxembourg.

Bulk sugar terminal in Cuba[2].—The sixth Cuban terminal for bulk sugar, in the port of Carupanu, has recently been opened by the Prime Minister, Fidel Castro. The terminal will have an annual capacity of 600,000 tonnes of sugar. The five-year plan provides for construction of a further terminal by 1980.

US beet sugar factory conversion to refining[3].—Like the Holly Sugar Company's Santa Ana factory in California[4], the Fremont, Ohio, factory of Great Western Sugar Co. is to be converted into a refinery for raw cane sugar, to be shipped through the St. Lawrence Seaway and carried by truck from the port of Toledo on Lake Erie.

Belgium campaign results, 1977/78[5].—The beet sugar campaign of 1977/78 in Belgian sugar factories ended with a production of 725,000 tonnes, equivalent to 788,000 tonnes, raw value. The average beet yield per hectare was between 48 and 49 tonnes, at a sugar content of 16%. A slight increase in the sugar beet area is expected for 1978.

Singapore sugar imports and exports, 1977[6].—Imports of sugar into Singapore in 1977 totalled 132,205 tonnes, tel quel, of which 94,763 tonnes were from Australia and 36,000 tonnes from Fiji. This compares with 109,032 tonnes in 1976 of which 79,609 tonnes came from Australia and 18,500 tonnes were from Fiji but there were also 2000 tonnes from China and 8785 tonnes from Thailand. Exports fell from 20,794 tonnes in 1976 to 16,094 tonnes in 1977, of which 10,872 tonnes went to Saudi Arabia (11,692 tonnes in 1976), 2190 tonnes to Hong Kong (3753 tonnes) and 1569 tonnes to the United Arab Emirates (4170 tonnes).

Japan sugar imports, 1977[7]

	1977	1976
	—— *tonnes, tel quel* ——	
Australia	640,618	783,186
Austria	2,430	0
Belgium	59	0
Brazil	155,395	174,179
Brunei	599	0
Cuba	163,922	73,317
Germany, West	36	0
Philippines	230,065	106,606
South Africa	610,650	398,581
Taiwan	281,520	226,821
Thailand	621,306	662,598
UK	0	100
USA	53	289
Other countries	220	20
Total	2,706,873	2,425,697

Hong Kong sugar imports and exports[8].—Imports of sugar by Hong Kong in 1977 totalled 100,968 tonnes, tel quel, as against 87,945 tonnes in 1976. Principal origins were South Korea (49,316 tonnes) and China (29,269 tonnes) as in 1976 (32,592 and 13,408 tonnes, respectively). Exports reached only 2819 tonnes in 1977, compared with 10,377 tonnes a year earlier, when markets had included Indonesia (6099 tonnes) and Ghana (2499 tonnes).

Rumania campaign results, 1977/78[9].—According to official figures, the sugar beet crop in Rumania in 1977/78 amounted to 6,249,000 tonnes, 662,000 tonnes or nearly 10% less than produced in 1976 and 2,231,000 tonnes less than provided for in the 1977 plan. The beet yield was 24·54 tonnes per hectare, down nearly 5 tonnes from the 29·4 tonnes of 1976. Sugar production amounted to 713,000 tonnes, white value (equivalent to 775,000 tonnes, raw value), which is only slightly below the planned quantity of 718,000 tonnes.

Philadelphia sugar refinery improvements[10].—As a first stage in a programme which will include an increase in capacity, a cooperative scheme has been announced whereby the City of Philadelphia will build a new pier to be leased to the Port Authority and sub-leased to National Sugar Refining Co. The Port Authority is to install new ship-unloading equipment and the refinery to build a new raw sugar warehouse. At present, the refinery receives between 450,000 and 500,000 short tons of raws a year which is unloaded at an old pier in poor condition which is two miles from the refinery. The cost of the project will include $4 million for the pier, $3 million for the unloading equipment and $2 million for the warehouse. Construction is expected to be completed by late 1979.

Texas and Florida 1977/78 sugar crops[11].—The 1977/78 sugar cane harvest in Texas ended on 9th April. The 35,000 acres planted to cane in the Lower Rio Grande Valley produced 1,116,649 short tons of cane which was just less than the Growers' Cooperative pre-harvest target of 1,200,000 to 1,300,000 tons. The cane yielded 86,198 tons of sugar and 43,570 tons of molasses for cattle feed. The Cooperative has stored 48,000 tons of sugar under the sugar loan provision of the 1977 Farm Bill. The Florida sugar factories crushed 9,028,952 tons of cane during the 1977/78 crop; this was 9% down from the previous season's 9,919,000 tons. The cane yielded 893,830 tons of raw sugar, compared with 930,000 tons in 1976/67. Molasses production was 5,820,961 gallons. As in 1976/77, freezing temperatures during the harvest reduced the sugar yield of this season's crop.

[1] C. Czarnikow Ltd., *Sugar Review*, 1978, (1378), 44.
[2] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (3), 12.
[3] *Sugar y Azúcar*, 1978, **73**, (2), 14.
[4] *I.S.J.*, 1978, **80**, 98.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (3), 8.
[6] C. Czarnikow Ltd., *Sugar Review*, 1978, (1377), 40.
[7] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (9), S10.
[8] C. Czarnikow Ltd., *Sugar Review*, 1978, (1377), 41.
[9] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (7), 13.
[10] *Willett & Gray*, 1978, **102**, 102–103.
[11] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (13), 19, 24.

Australia sugar exports, 1977[1]

	1977	1976	1975
	tonnes ,raw value		
Canada	656,926	463,624	473,884
China	271,648	225,471	36,965
Japan	846,055	805,347	265,803
Korea, South	298,468	184,242	218,059
Malaysia	125,591	213,606	266,803
New Zealand	144,904	58,196	59,869
Oceania	9,332	9,249	9,736
Papua-New Guinea	23,231	20,342	19,670
Singapore	102,448	85,484	111,977
UK	29,671	178,241	16,569
USA	456,975	377,186	496,703
	2,965,249	2,620,988	1,976,038

Switzerland sugar imports[12]

	1977	1976
	(tonnes, tel quel)	
Austria	0	15,535
Cuba	2,733	1,388
Czechoslovakia	1,339	1,156
France	78,611	133,765
Germany, East	1,515	0
Germany,West	115,997	36,975
Holland	0	1,094
Italy	1,011	0
UK	33,051	18,106
Other countries	708	350
	234,965	208,369

French sugar factory closures[2].—After closure of a number of sugar factories in recent years, four more are to close in 1978, namely Coulommiers, Iwuy, St.-Just-en-Chaussée and Villeron.

Philippines-China trade agreement[3].—Under a recently signed trade agreement, China will purchase between 100,000 and 150,000 tonnes of sugar from the Philippines during 1978. In 1977 China purchased 209,000 tonnes.

Belize sugar crop, 1976/77[4].—The latest sugar crop in Belize, which ended in August 1977, totalled 96,123 tonnes, raw value. Of this 3571 tonnes was produced in December 1976 whereas the 1977/78 crop started in December with a monthly production of 5279 tonnes. 1977 calendar year production was thus 97,831 tonnes, while calendar year exports totalled 85,785 tonnes, of which 48,478 tonnes were to the UK and 37,307 to the USA.

Louisiana sugar factory closures[5].—Two more of the raw sugar factories of Southdown Sugars Inc.—the Cedar Grove mill at White Castle and the Armant mill at Vacherie—are to be closed permanently; Southdown has already announced the closure of its raw sugar factory and refinery at Houma[6].

Jamaica sugar strike[7].—A strike of sugar workers began on 2nd February at Frome and spread to the rest of the island's factories. It was settled on the 2nd March by an across-the-board wage increase of 20%, but millions of dollars have been lost as a result of cane deterioration in the fields and lost production. Originally, production was expected to reach 320,000 tonnes but now is expected to be less than the combined EEC + ISA quotas of 239,000 tonnes.

Finland sugar imports[8].—*Imports into Finland in* 1977 totalled 190,182 tonnes, raw value, as compared with 140,945 tonnes in 1976. The principal suppliers were Cuba with 113,244 tonnes (69,601 tonnes in 1976), Brazil with 36,815 tonnes (47,977 tonnes), the Dominican Republic with 12,421 tonnes (23,367 tonnes), Argentina with 11,413 tonnes (0) and Belgium with 10,649 *tonnes* (0), while West Germany provided 5640 tonnes (0).

New Pakistan sugar factory[9].—The Pakistan Industrial Credit & Investment Corporation has granted loans for several new projects including 50% of the foreign exchange cost of the 2000 t.c.d. sugar factory in Mirpur Bathero, Thatta district.

Bulk sugar reception terminal in France[10].—A new fully-mechanized sugar terminal is being built in the port of Dunkirk and should be finished in the Autumn. According to an Agriculture Ministry bulletin the terminal may handle 200,000 tonnes per year; it will cost 30 million francs and will be the first of ite *kind in Europe, making sugar handling in the port much mors* efficient. In 1977, around 500,000 tonnes of sugar passed through Dunkirk.

Indonesian cane variety[11].—According to press reports, Indonesian botanists have developed five new high-yielding *cane varieties*, one of which reaches a height of 3·75–4·25 metres, does not flower but has a long lifespan, and is immune to stem and leaf borers, with a yield of 100–140 tonnes per hectare and a sugar content of 9–10%.

Australia-Singapore sugar contract talks[13].—The long-term sugar contract between Australia and Singapore ts under renegotiation and revisions similar to those agreed with Japan and Malaysia can be anticipated.

Morocco sugar project[14].—A new company, Zemamra S.A., has been formed for construction of a second sugar factory in Doukkala, located at Sidi-Bennour. Its capital amounts to 8 million dirhams (U.S. $1·7 million). Among the partners are Cosumar, Doukkala S.A., a Moroccan-Kuwaiti consortium for development and the Alami Group.

Jamaican sugar production drop[15].—According to reports from Kingston, sugar production in Jamaica up to mid-April was 35% lower than in the corresponding period of the 1977 crop. The sugar factories produced 98,643 long tons from 1,105,051 tons of cane, as against 151,427 tons of sugar from 1,535,167 tons of cane last year. Sugar production in 1977 was itself the lowest for thirty years. The situation is attributed to unfavourable weather conditions.

Bulk terminal in Florida[16].—The Florida Sugar Marketing and Terminal Association Inc., made up of five Florida sugar producing companies, held a ground-breaking ceremony on 17th January for a bulk raw sugar terminal at the Port of Palm Beach. When completed the terminal will receive sugar by truck from the Florida producing areas and will send it by sea to the North-East and New Orleans.

Hungary sugar beet production target[17].—*Target sugar* beet production for 1978 is 4·5 million tonnes, 9·57% higher than production in 1977 which reached 4,107,000 tonnes against 3,925,000 tonnes in 1976. Before 1970 Hungary was an occasional net exporter but, during the past few years, production has fallen short of consumption so that sugar imports have been necessary to cover domestic requirements. Owing to the good performance of 1977/78, no sugar imports will be needed this year, according to informed sources. Even if the target beet production is achieved, however, it seems to be highly unlikely that Hungary will emerge as a net exporter.

New Yugoslavia sugar factory[18].—The Credit Bank of Maribor has granted a loan of 157 million dinars (US $8,600,000) to finance a sugar factory in Ormoz, Slovenia.

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[1] *I.S.O. Stat. Bull.*, 1978, **37**, (2), 20.
[2] *Sucr. Belge*, 1978, **97**, 116.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (7), 20.
[4] *I.S.O. Stat. Bull.*, 1978, **37**, (3), 22.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (8), 12.
[6] *I.S.J.*, 1978, **80**, 9.
[7] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (7), 15; (8), 12.
[8] *I.S.O. Stat. Bull.*, 1978, **37**, (3), 45.
[9] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (8), 15.
[10] *Westway Newsletter*, 1978, (53), 16.
[11] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (8), 15.
[12] C. Czarnikow Ltd., *Sugar Review*, 1978, (1376), 36.
[13] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (8), 16.
[14] *Westway Newsletter*, 1978, (53), 17.
[15] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (13), 26.
[16] *Westway Newsletter*, 1978, (53), 18.
[17] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (11), 10.
[18] *Westway Newsletter*, 1978, (53), 18.

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