INTERNATIONAL SUGAR JOURNAL

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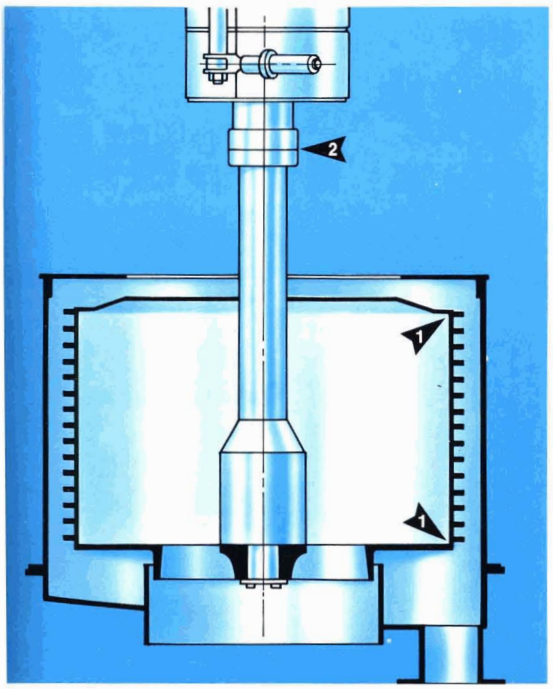

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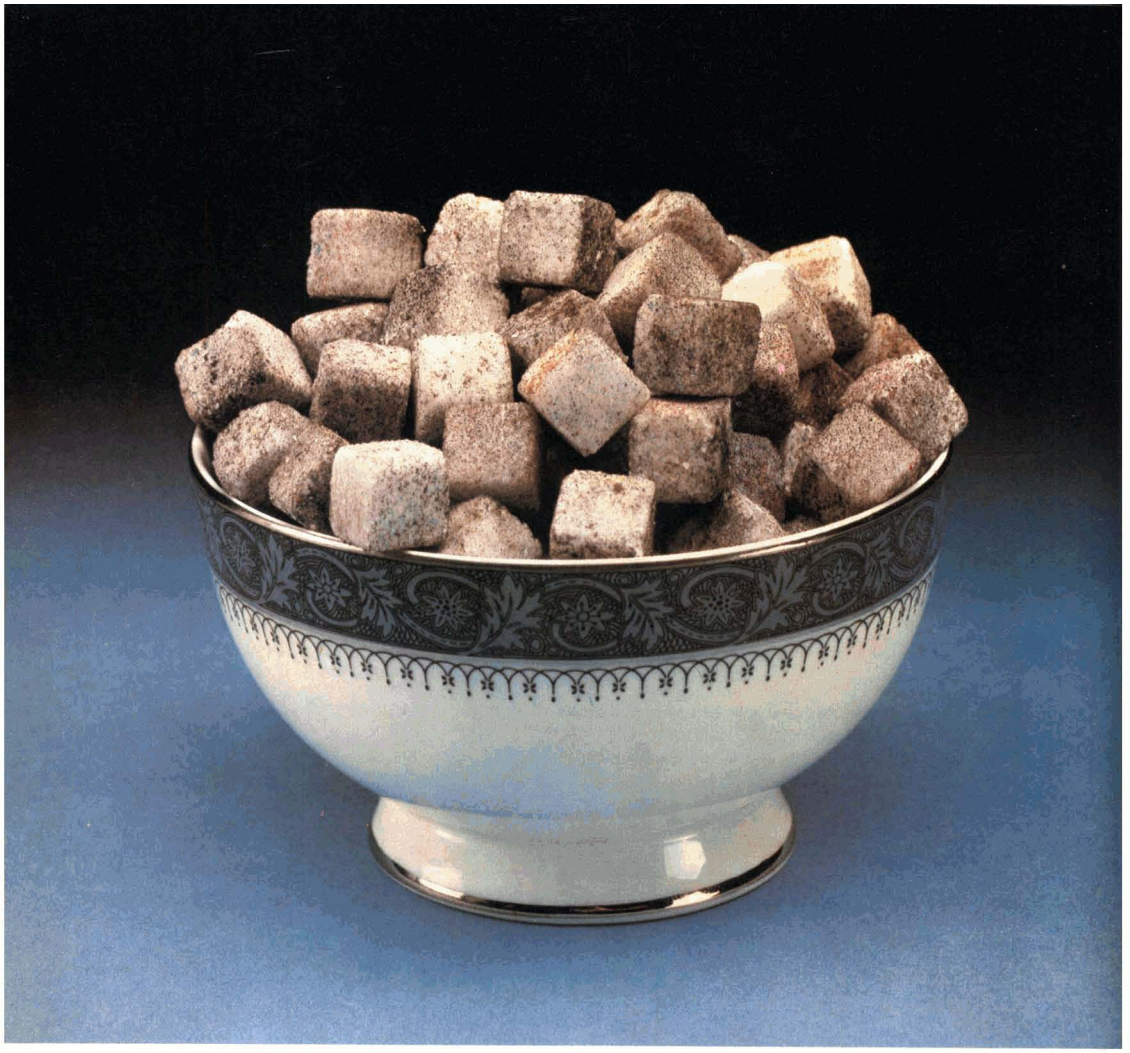

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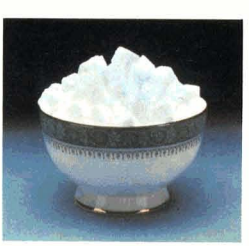

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NOTES AND COMMENTS

World sugar balance 1979/80

World Sugar Journal has recently published[1] its first estimate of sugar supply and distribution in 1979/80, as follows:

	1979/80	1978/79	1977/78
		tonnes, raw value	
Initial stocks	22,487,000	21,434,000	17,808,000
Production	91,481,000	90,741,000	90,781,000
Imports	25,000,000	25,634,000	24,390,000
	138,968,000	137,809,000	132,979,000
Consumption	94,144,000	90,479,000	84,713,000
Exports	25,000,000	24,843,000	26,832,000
Final stocks	19,824,000	22,487,000	21,434,000
Commercial stocks	18,002,000	17,421,000	16,724,000
ISA Special stocks	2,500,000	2,000,000	1,000,000
Real surplus	-678,000	3,066,000	3,710,000

According to WSJ definitions, "Commercial stocks" are those needed for normal distribution within countries and correspond to two months consumption. The real surplus is the final stock figure less such commercial stocks and those required under the International Sugar Agreement. As may be seen, sharply increasing consumption and only slightly higher production combine to bring the surplus from more than 3 million tons to a deficit of 678,000 tonnes. Of course, were there to be a shortage so that the ISA daily price rose above the floor level of 11 cents/lb, the restrictions imposed by compulsory stockholding would gradually be eased to prevent too rapid a price rise.

International Sugar Agreement

At its September meeting, the International Sugar Council agreed to defer its decision on whether to take into consideration the new New York spot price in calcaulating its own Daily Price.

The Council also agreed to increase contributions to the administrative budget by £150,000 or £75 per vote, to be offset against 1980 contributions if the Stock Financing Fund is brought properly into being before the end of the year. The contributions will not be used directly but will increase the collateral against which the Fund can borrow from commercial banks. Such borrowings have been used to pay the expenses of administering and inspecting the special stocks set up under the Agreement, although, in the absence of US ratification of its membership, contributions to the Fund, which was to cover these expenses as well as the storage costs, are still in abeyance.

Europe beet sugar production 1979/80

Tests are made to assess beet root yields and sugar contents and their progress during the two months before the campaigns start in Europe. Of themselves, the test results do not allow calculation of production figures but, by comparison with corresponding data from previous years, allow the likely crops to be estimated. The final outturns are, of course, still dependent on the vagaries of the weather, with the possibility of frost and rainy weather hindering harvesting and depressing sugar contents, or fine weather permitting continuing growth and sugar accumulation.

On a basis of the results of tests data accumulated during August and early September, F.O.Licht GmbH recently published their first estimate of sugar production in Europe during the 1979/80 campaign[1] and these figures are reproduced below with comparative figures for the two previous campaigns.

	1979/80	1978/79	1977/78
		tonnes, raw value	
West Europe			
Belgium/Luxembourg	850,000	902,000	791,000
Denmark	440,000	443,000	566,000
France	3,750,000	4,065,000	4,268,000
Germany, West	2,710,000	2,998,000	3,076,000
Holland	837,000	1,034,000	905,000
Ireland	138,000	204,000	182,000
Italy	1,630,000	1,630,000	1,355,000
UK	1,100,000	1,111,000	1,032,000
Total EEC	*11,505,000*	*12,387,000*	*12,175,000*
Austria	370,000	357,000	495,000
Finland	100,000	104,000	70,000
Greece	340,000	354,000	294,000
Spain	840,000	1,189,000	1,193,000
Sweden	346,000	339,000	343,000
Switzerland	103,000	107,000	85,000
Turkey	1,100,000	1,096,000	1,082,000
Yugoslavia	890,000	776,000	766,000
Total West Europe	*15,594,000*	*16,709,000*	*16,508,000*
East Europe			
Albania	20,000	20,000	12,000
Bulgaria	240,000	250,000	210,000
Czechoslovakia	820,000	886,000	939,000
Germany, East	670,000	780,000	780,000
Hungary	520,000	553,000	486,000
Poland	1,630,000	1,763,000	1,850,000
Rumania	710,000	602,000	775,000
USSR	8,400,000	9,100,000	8,825,000
Total East Europe	*13,010,000*	*13,953,000*	*13,877,000*
Total Europe	28,604,000	30,662,000	30,385,000

In the EEC lower crops are forecast for all countries but Italy, especially in those countries where areas have been reduced following cuts in the *B*—quota. Licht note that their figures confirm the estimate of the EEC's Sugar Management Committee that export availability from the Community will be reduced from 3.2 million tonnes in 1978/79 to 2.8 million tonnes in 1979/80.

A remarkable change in the statistical position of Spain is reported; after substantial accumulation of stocks through overproduction in the past few years, consumption is expected to exceed production by an estimated 260,000 tonnes in 1979/80, although no imports above recent levels are expected. Yugoslavia is expected to raise production markedly and is likely to have an exportable surplus of 120,000 tonnes.

Bad weather at the beginning of the season and subsequent drought harmed the Soviet beet crop and, in spite of a recent recovery, a fall of 700,000 tonnes is expected, while reductions are also noted for all other East European countries but Rumania.

The overall picture is one of considerably less sugar produced in Europe which, with a likely small increase in consumption, will mean less pressure on the white sugar market during the coming year.

US sugar legislation

Discussion in the House of Representatives of the Sugar Bill had been scheduled for September 20 but other business supervened and it was postponed until the

[1] 1979, **2**, (2), 10-13, 32.
[2] *International Sugar Rpt.*, 1979, **111**, 503-504.

second or third week in October. The Bill is almost in two parts, one concerned with domestic sugar affairs and the other permitting US ratification of ISA membership. It has been possible, under existing legislation, to continue administration of the domestic industry and there has been little incentive to make great efforts to break the deadlock within Congress. But this has had, and continues to have, more and more serious ill-effects on the other exporting members of the Agreement who have been forced by US dilatoriness to finance stocks withheld from the market under the Agreement (a feature introduced and strongly promoted by the US during the 1977 negotiations) at a cost which they can ill afford. The International Sugar Organization is also likely to be in some difficulty, even if the Bill is approved by the House, since there is little likelihood of Senate approval before December 1, the fall-back date for the start of contributions to the Stock Finance Fund, and the Council at its meeting in November will be badly hindered in having to make decisions relating to 1980, two years after the Agreement came into force.

World sugar prices

Reports of crop damage in the Caribbean spurred the increase in sugar prices at the beginning of September and from £107 per tonne on August 31, the LDP rose to £109/£111 during the period up to September 11. A movement away from currencies, evidenced by the sharp rises in the prices of gold and silver, together with increasing demand as sugar futures rose, and the improved statistical position, brought prices higher, the LDP rising to £120 before falling back to £114 but recovering to £121 by September 28. The premium of the London Daily Price for white sugar over that of raws stayed reasonably steady, varying between £6 and £11, so that the LDP(W) also rose during the month, with a gain from £115 on August 31 to £128 per tonne by September 28.

US sugar import fee

On September 25 the US Secretary of Agriculture announced that, with the increase in the New York spot price for raw sugar to an average of 9.53 cents per lb over the period August 22 – September 19, the import fee for sugar would decrease by 0.60 cents to 1.76 cents per lb for raw sugar and to 2.28 cents per lb for refined sugar, both with effect from October 1. The reductions were effected under the flexible fee system established by Presidential proclamation in December 1978 in order to provide a response to changes in world prices while giving a market price objective of 15 cents per lb for raw sugar.

Foreign opposition to CFTC proposals

Objections have been made by the London Commodity Exchange and other foreign trading organizations to proposals by the US Commodity Futures Trading Commission which would require brokers handling foreign business to disclose both the identity of their clients and the details of their trading position on each futures market[1]. In order to enforce compliance with the proposed regulations, all foreign users of US commodity exchanges dealing directly with a US futures commission merchant or indirectly with a foreign broker would have to designate an agent in the US to receive service of communications issued by the CFTC.

Federal regulation of US futures markets in domestic produce has been a force for many years but it was only since the establishment of the Commission in 1974 that this has been extended to international markets trading in largely non-US produce. From a European standpoint a different approach is justified where markets have an important international content. As C. Czarnikow Ltd. comment:

"The world needs free and effective international markets for the efficient distribution of primary commodities. In the competitive conditions of the international trade in these goods the need for freedom to trade quickly in the most compatible market without the cost of elaborate agency arrangements and bureaucratic form-filling is self-evident. Furthermore, international traders, particularly governments and quasi-governmental organizations which nowadays play a large part, are bound to suspect the need for and true motive behind the accumulation of so much privileged and otherwise apparently unnecessary information by any one country."

US loan sugar sales

Bids for the first 30,000 short tons of loan-forfeited sugar[2], for unrestricted use, were called for by the Commodity Credit Corporation on September 7. On September 25, however, the CCC announced[3] that all bids for the sugar, stored at the Florida Sugar Marketing and Terminal Association, Jacksonville, and the Rio Grande Valley Sugar Growers Inc., Santa Rosa, Texas, had been rejected owing to price. Bids were received from five companies. A second invitation will be made to prospective bidders for October 9.

Mexico sugar problems

Despite being a major producer, Mexico appears to be faced with a need to import sugar to meet domestic requirements, a situation in stark contrast with the country's status as an exporter of around 618,000 tonnes in 1970. With an area under cane 12% greater than in 1977/78, the 1978/79 crop was expected to yield 3,200,000 tonnes of sugar, raw value, which would have allowed Mexico to export her ISA quota of 70,000 tonnes with only a small reduction in stocks. Improved varieties were expected to raise yields; however, heavy and persistent rain, labour shortages and lack of harvesters, loaders and transport equipment had combined with deficiencies in mill equipment and operation to reduce sugar production.

The sugar producers union has not yet published official figures but, according to unofficial sources, production has reached only 2,900,000 tonnes. Cane in an amount estimated between 2,000,000 and 3,000,000 tonnes has been left in the fields unharvested. It is admitted by the President of the National Union of Cane Producers that growers planted too much cane for the factories' capacity, but it is claimed that 30 of the country's 65 mills require urgent repairs and replacements which would require an outlay of at least $132,000,000. The Director of the National Sugar Industry Commission has announced the creation of a national repair plan for the sugar industry which will commence a complete overhaul of equipment after the 1978/79 season. If such a plan is successful, Mexico may be able to meet domestic demand and its export quota for the ISA. However, drought has been experienced in several states and irregular rainfall so that the cane supply may be reduced.

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[1] C. Czarnikow, Ltd., *Sugar Review*, 1979, (1453), 159.
[2] See *I.S.J.*, 1979, **81**, 290.
[3] *Lamborn*, 1979, **57**, 153.

Advanced flow measurement technology in sugar industry

By WOLFGANG HOGREFE
(Fischer & Porter GmbH, D-3400 Göttingen, Germany)

Everywhere processing engineers aim at improving production methods so as to assure optimum quality and quantity of the final product. Measuring and control instrumentation is one of several means to achieve this object in regulating and supervising operation. New findings in processing as well as in measuring and control techniques result in improved or completely new production methods. To meet this target the cooperation of experts in all areas involved is required. Particularly the application of magnetic and liquid vortex flowmeters in the sugar industry has demonstrated how innovations can be profitably and successfully utilized. Therefore, an introduction to design features and performance of these instruments will be followed by a discussion of application criteria.

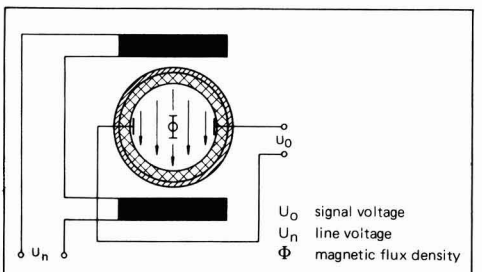


Fig. 1 Operating principle of sensing device

Measuring instruments

Both the magnetic flowmeter and the liquid vortex flowmeter are characterized by the feature that they have no moving parts in the liquid flow and that mechanical wear is, therefore, reduced to a minimum. The vortex flowmeter is also a low-cost instrument and preferred in routine use for a variety of liquid flow measurement applications.

Magnetic flowmeter

The principle of magnetic flow measurement has been known for 20 years. Since then instruments have been continuously improved. A recently introduced system operates with a pulsating direct current providing accuracy and steady zero. Another result of key technological achievement is the capacitance pick-up designed to measure liquids which tend to build non-conductive deposits.

Principle of operation

In an electric conductor which moves in a magnetic field, an electric voltage is induced dependent on the force of the magnetic field and the velocity of the movement. In the magnetic flowmeter this conductor is the fluid to be measured flowing through the pipe. Perpendicular to the flow axis the pipe is transversed by a magnetic field, generated electrically by excitation coils (see Fig. 1).

In order to avoid short-circuiting of the resultant voltage at the metal pipe, the interior of the meter pipe has to be lined. The signal voltage U_o, which is proportional to the product of the magnetic flux density B and the flow velocity, is picked up by two electrodes:

$$U_o \sim B \cdot v$$

The magnetic flux density B is a meter factor. The signal voltage U_o then is proportional to the flow velocity v:

$$U_o \sim v.$$

For a constant cross sectional area A the signal voltage U_o is also proportional to the volumetric flow rate:

$$v = \frac{Q}{A}$$

Since

$$U_o \sim v,$$
$$U_o \sim Q$$

An A.C. voltage of 50 Hz is used to generate the magnetic field as the polarizing potential which is built up at the interface between fluid and metal electrode surface would cause measurement errors if a direct current were used for excitation. When using an A.C. voltage the signal voltage U_o is also an A.C. voltage which can be separated from D.C. voltages by capacitive or inductive coupling to the input circuit of the series-connected converter.

The converter operates on the balancing principle, that is, the signal voltage is compared with a balancing voltage. This method permits non-dissipative signal pick-up, as the signal voltage would break down when loaded.

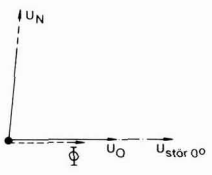
The converter further suppresses all quadrature voltages out-of-phase with the signal voltage. Quadrature voltages in the detector caused by the system's geometry are eliminated during calibration. External quadrature voltages also affect the system.

Experience in flow measurement has shown that the pipe section of an electric system is an ideal conductor for grounding currents, while the potential gradient in the pipeline creates potential differences between the pick-up electrodes of the magnetic flowmeter. Therefore, a quadrature voltage $U_{stör}$ is measured in addition to the signal voltage U_o.

All quadrature voltages are geometrically converted into one component that is in-phase with the signal voltage U_o and a second one that is 90° out-of-phase Thus, all out-of-phase voltages, even if they change, are automatically balanced.

The vector diagram in Fig. 2 shows that the in-phase component of the quadrature voltage $U_{störOo}$ is added

to the signal voltage U_O. This could create erroneous information. To avoid such errors the converter features a zero adjustment, whereby a balancing voltage of the order of the quadrature voltage $U_{störO}$ is fed into the system. Zero adjustment is made at zero flow but with a full meter tube, e.g. without availability of signal voltage U_O. After processing the signal, the converter supplies a 0-20 mA or 4-20 mA current output or a scaled pulse output corresponding to the direct engineering measurement unit desired.



U_N	supply and exciting voltage
U_O	signal voltage
Φ	magnetic flux density in the meter pipe
$U_{stör\,0°}$	0°-component of quadrature voltage

Fig. 2 Weighing factor distribution of voltages

Magnetic flowmeter with D.C. pulse excitated field

To eliminate quadrature voltages, caused by operating from A.C. voltage, requires considerable engineering efforts. Measurement errors are likely to occur when the 0°-component of the quadrature voltage $U_{störO}$ is changing during operation, thereby also changing the zero adjustment. When the pipeline is additionally loaded by other first users or when other pipelines are loaded through changeover or when other electric lines are adjacent to the pipeline, the zero has to be readjusted during a shutdown. Within continuous processes, as are customary in the sugar industry, even such a short-term shutdown of an entire system is not practical. What precautions are necessary to prevent measurement errors of this type?

The magnetic flowmeter with D.C. pulse-excited field provides automatic zero adjustment and is therefore particularly suitable for continuous processes.

Quadrature voltages would be ineffective in a system operating only from direct voltage, that is a system where the field is also excited by a direct current. This method, however, is adversely affected by the polarizing potential produced at the interface between liquid and electrode which renders the actual process signal inoperative.

If an intermittent D.C. voltage is used for excitation, then the potential may be largely suppressed and the residual filtered as follows (see also Fig. 3): for a period of 160 millisec the excitation coils are supplied with D.C. voltage. Since their inductive resistance is very high, a transient response is initiated, which upon termination results in a pure D.C. voltage excitation. It is during this phase, i.e. the last 40 millisec of the first 160 millisec interval that the electrode voltage U_E is transmitted to the converter. In this first phase M_1 the electrode voltage U_E not only contains the actual signal voltage, but also all quadrature voltages, the residual polarizing potential U_p and the quadrature voltages $U_{stör}$:

$$M_1 : U_{E1} = U_O + U_p + U_{stör}$$

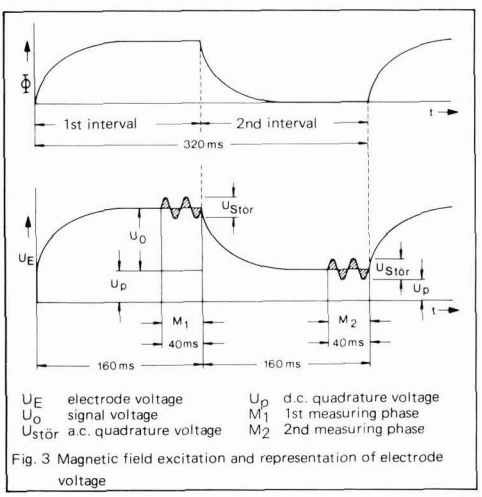
This value is stored to be available in the following process. During the second 160 millisec interval the field excitation is turned off. Again a transient response is produced until the excitation is actually zero. Again the electrode voltage U_E is determined during the last 40 millisec. Since there is no magnetic field no signal voltage U_O will be generated during the second measurement phase M_2, while the other voltages remain:

$$M_2 : U_{E2} = U_p + U_{stör}$$

The electrode voltage U_{E2} thus determined is subtracted from the stored factor U_{E1}

$$U_{E1} - U_{E2} = U_O$$

The result of this subtraction, the signal voltage U_O, which is proportional to the rate of flow Q, is free from quadrature voltages, even if they are time-variable. Thus, a system has been developed, where zero, adjusted once during manufacturing, is automatically aligned in further operation.



U_E	electrode voltage	U_p	d.c. quadrature voltage
U_O	signal voltage	M_1	1st measuring phase
$U_{stör}$	a.c. quadrature voltage	M_2	2nd measuring phase

Fig. 3 Magnetic field excitation and representation of electrode voltage

Although the series-connected converter differs from the 50 Hz system, it will also supply a 0-20 mA or 4-20 mA analogue and a digital output to be scaled, if desired.

The magnetic flowmeter not only provides better accuracy, but also saves considerable energy.

Magnetic flowmeter with capacitive pick-up

Picking up the signal in both magnetic flowmeter systems described above is based on the two metal electrodes in contact with the fluid. If this connexion is interrupted, the signal voltage cannot be detected. Interruptions of this kind are due to non-conductive deposits on the electrodes such as greasy coatings, sedimentation or crystallization.

Embedded into the meter lining of the magnetic flowmeter with capacitive pick-up are large surface electrodes so that they are not in contact with the fluid to be measured (see Fig. 4).

Each electrode, together with the fluid wetting the

interior of the meter pipe forms the capacitor C_n with a dielectric in terms of the lining. The signal voltage generated within the fluid is picked up via these capacitances while the shielding electrodes, whose potential is entrained, are a protection against capacitive effects from the metal meter pipe. Since the electrode voltage is relatively low, it has to be amplified immediately behind the electrodes. This system operates from a 50Hz A.C. voltage.

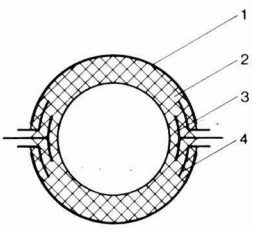


Fig. 4 Cross-sectional view of magnetic flowmeter with capacitive signal pick-up. Key: 1 Tube; 2 Insulation; 3 Meter electrode; 4 Shielding electrode

The 50 HZ system's converter described above is also part of the magnetic flowmeter system with a capacitive signal pick-up (see Fig. 5).

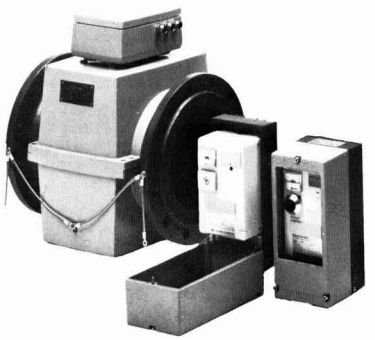


Fig. 5 Magnetic flowmeter and converter

Summarizing the magnetic flowmeter system's advantages:

There are no moving parts in the meter tube and therefore hardly any wear.

There is no pipe restriction, hence no additional pressure loss.

Measurement is independent of pressure, temperature, density, consistency, viscosity and solids in suspension.

Flow measurement is linear and proportional.

Installation may be at any given point in the pipeline.

No straight pipe runs are required; the instrument is not required to be installed immediately behind gate valves or elbows.

The application criteria for magnetic flowmeters are given in the comparison of the different magmeter types in Table I.

Liquid vortex flowmeters

In recent years liquid vortex flowmeters have come of age in routine use flow metering in the sugar industry. Since this flowmeter is a general purpose broad application meter it is liable to become a standard instrument in defined applications.

In turbulent flows a boundary layer with sharp velocity gradient forms on the immediate wall surface. Owing to wall friction the wall-adjacent fluid particles are retarded and produce a zone of low pressure. Overlying liquid layers are not affected. In non-streamlined bodies (see Fig. 6) the unretarded liquid particles flow into the resulting wake with a relatively reduced pressure to generate a vortex.

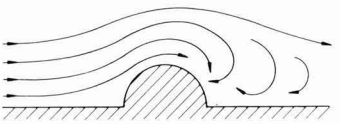


Fig. 6 Non-uniform flow pattern

When a body is inserted into the stream vortices are formed on both sides. They are alternately shed from the main stream when enhanced to create a flow profile in which both vortices are alternately detached. The vortex frequency of the classic street pattern described and analysed by von Karman (see Figs. 7, 8 and 9) is proportional to flow.

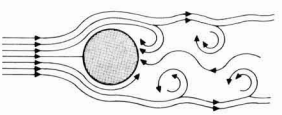


Fig. 7 Formation of vortices at higher flow velocities in the street pattern described by Karman

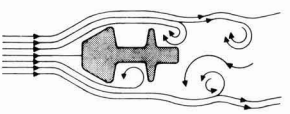


Fig. 8 Sensor in the street pattern

The alternating vortices detach themselves from the boundary of the body and create a zone of low pressure which shifts from side to side, producing a variable side thrust. The frequency with which the vortices are shed is linear to the incoming fluid velocity, and therefore directly related to volumetric flow rate.

Inside the vortex flowmeter a fixed trapezoid body

Table I. Comparison of the different magnetic flowmeters

Criteria	Standard model 50 Hz sine wave excitation	D.C.-pulse excitation	Capacitive signal pick-up 50 Hz sine wave excitation
Pipe size, mm	2.5 to 2000	2.5 to 2000	65 to 500
Minimum conductivity limits of fluid, $\mu S.cm^{-1}$	20 or 0.5 with preamplifier	5	0.05
Power consumption in % (dependent on meter size)	100%	⩽20% (based on 50 Hz excitation)	100%
Accuracy	±0.5% of full scale plus ±0.5% of rate	Q (%) / Error: 50 to 100 / ±0.5% of full scale; 10 to 50 / 1% of rate; 1 to 10 / 0.1% of full scale	±0.5% of full scale plus ±0.5% of rate
Quadrature effects	automatic compensation; 0°-component through solid zero compensation	automatic compensation of all quadrature voltages	automatic compensation; 0°-component through solid zero compensation
Zero adjustment	adjustable at zero flow	no adjustment; automatic alignment	adjustable at zero flow
Output time constant	adjustable between 0.5 and 9.0 sec	approx. 4 sec	adjustable between 0.6 and 9 sec
Deposits in meter tube	partly coated electrodes cause zero drift; insulating coating prevents signal pick-up	partly coated without effects; insulating coating prevents signal pick-up	insulating coatings have no effect
Maximum temperature limits (dependent on meter size and liner)	180°C	180°C	90°C

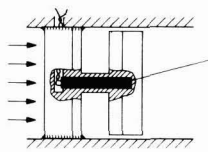


Fig. 9 Side view of sensor

is used to which a T-shaped tail-piece is attached and slightly strained by the vortices. Sensing consists essentially of detecting these strain changes. To do this an internal strain gauge is used. The small deflection is transduced into a resistance and converted in the signal conditioner.

The liquid vortex flowmeter's standard output (see Fig. 10) is a digital signal. A scaler module provides conversion of the process flow frequency to pulses equivalent to the direct reading, engineering measurement unit desired. The signal conditioner can be mounted integrally on top of the flowmeter, but can also be installed separately.

Itemizing the advantages of the liquid vortex flowmeter:

There are no moving parts in the meter tube (movement of the T-shaped tail-piece and strain gauge is only some μm); hence there is nothing to wear out.
Pressure loss is negligible.
Digital electrical signals are produced.
The meter is low in cost compared with magnetic flowmeter.
Flow signals are linear and proportional.

The liquid vortex flowmeter is useful for measurement of fluids with a low viscosity only.

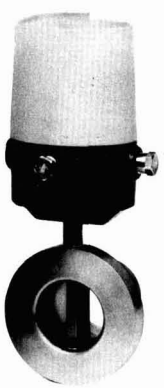


Fig. 10 Liquid vortex flowmeter, size DN 100 mm (4") with integral signal conditioner

Flowmeter application in the sugar industry

There are, of course, other flow measurement techniques which will not be discussed, since they are generally known and only the application of magnetic and liquid vortex flowmeters is of interest here.

The given operating conditions determine service of the magnetic flowmeter and the choice of materials of construction for liner and electrodes. Important considerations are the chemical resistance to the process fluid as well as effects of physical factors like temperature and pressure. Decisive for service in the sugar industry is the maximum temperature of 90°C for the hard rubber liner. As this limit is exceeded only rarely the

magnetic flowmeter with a low-cost hard rubber lining can handle the vast majority of liquid applications. In cases of higher temperatures a PTFE liner is compatible with the fluid.

Considering the fact that all instrumentation in the sugar factory is continuously in operation during the campaign and that a shut-down for checking is inconceivable, then stabilizing properties such as the solid zero of the magnetic flowmeter with a D.C. pulse-excited field are particularly desirable, providing accuracy and proven performance.

All wetted parts of the liquid vortex flowmeter are manufactured from stainless steel, making it almost immune to chemical effects. The liquid vortex flowmeter above all is capable of handling fluids with a low viscosity. As a digital instrument it is largely independent of disturbances. Electronic filters eliminate all interfering pulses.

A review of the limitations and capabilities of these flowmeters is given in the application and service examples below – where EMF is generally introduced as an abbreviation for the magnetic flowmeter and LV generally applies to the liquid vortex flowmeter.

Diffusion

In the process of extracting juice the EMF is preferred because it is capable of handling the fluid flow of liquids with solids in suspension. The cossette-juice mixture with a temperature of about 70°C permits use of an EMF with hard rubber lining and stainless steel electrodes. This measurement provides the process variable for control of the cossette pumps. The filling level in the cossette scalder is used as set point.

The selection of the appropriate EMF size should be based on the flow velocity within the metering tube. Principally, the EMF full scale value may be between 0.5 and 10 $m.sec.^{-1}$. Depending on the converter to be used in conjunction with EMF, this full scale value can either be fixed or continuously adjusted.

In order to reduce frictional losses to a minimum, the flow velocity of fluids with solids in suspension or viscous fluids is set to a low value. The full scale value for cossette-juice mixtures is generally between 1 and 2 $m.sec^{-1}$. An EMF size DN 150 (3 in) will serve a flow range of 0 to 80 $m^3.hr^{-1}$ while the full scale is set to 1.3 $m.sec^{-1}$. When selecting the proper EMF, the size of the pipeline is also of considerable importance. Often, however, pipe sizes are so large that a reducer will be required when mounting the EMF.

Owing to the solids in suspension in the diffusion juice the EMF is suitable for measuring this fluid, too. Temperatures are low so that an EMF with hard rubber lining is sufficient. Its process signal sometimes also serves as process variable to control the flow of the diffuser juice.

The circulating juice can also be measured by a hard rubber-lined EMF. When the flow through the circulating juice heater has to be kept constant by means of a by-pass control (see Fig. 11), the value indicated is utilized as process variable, although this is not standard procedure. In other cases the flow of vapour through the circulating juice heater is controlled via the juice temperature.

The level of a diffusion tower may be controlled by the power consumption of the drive motor of the cossette conveyor. When feeding press water and fresh water to the diffuser, the flow of the press water is fixed by the process while the supply of fresh water has to be controlled. Both flow rates have to be measured. Owing to solids in suspension in the press water an EMF with hard rubber lining will serve the application. A LV would also be sufficient to measure fresh water, but, since it is customary to apply uniform instrumentation for one control loop, an EMF is preferable. Flow velocity of the fresh water may be slightly higher than that of juice as the frictional loss is not as high. Assuming a fresh water flow rate of 0 to 20 $m^3.hr^{-1}$ an EMF size DN 50 mm (2 in) will be capable of handling this application. The full scale value is set to 3.3 $m.sec^{-1}$.

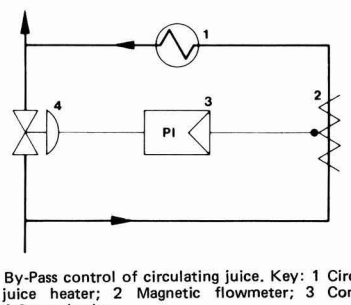


Fig.11 By-Pass control of circulating juice. Key: 1 Circulating juice heater; 2 Magnetic flowmeter; 3 Controller; 4 Control valve

Juice purification

Proper adding of lime during preliming and defecation should be based on the flow rate of the diffusion juice, measured by a hard rubber-lined EMF with stainless steel electrodes, since the fluid contains solids in suspension.

If the lime is charged by means of a dosing pump, the raw juice flow may be used to control the drive motor.

Fig. 12 shows another example of controlling the lime flow rate. The pH value serves as a set point. Owing to the abrasive action of lime the meter tube is subject to special wear, but the flow rate can be measured by an EMF with hard rubber lining. In practice, however, PTFE is preferred as a liner on account of its smooth surface. Electrodes should not extend beyond the lining. Shown in the example is an additional control for raw juice.

Prior to carbonatation the juice may again be measured by an EMF with hard rubber liner. This flow value may also be used for control of the pH value, by regulating the flow of carbon dioxide.

After the first carbonatation tank measurements are normally checked before filtration or transfer to the thickener. A hard rubber-lined EMF is suitable for measuring the flow of sludge. Occasionally a flow control is applied for the sludge whereby the sludge flow rate serves as set point.

Thickener operation is generally time-controlled, based on the assumption that the flow rate is constant. Optimum results, though via a more costly method, will be obtained from flow rate-controlled operation of the individual thickeners.

The process signal from all flowmeters in front of the filters will then be integrated, i.e. the total volume will be integrated. Predetermining counters will signal maximum and minimum values. An EMF with hard rubber lining and stainless steel electrodes can serve this application.

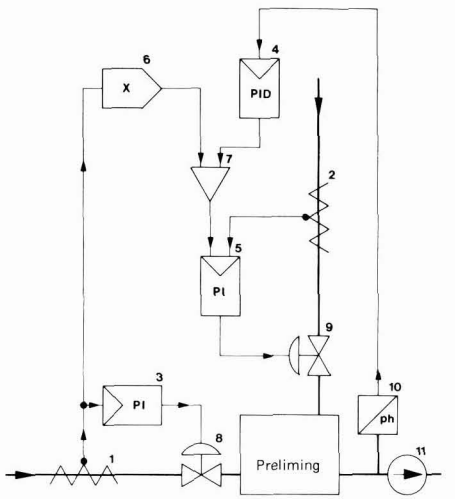


Fig. 12 pH control during preliming. Key: 1 EMF for measurement of diffusion juice; 2 EMF for measurement of lime; 3 Raw juice flow controller; 4 pH set point controller; 5 Controller for lime flowrate; 6 Ratio station; 7 Adder; 8 Diffusion juice control valve; 9 Lime control valve; 10 pH transmitter; 11 Pump

The above control system may also be utilized in the filter press section. The volume of thick sludge is measured by an EMF of similar design, while the individual filter presses are adjusted to a preset volume. So far this control system has been chosen only rarely as opposed to the widespread measurement of thickened sludge when recirculated for preliming. Occasionally, also the flow is controlled at this point. An EMF with hard rubber lining is again recommended.

Evaporators

When entering the evaporators the flow of thin juice should be measured by an EMF. In some cases the feed of thin juice will also be regulated, thereby controlling the Brix. A hard rubber-lined EMF with stainless steel electrodes may be applied to this measuring and control loop. If the thin juice is measured after preheating however, a hard rubber liner must be replaced by PTFE. Temperatures above 120°C require EMF for high temperature service.

Condensate flow rate can be measured by a LV, if the maximum temperature does not exceed 120°C. When using an EMF for the condensate flow measurement maximum temperatures have to be observed.

Sugar house

In the sugar house, where the water balance is of importance, the condensate flow will be measured at several points, e.g. at the crystallizer and upstream of the vacuum pan. The LV easily handles these applications. Totalizing the flow volume is relatively simple since the LV provides a digital output signal. The scaling to engineering units is simple. A LV available with integrally mounted or separate signal conditioner is recommended for metering the wash water to the centrifugals. Owing to considerable vibrations caused by transients in the wash water pipeline, use of a separately mounted signal conditioner is recommended. A flow rate of 50 $m^3.hr^{-1}$, for instance, could be handled by a LV, size DN 80 mm or DN 100 mm (3 in or 4 in). The span is determined by the minimum range limit, an instrument-inherent factor. For a LV, size DN 80 mm (3 in) this span would be 5.2 to 50 $m^3.hr^{-1}$ or 9 to 50 $m^3.hr^{-1}$ for a size DN 100 mm (4 in).

In most sugar factories better results in after-product vacuum pans are obtained by installing ion exchangers (e.g. Quentin process) in front of the pan. In order to keep the exchanger active, it has to be charged with various liquids and requires volume-dependent control.

Owing to its feature of measuring the flow independent of temperature, density and conductivity, an EMF with PTFE liner and "Hastelloy C" electrodes is ideally suited to measure the flow (see Fig. 13). The flow rates of brine, water and various juices are also metered by EMF. Several series-connected predetermining counters initiate volume-dependent control pulses.

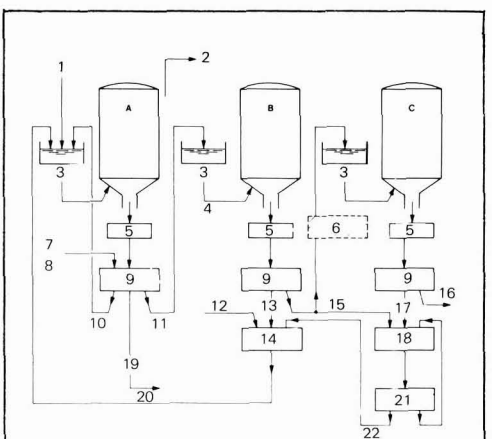


Fig. 13 Schematic representation of the vacuum pan station. Key: 1 Thick juice; 2 Afterproducts; 3 Storage tank; 4 B-syrup; 5 Crystallizer; 6 Desugaring process (e.g. Quentin process); 7 Water; 8 Steam; 9 Centrifugal; 10 High wash syrup; 11 High green syrup; 12 Wash syrup; 13 Intermediate or high raw sugar; 14 High melter; 15 Green syrup; 16 Molasses; 17 Raw or low raw sugar; 18 Affination crystallizer; 19 White sugar; 20 Sugar dryer, sugar stores; 21 Affination centrifugal; 22 Affination raw sugar; A White pan; B Intermediate pan; C Raw pan

Other measurements

Molasses, frequently with entrained air creating a semi-emulsion, can be metered by an EMF, but, since the EMF does not distinguish between air and molasses, erroneous information in terms of the entrained air will be supplied. Bullet-nose electrodes, the tips of which protrude into zones of higher velocity, facilitate self-cleaning of the electrodes from deposits.

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When measuring the volume of waste water as requested by authorities an EMF may again be used. Hard rubber lining and stainless steel electrodes are normally compatible with this service, though bullet-nose electrodes are recommended. Total flowrate is integrated and can be read in engineering units by a counter.

Summary

New measurement instruments and techniques are always of interest when their features translate directly into benefits to the user. Two instruments are described which are likely to become standard equipment in the sugar industry: (1) the magnetic flowmeter with a D.C. pulse-excited magnetic field guaranteeing total zero stability and hence high accuracy, and (2) the liquid vortex flowmeter, a digital instrument with no moving parts, which is low in cost.

Technologie de pointe dans la mesure des débits dans l'industrie sucrière

Les nouveaux instruments de mesure et les nouvelles techniques sont toujours intéressants si leurs caractéristiques se traduisent directement par des bénéfiees pour l'utilisateur. On décrit deux instruments qui deviendront sans doute de l'appareillage courant dans l'industrie du sucre : (1) le débitmètre magnétique à impulsion du champ par C.C., garantissant la stabilité totale du zéro et donc de grande précision et (2) le débitmètre vortex pour liquides, un instrument digital sans organes mobiles et peu coûteux.

Fortgeschrittene Durchflußmeßtechnologie in der Zuckerindustrie

Neue Meßgeräte und -Verfahren sind immer von Interesse, wenn sie an Hand ihrer Eigenschaften Vorteile für den Anwender bieten. Zwei Geräte werden beschrieben, die sicher Standardeinrichtungen in der Zuckerindustrie werden sollen: (1) der magnetische Durchflußmesser mit von Gleichstrom erregtem, pulsierendem Magnetfeld, was einen festen Nullpunkt garantiert und damit eine erhöhte Meßgenauigkeit, und (2) der Wirbeldurchflußmesser, ein digital arbeitendes Gerät, das keine beweglichen Teile enthält und das relativ preisgüngstig ist.

Tecnología avanzado de medición de flujo en la industria azucarera

Nuevos instrumentos de medición y técnicas estan siempre de interés cuando sus características trasladan directemente en beneficios al usuario. Se describen dos instrumentos que probablemente llegan a ser equipos normales en la industria azucarera: (1) el flujometro magnético con campo magnético excitado por un pulso de C.D., que asegura estabilidad total del cero y, por eso, alta precisión, y (2) el flujometro a vórtice líquido, un instrumento digital sin piezas movedores que es bárato.

Studies on the interaction between gamma-BHC and nitrogen application in sugar cane*

By P.P. SINGH and K. KUMAR

(G. B. Pant University of Agriculture and Technology, Pantnagar, India)

The insecticide gamma benzene hexachloride (BHC) is detrimental to all the macro- and micro-flora, beneficial and harmful to cane, which are found in the soil. Reports have also been published[1] that gamma-BHC also retards the mineralization of nitrogen by reducing the population of ammonifying and nitrifying micro-organisms.

The slow release of nitrogen from applied fertilizer by way of conversion of simple N-compounds to polymeric forms has also been reported in the literature[2]. Field experiments conducted in sugar cane have revealed that gamma-BHC and "Telodrin" resulted in higher cane yields but did not show any interaction with nitrogen. However, the increase in yield was not solely attributable to the control of pests[3,4]. On the other hand, Srivastava & Ghosh[5] found that nitrogen in the presence of gamma-BHC is utilized more efficiently by sugar cane.

The object of the present study was to investigate whether gamma-BHC interacted with nitrogen insofar as the response of sugar cane to nitrogen was concerned, *i.e.* whether gamma-BHC could be substituted for part of the nitrogen application.

Materials and methods

The interaction effect of gamma-BHC and nitrogen was studied in field trials conducted over three crop seasons, *viz.* 1972/73, 1973/74 and 1974/75, at the Crop Research Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, India. Pantnagar is located in the Nainital District of the state of Uttar Pradesh in northern India at 29°N, 79°E and at an altitude of 244 metres.

Meteorological data indicate that the climate of Pantnagar is subtropical and humid; the area receives some 1250 mm of rainfall in the monsoon season from mid-June to September. Light showers (about 80 mm) are also received during the winter. Wind storms are common in June and September. Winters are cool and frost often occurs in the last week of December and first half of January. Summers are hot, May and June being the hottest months of the year.

The sugar cane crop is mainly planted in February-March and harvested after one year of growth. The soil of the experimental plots was a silty loam containing 1.2% of organic carbon, 55 kg.ha^{-1} of available P and 375 kg.ha^{-1} of available K. The pH of the soil was 7-8 in a 1:2.5 soil:water suspension. The water table fluctuated from 55 cm in the monsoon to 163 cm in the summer season.

*Research paper No. 1787 of the Experiment Station, G. B. Pant University, Pantnagar.

[1] Jaiswal: *J. Research* (Punjab Agric. Univ.), 1967, **4**, 223-227.
[2] Jaiswal, Saini & Sharma: *Plant and Soil*, 1973, **25**, 33-40.
[3] Siddiqui, Rajani & Singh: *Indian J. Sugarcane Res. & Dev.*, 1959, **3**, 227-232.
[4] Singh & Sandhu: *Indian Sugarcane J.*, 1963, **13**, 319-323.
[5] *Proc. 13th Congr. ISSCT*, 1968, 563-568.

The experiments consisted of two levels of gamma-BHC (0 and 1 kg.ha^{-1}) and three levels of nitrogen (0, 75 and 150 kg.ha^{-1} N) and, during the first two seasons, were conducted in a randomized block design with four replications. Cane of variety Co 1148 was planted in the second fortnight of February with a seed rate of 35,000 three-budded setts per hectare. During the third season, the treatments of the experiment were modified; instead of one variety, three varieties, *viz.* BO 54, CoS 611 and Co 975, were used to see if there was a differential response to gamma-BHC.

Nitrogen levels were changed to 0, 50, 100 and 150 kg.ha^{-1}, narrowing the difference between levels so that more precise relationships could be worked out. The date of planting was delayed from February to April to see if the gamma-BHC would affect the germination rate and crop growth under abnormal planting situations.

Results and discussions

Application of gamma-BHC under optimum planting conditions during 1972/73 and 1973/74 neither affected germination percentage, number of tillers and millable canes and cane yield at a statistical level of significance

Under late planting conditions, as is generally the case under northern India conditions, application of gamma-BHC increased cane yields significantly over the control (Table II). However, there was again no interaction with nitrogen level, signifying that it had a direct effect on cane yield by way of controlling the borers which were found in the experimental plot. On average, the gamma-BHC treated plots had 5.6% of dead hearts whereas there were 31.5% dead hearts recorded for the untreated plots.

It is also the common experience of sugar cane workers that late-planted crops are infested by root and shoot borers, resulting in poor plant stands with reduced primary shoots which contribute towards the major portion of cane yield at harvest. It is interesting to note that gamma-BHC had a beneficial effect on the germination of sugar cane. Untreated plots recorded only 14.5% germination, whereas the treated plots showed 26.5% germination, a level which was significantly higher. In fact, 26.5% germination was almost the same as that recorded for the earlier, more timely planting conditions of the experiment.

Subsequently, more tillers and millable canes were recorded in the gamma-BHC treated plots as compared with untreated plots. This was not because the gamma-BHC affected the rate of tillering but because of the

Table I: Effect of levels of N and gamma-BHC on the performance of sugar cane variety Co 1148 during 1972/73 and 1973/74

Treatment	Germination, %		Tillers per ha		Millable canes per ha		Cane yield, tonnes.ha^{-1}	
	1972/73	1973/74	1972/73	1973/74	1972/73	1973/74	1972/73	1973/74
N-levels, kg.ha^{-1}								
0	27.8	41.0	395	149	78.6	76.7	56.6	67.9
75	30.2	44.2	289	156	89.4	89.2	76.2	84.4
150	31.4	36.5	361	152	79.4	68.2	69.7	63.4
S.Em±	1.3	4.4	22	7	3.7	4.6	5.2	5.1
C.D.5%	NS	NS	NS	NS	NS	14.0	15.7	15.6
Gamma-BHC level, kg.ha^{-1} a.i.								
0	29.4	40.6	313	149	84.4	78.9	67.5	72.2
1	30.1	40.5	316	155	80.5	77.1	67.5	71.6
S.Em±	1.0	3.6	18	5.7	3.0	3.8	4.2	4.2
C.D.5%	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non-significant

directly nor did it interact with nitrogen level. The interaction effects for all plant characters and for yield were statistically not significant (Table I). Under the optimum planting conditions at Pantnagar where the organic content of the soil is high (1.2%), the Co 1148 cane variety responded only up to 75 kg.ha^{-1} of N, beyond which level the yield declined. At the higher nitrogen dosage, owing to the succulent nature and pith development in the cane, the possibility of interaction between gamma-BHC and nitrogen application was ruled out. This implies that, under conditions where there is a smaller risk of damage to the young growing shoots by the root borer (*Emmalocera depressella*), shoot borer (*Scirpophaga nivella*) or termite, and where the high organic carbon content of the soil restricts the response of sugar cane to the lower dose of nitrogen (by way of regular supply of nitrogen by slow mineralization), the application of gamma-BHC could not be substituted for even part of the nitrogen application. Many workers have reported little or no response of sugar cane to nitrogen under conditions of high organic carbon in the soil[6,7,8]

better germination obtained in those plots. The numbers of tillers per plant remained the same in all treatments. The initial plant population per unit area in the case of treated plots was higher and hence the higher number of tillers recorded for that treatment. Thus, it may be inferred that gamma-BHC was effective only at the initial germination stage of plant growth. If a later effect had occurred there would have been more tillers per mother shoot or greater plant height, but such was not the case. Therefore, the gamma-BHC accelerated the process of germination only, perhaps by way of control of insect pests affecting the buds. It might also have protected the cuttings from microbial attacks during the sub-optimal planting conditions.

During 1974/75 also, none of the interaction effects except that of varieties x nitrogen turned out to be significant, which implies that gamma-BHC interacted neither with varieties nor with nitrogen, and hence that

[6] Singh & Singh: *Ann. Rpt. Expt. Sta. Pantnagar,* 1969, 109-110.
[7] Singh: *M. Sc. (Ag.) Thesis,* (G. B. Pant Univ.), 1972.
[8] Aloma, Pérez & Cuellar: *Proc. 15th Congr. ISSCT,* 1974, 608-617.

the presence of gamma-BHC does not promote more efficient utilization of nitrogen. Singh & Jaiswal[9] also reported that the interaction between nitrogen and gamma-BHC was not significant in their investigations but, in the presence of gamma-BHC, the cane yield was increased even in control plots with no nitrogen application, and the magnitude of the increase in yield due to nitrogen application in the presence of gamma-BHC was the same as that recorded in control plots with and without gamma-BHC. Thus it is evident that gamma-BHC had a direct effect on cane yield, either through control of insects damaging the young growing shoots or by modifying the uptake pattern of mineral ions such as K^+ or SO_4^{--} as has been demonstrated by Singh & Jaiswal[9]. However, the gamma-BHC did not interact with nitrogen and hence cannot be substituted for it or *vice-versa*. It may also be noted that the quality of juice was also not affected by application of gamma-BHC.

l'Université d'Agriculture et de Technologie G. B. Pant à Pantnagar. Les rèsultats de l'étude ont révélé qui'il n'y avait pas d'interaction entre le gamma-HCH et l'azote pour aucune des dates de plantation et que la substitution de l'azote par le gamma-HCH n'est dès lors pas réalisable. Cependant, le gamma-HCH a eu un effet bénéfique sur le germination de la canne plantée sur le tard de la saison en protégeant les boutures contre les attaques possibles des termites et des borers.

Untersuchungen über das Zusammenwirkung von gamma-HCH und Stickstoffdüngung in Zuckerrohr

In drei Anbauperioden, 1972/73, 1973/74 und 1974/75, wurden am Crop Research Centre des G. B. Pant University of Agriculture and Technology, Pantnagar, Feldversuche durchgeführt, um herauszufinden, ob gamma-HCH als Substitut für einen Teil des Stickstoffs

Table II: Germination %, number of tillers and millable canes, cane yield and Brix of juice as influenced by varieties, levels of N and gamma-BHC during 1974/75

Treatment	Germination, %	Tillers per ha	Millable canes per ha	Cane yield, tonnes.ha^{-1}	Brix
Varieties					
CoS 611	15.0	110	72.7	64.5	18.4
Co 975	28.0	170	102.1	95.0	18.0
BO 54	18.5	159	113.7	90.9	18.3
S.Em±	1.3	3.4	3.2	1.6	1.6
C.D. 5%	3.7	9.6	8.8	4.5	NS
N-levels, kg.ha^{-1}					
0	25.5	151	96.0	78.4	18.6
50	20.4	150	101.5	84.9	18.0
100	17.8	141	94.3	84.9	18.2
150	18.3	143	93.2	85.6	18.1
S.Em±	1.5	4.0	6.6	1.9	1.9
C.D. 5%	4.3	NS	NS	5.2	NS
Gamma-BHC level, kg.ha^{-1} a.i.					
0	14.5	1.25	86.0	76.0	18.1
1	26.5	168	106.5	90.9	18.4
S.Em±	1.1	2.8	2.6	1.3	2.3
C.D. 5%	3.0	7.8	7.2	3.7	NS

Acknowledgement

The authors are grateful to the Dean, College of Agriculture, the Director of Research and the Head of the Department of Agronomy for providing the necessary facilities during this investigation.

Summary

Field experiments to establish whether gamma-BHC could be substituted for part of the nitrogen applied to sugar cane planted at or later than the normal date in northern India were conducted over three seasons, *viz.* 1972/73, 1973/74 and 1974/75, at the Crop Research Centre of the G. B. Pant University of Agriculture and Technology, Pantnagar. Results of the study revealed that gamma-BHC did not interact with nitrogen for either planting date so that substitution of gamma-BHC for nitrogen is not practical. However, gamma-BHC did have a beneficial effect on germination when the cane was planted late in the season, by protecting the setts against possible attack by termites and borers.

Etudes sur l'interaction entre le gamma-HCH et l'application d'azote sur canne à sucre

Des essais sur champ, dans le but d'établir si le gamma-HCH pouvait être substitué à une partie de l'azote appliqué sur canne à sucre plantée à ou après la date normale dans le nord de l'Inde, ont été effectués au cours de trois saisons, notamment 1972/73, 1973/74 et 1974/75, au Centre d'Etude des Récoltes de

eingesetzt werden könne, der dem Zuckerrohr, das zum normalen oder einem späteren Termin in Nordindien gepflanzt worden ist, gegeben wird. Die Ergebnisse zeigen, daß gamma-HCH mit Stickstoff bei jedem Pflanztermin nicht zusammenwirkt, so daß der Ersatz von Stickstoff durch gamma-HCH nicht praktisch ist. Jedoch beeinflußt gamma-HCH die Keimung positiv, wenn das Rohr zu einem späten Zeitpunkt gepflanzt worden ist, indem es die Setzlinge gegen den möglichen Angriff von Termiten und Bohrer schützt.

Estudios sobre la interacción entre gamma-BHC y aplicación de nitrógeno en caña de azúcar

Experimentos en el campo para establecer si es posible sustituir en gamma-BHC una parte del nitrógeno aplicada a caña de azúcar, planteado a la fecha normal o después en el norte de la India, se han conducido en tres campañas, es decir 1972/73, 1973/74 y 1974/75, al Crop Research Centre de la G. B. Pant University of Agriculture and Technology, Pantnagar. Las resultas del estudio demuestran que no había interacción entre gamma-BHC y nitrógeno para cualquiera fecha de planteación, tal que no es práctica la sustitución de nitrógeno en gamma-BHC. Sin embargo, gamma-BHC hubo un efecto beneficial sobre germinación cuando la caña se ha planteado hacia fines del sazón, por protección de los trozos contra ataque de termitas y barrenadores.

[9] *Proc. 15th Congr. ISSCT,* 1974, 601-607.

Sugar beet phenols

Investigation of phenolic compounds from sugar beet in relation to the formation of colour

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PART 1

Introduction

Recently, a review was published on the formation of colour compounds during the production of sugar from sugar beet[1]. On the basis of a number of experiments and analyses our attention has been turned to phenolic compounds and betalains as compounds which have a high potential as colour forming substances. Addition of phenolic compounds, such as dopa, to raw juice gives, after juice purification, a 2nd carbonatation filtrate containing high-molecular colour compounds. We have demonstrated the presence of similar high-molecular colour compounds in *C*-sugar.

Furthermore, in some experiments we have shown that by adding digestion juice from red beet to raw juice from sugar beets and carrying out a laboratory juice purification, a 2nd carbonatation filtrate with a high colour is obtained. The pigments in beetroot are called betalains, and they occur in 10 families of the order of Centrospermae[2,3]. The chromophore of betalains includes both betacyanins and betaxanthins which are red-violet and yellow compounds, respectively. The sugar beet and the beetroot both belong to the family of *Beta vulgaris*. These facts have drawn our attention not only to the pigment system itself, but also to the compounds which are their precursors. This is due to two reasons. First, since the beetroot pigment system is not removed completely during juice purification, some of the precursors might also contribute to the colour of the 2nd carbonatation filtrate. Second, some of the precursors may be found in high concentrations because they are not only precursors of the pigment system, but also of a number of important compounds in the sugar beet (lignin, hormones, etc.).

For some years it has been know that L-dopa is one of the intermediates in the formation of betalains[4]. Like other amino-acids, dopa can be determined by Moore & Stein's colorimetric method with ninhydrin after separation of the amino-acids on an ion-exchange resin[5]. However, the concentration of dopa is much lower than the concentration of many of the others (glutamine, asparagine, γ-amino butyric acid, etc.), and therefore the determination of this compound involves a high degree of uncertainty, for which reason a more accurate analysis method is needed for dopa.

The presence of very reactive colour-forming substances, such as dopa, in sugar beets and in raw juice can be seen in a number of ways. Beet slices exposed to the atmosphere are observed to turn dark within a short time, and they may turn quite black. Addition of hydrogen peroxide to diffusion will result in dark juice and pulp. In diffusion the juice turns from light in most of the diffuser to dark when the juice meets the fresh beet slices mixed with air. If milk-of-lime is added to beet slices, these will turn green.

The concentration level of these compounds which easily form colour may probably vary considerably from one campaign to the next. This might be anticipated since the colours of the 2nd carbonatation filtrate, thick juice, and white sugar vary and are highly dependent on the beet growing conditions[1]. The variations in colour cannot only be put down to variations of the processing in the beet sugar factory, but must also be caused by variations in the beet quality in terms of the content of the precursors of colour formation.

A reduction of colour in juice and sugar may be achieved through a thorough knowledge of the compounds from which the colour bodies are formed and the chemical properties of these compounds.

Investigations of phenolic compounds

For years, many people have been wondering about the composition of the compounds causing the darkening of juice from sugar beet. Schneider[6] considered that it was catechol, and Tullin[7] and Brieghel-Müller & Bollerup[8] have also suggested pyrogallol. Their suggestions have not been supported by analytical data. Gross & Coombs[9] have investigated the enzymatic colour formation with their special attention turned to dopa. They succeeded in isolating an enzyme with a molecular weight of about 200,000 capable of both hydroxylating tyrosine to dopa and oxidizing this *o*-diphenol product to the *o*-quinone.

However, they stated that they were unable to find any of the compound in juice from sugar beet. Recently, the formation of coloured compounds from phenolic compounds in sugar cane has been studied[10,11], but quantitative determinations were not carried out. Hence it is evident that only very limited information is available on the subject within the sphere of sugar manufacturing. In order to achieve better knowledge of the phenolic compounds in sugar beet it is natural to adopt methods used in the study of compounds known from medical pharmacology.

As mentioned above, the amino-acid L-dopa may be found in raw juice. This compound belongs to a group of substances called catecholamines characterized by an amine group in an aliphatic side chain to catechol (*ortho*-dihydroxybenzene)[12]. Prior to the quantization of catecholamines in a sample the compounds must be isolated and concentrated to a relatively pure extract. A reversible adsorption on alumina of

1 Madsen, Kofod Nielsen, Winstrøm-Olsen & Nielsen: *Sugar Tech. Rev.*, 1978/79, **6**, 49-115.
2 Mabry & Dreiding: *Recent Adv. in Phytochem.*, 1968, **1**, 145-160.
3 Elbe: "The Betalains" in "Current Aspects of Food Colorants" (CRC Press, Inc.), 1977, pp. 29-39.
4 Tedder, Nechvatal, Murray & Carnduff: "Basic Organic Chemistry. Part 4, Natural Products" (Wiley, London), 1972, Chapter 3.
5 Maag, Hecker & Whitaker: *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 154-163.
6 *Proc. 15th Sess. C.I.T.S.*, 1975, 569-584.
7 *Proc. VIII Congr. Int. Ind. Agric. (Bruxelles), 1950.*
8 *ibid.*
9 *I.S.J.*, 1976, **78**, 69-73, 106-109.
10 Coombs & Baldry: *ibid.*, 1978, **80**, 291-294.
11 Goodacre & Coombs: *ibid.*, 323-327.
12 Goth: "Medical Pharmacology", 6th Edn. (C. V. Mosby Company, St. Louis), 1972.

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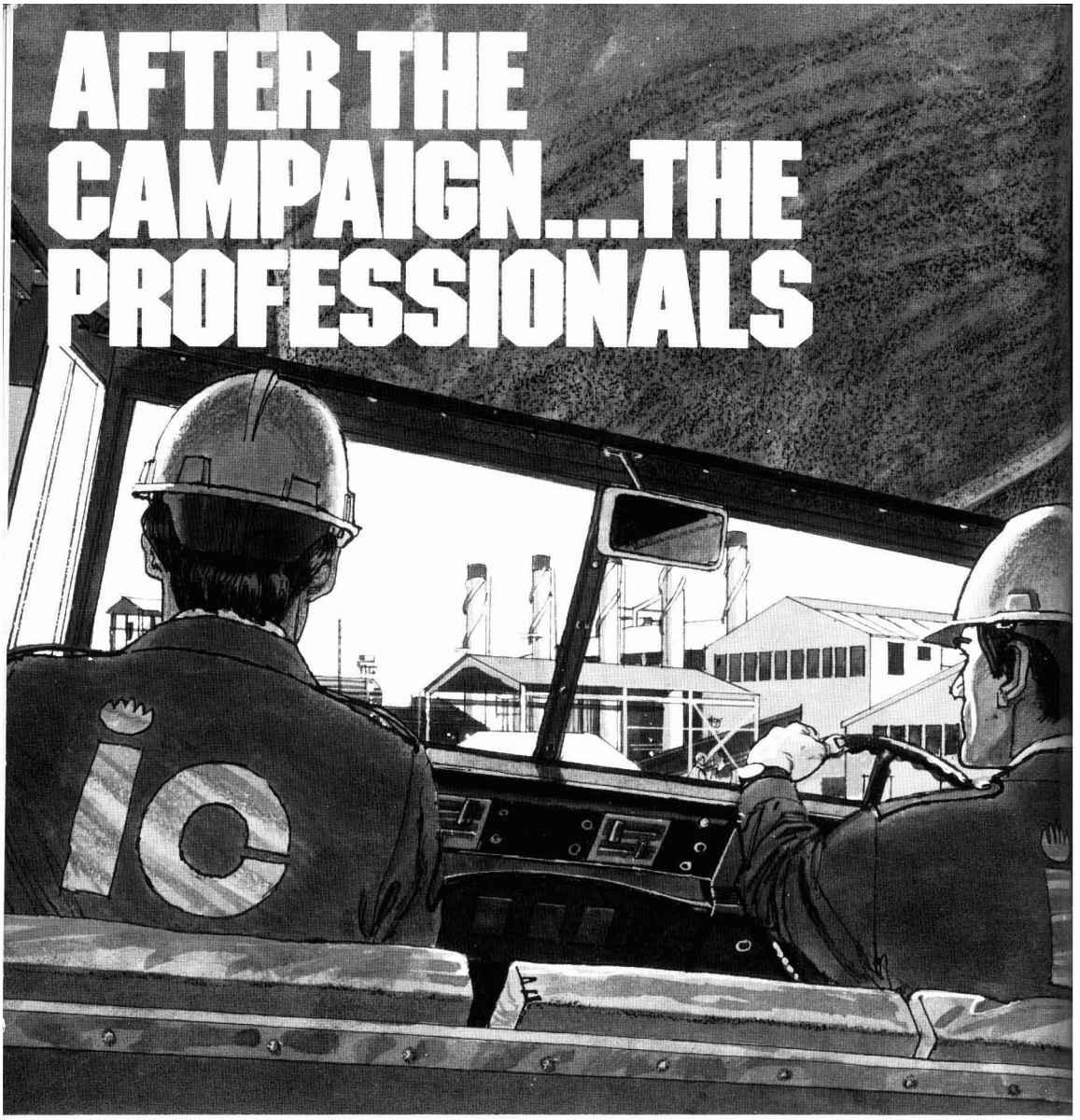

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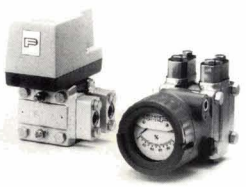

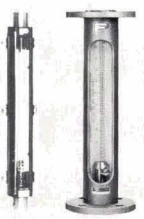

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			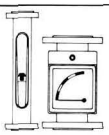	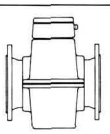	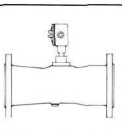	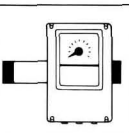	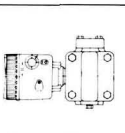	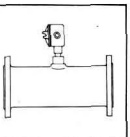
Metering Principle			**Variable Area Flowmeter**	**Magnetic Flowmeter**	**Swirlmeter**	**Vortex Flowmeter**	**ΔP Transmitter**	**Turbine Flowmeter**
Options			Glass tube ● Metal tube	Galvanic pick-up ● Capacitive pick-up				
Operating limits								
Flowrate (full scale values)	Gases, Q_n	min	1.5 l/h ● 4.5 m^3	no	10 m^3/h	no	1 m^3/h	no
		max	1500 m^3/h ● 3500 m^3/h	no	16000 m^3/h	no	unlimited	no
	Liquids	min	18 l/h ● 150 l/h	12 l/h ● 6 m^3/h	4.0 m^3/h	11 m^3/h	5 l/h	182 l/h
		max	52 m^3/h ● 120 m^3/h	144000 m^3/h ● 6600 m^3/h	810 m^3/h	316 m^3/h	unlimited	3630 m^3/h
Meter size DN mm			2 to 100 ● 15 to 100	3 to 2000 ● 50 to 500	15 to 400	25 to 150	unlimited	6 to 200
Rangeability			1:12.5 ● 1:10	1:100 ● 1:100	1:15	1:15	1:5 (1:10)	to 1:200
Max. operating pressure			Dep. on size ● 100 bars	250 bars ● 16 bars	100 bars	40 bars	< 420 bars	40 bars
Max. operating temperature			200°C ● 400°C	180°C ● 90°C	110°C	120°C	1000°C	232°C
Fluid limitations	Viscosity		< 1000 cSt Dep. on size	no	⩽ 20 cSt	< 5 cSt	Dep. on pressure head device	⩽ 60 cSt Dep. on size
	Conductivity		no	0.5 µS/cm ● 0.05 µS/cm	no	no	no	no
Notes							Min. Δp 1 mbar; Max. fluid temp. for DPT 120°C (177°C)	
Applications								
Gases			●	no	●	no	●	no
Fluid	non-viscous		●	●	●	●	●	●
	viscous		●	●	●	no	●	●
	with solids		no	●	no	●	●	no
	corrosive		●	●	●	●	●	●
Accuracy	standard		1.6 % full scale	1 % of rate	1 % of rate	1 % of rate	0.25 % of span	0.25 % of rate
	w. spec. calibr.		1.0 % full scale	0.5 % of rate	no	no	no	no
Mounting position			vertical	any	any	any	any	any
Connections	flange		●	●	●	●	●	●
	thread		●	no	no	●	●	●
Pressure loss in flow meter			●	no	●	●	●	●
Indication and output signal								
Indication			● Local	Remote	Remote	Local	Local	Remote
Electronic signal			●	●	●	●	●	●
Pneumatic signal			●	I/P-transducer	I/P-transducer	I/P-transducer	●	I/P-transducer
Pulse output			●	●	●	●	no	●
Alarm switch			●	Separate	Separate	Separate	Separate	Separate
Local integrator/counter			●	●	●	●	Remote	Remote

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the phenolic compounds at pH 8.0-8.5 is normally used in the procedure[13]. After washing the alumina with water to remove impurities, the catecholamines are released by addition of diluted acetic acid. The content of catecholamines is then normally determined by a trihydroxyindole (THI)-fluorometric method. The accuracy and practicality of a number of suggested methods have been tested and evaluated[14]. Further studies included histo-chemical fluorescence microscopy techniques developed by Swedish investigators allowing an actual visualization of the catecholamine-containing structures[15].

During the last few years the application of high-performance liquid chromatography (HPLC) has been brought into operation to separate the catecholamines. The methods used are reverse-phase chromatography with electrochemical detection[16] or measurements with a UV-detector[17].

EXPERIMENTAL

Principle of purification

The principles of the analytical methods outlined in the literature have been adapted and further developed for use in the sugar industry. Our analytical procedure is a compromise between the following:

(a) a specific isolation of catecholamines and closely related compounds is desired, as is
(b) a concentration of the compounds so that the concentration in the sample used for HPLC is considerably higher than in the juice sample;
(c) a high analytical accuracy is required, while
(d) the sample preparation should be carried out within a reasonable time.

The procedure requires much care and precision. Otherwise, interference from compounds entering during the procedure could occur since, as it will turn out, the concentration of catecholamines in sugar factory juice is fairly low and detection is performed in the range of a UV-spectrophotometer where many compounds absorb light. With the procedure developed it is expedient to purify the catecholamines from 3-5 samples within the same period.

Reagents and materials for the purification

(1) Water. Prepare all reagents with deionized and distilled water.

(2) HCl,2N. Prepare from ampoule.

(3) Alumina (Aluminium oxide), Al_2O_3

Boil 300 g Al_2O_3, Merck Aluminiumoxid 90 (Aktivsauer für die Säulen-Chromatographie) in 1000 cm^3 of 2N HCl for 30 minutes in a reflux apparatus. Pour off the cloudy, yellowish supernatant. Stir the alumina briefly in 1 litre of water, allow to settle for 5 minutes and again decant the supernatant. Repeat this washing and decanting process with water 12-15 times until the wash water clears after 5 minutes of settling and is of pH 4-5. Collect the alumina in a 20 cm diameter Büchner funnel, cover it, and allow to dry overnight at room temperature. Finally, dry it in an oven at 100°C for 2 hours.

(4) EDTA, 0.2M. Dissolve (by heating) 74.4 g "Titriplex III" (disodium ethylene-diaminetetraacetate, $Na_2C_{10}H_{14}O_8N_2,2H_2O$. Merck Art. 8418) in water, cool and make to 1000 cm^3.

(5) Ascorbic acid, 1%. Dissolve 250 mg ascorbic acid in 25 cm^3 water just before use.

(6) NaOH, N and 1/28 N. Prepare from ampoules.

(7) Acetic acid, 0.2M and 0.5M. To 1000 cm^3 dilute 11.6 cm^3 and 29.0 cm^3, respectively, of glacial acetic acid with water.

Procedure of purification

Weigh a 400 cm^3 beaker (*a grams*), add a sample of about 250 cm^3 and weigh again (*b grams*). Add 60 cm^3 of 0.2M EDTA solution and 5 cm^3 of 1% ascorbic acid and weigh this (*c grams*). Mix the liquid with 25 g "Celite" analytical filter aid and filter through glass filter paper. Collect the liquid and weigh it *(d grams)*. While stirring constantly with a magnetic stirrer add 3.0 g alumina to the liquid. While the pH is measured continuously with a glass electrode, add N NaOH to pH 8.4. Stir for 7 minutes, adding 1/28N NaOH as necessary to keep the pH at 8.4. Run the stirrer just fast enough to keep the alumina suspended.

Stop the stirrer and let the alumina settle. Decant the liquid above the alumina and wash it, the electrodes, and the beaker twice with 50 cm^3 of water. Use two amounts of 10 cm^3 of water to transfer the alumina to a 0.7 x 20 cm chromatographic column (Bio-Rad Laboratories, Cat. No. 737-1242). Allow the water to drain through, add 1 cm^3 0.2M acetic acid and discard the eluate. Place a beaker (*e grams*) under the column and add to the top of the alumina 10 cm^3 0.5M acetic acid. Collect the eluate in the beaker and finally weigh this (*f grams*). The liquid is membrane-filtered through a 0.45 μm filter. The filtrate is used as the sample for HPLC.

Apparatus for HPLC

A liquid chromatograph with units from Waters Associates Inc. was used. The equipment consisted of a model 6000A Solvent Delivery System, U6K Universal Injector, and a model 450 UV/VIS Variable Wavelength Detector. The signal from the detector was connected with a Hewlett-Packard 3385 Chromatography Automation System which includes units for plotting the signal, printing the retention time, and calculation of the area of the peaks. We used a Waters "μBondapak C_{18}" column (10 μm ave. particle size, 3.9 mm i.d. x 30 cm). The principles of HPLC are well known[18].

Analyses with HPLC

All results quoted in this article were obtained under the following experimental conditons:

Solvent: 0.2 (v/v) % acetic acid filtered through a 0.45 μm filter.
Flow rate: 1.0 $cm^3.min^{-1}$
Temperature: ambient (20°C).
Sample volume: 25 mm^3
Detector: UV, 0.1 aufs.

The column was fluxed daily with a 80:20 methanol:

---

[13] Crout: *Stand. Methods Clin. Chem.*, 1961, **3**, 62-80.
[14] Quek, Buttery & De Witt: *Clinica Chemica Acta*, 1975, **58**, 137-144.
[15] Hillarp, Fuxe & Dahlström: *Pharmacol. Rev.*, 1966, **18**, 727-741.
[16] Keller, Oke, Mefford & Adams: *Life Sciences*, 1976, **19**, 995-1004.
[17] Mell & Gustafson: *Clin. Chem.*, 1977, (23/3), 473-476.
[18] Engelhardt: "Hochdrunk Flussigkeits-Chromatographie". (Springer Verlag, Berlin), 1977.

water mixture.

In this chromatographic system we are dealing with reverse-phase liquid chromatography. The number of theoretical plates turned out to be about 6000.

Quantitative determinations of components in the sample

When a peak in a chromatogram has been identified as a commercially available pure substance (a standard compound), it is possible to calculate the concentration of the compound in the sample. The concentration c_i of the compound "i" is given by the formula:

$$c_i = \frac{f-e}{b-a} \times \frac{c-a}{d-a} \times \frac{1}{R_i} \times \frac{A_i\,(\text{sample})}{A_i\,(\text{standard})} \times K_i$$

R_i : Recovery of standard compound "i" after the purification procedure.

A_i (sample): Area of the peak "i" in the chromatogram of the sample.

A_i (standard): Area of the peak "i" in the chromatogram of the standard.

K_i: The concentration of the standard in the standard solution used in the determination of A_i.

All the standard compounds used in these investigations were supplied from Sigma Chemical Company in the highest obtainable grade of purity.

RESULTS AND DISCUSSION

Elucidation of the purification procedure

Ascorbic acid is used as a reducing agent to remove dissolved oxygen and possibly reduce phenolic compounds in the quinone state and thereby stabilize the compounds for the assay. The reduction of benzoquinone to hydroquinone by ascorbic acid is easily obtained, and a result is shown in Figure 1.

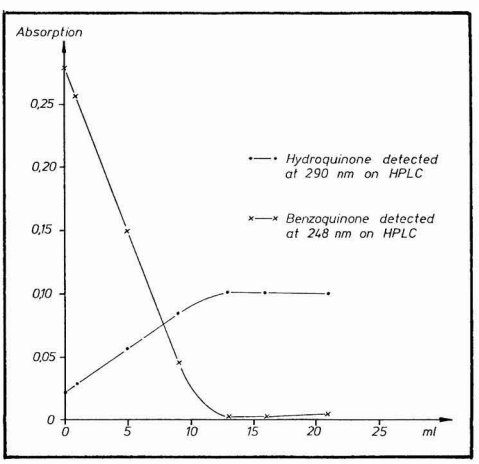


Fig. 1. Reduction of 0.116 mmol benzoquinone to hydroquinone with ascorbic acid (0.0071 mmol.cm^{-3}) in acetate buffer, pH 4.6

The EDTA solution added to the sample has turned out to result in higher peaks in the chromatogram. The effect of EDTA is possibly due to its complex formation with divalent metal ions such as magnesium (about 130-180 ppm in raw juice), calcium (about 10-25 ppm) and iron (about 10-40 ppm). These ions are believed to form complexes with phenolic compounds also.

We have found that in some cases the addition of sodium azide to raw juice at the time the sample was taken has altered the appearance of the chromatogram substantially compared with the result from juice left in the laboratory for some time. This may possibly be due to enzymatic activity. However, in general, we have omitted the addition of sodium azide since we wanted to make the purification as simple as possible, and we carried out the purification as soon as possible after the sample was taken.

Experiments have shown that although phenolic compounds are more stable at low pH than at high pH, addition of hydrochloric acid did not lead to an increase of the area of the peaks in the chromatograms.

During the filtration with "Celite" analytical filter aid some loss of phenolic compounds takes place. However, if a pre-filtration of raw juice is not made before the addition of the alumina, a later recovery of the phenols from the alumina is practically impossible.

The strength and volume of the acetic acid used in the desorption of the phenolic compounds from the column with alumina is a compromise between the desire for complete desorption, a high concentration of the phenolic compounds in the sample for HPLC, and as low a concentration of acetic acid as possible in the sample since a lot of acetic acid in the sample might lead to a certain alteration of the chromatogram.

When we initiated these investigations, we could not know whether we were going to find any compounds of importance from the juice in the acetic acid from the alumina containing column. However, by adding an excess of sodium hydroxide, the appearance of the liquid turned from pale yellow to a very dark colour showing the presence of some reactive compounds such as phenols.

Chromatograms from HPLC

Normally, the detector was adjusted within the wavelengths of 250-300 nm. Above 300 nm practically no absorption was found.

A chromatogram listed on the plotter consists of two parts. First, a representation of the detector signal with the time of elution stated next to the peaks. With a flow rate equal to 1.0 cm^3.min^{-1} the time is the same as the elution volume. Second, a list of peaks measured and the corresponding areas are listed.

Figs. 2-4 show representative chromatograms of compounds purified from raw juice from our Nakskov factory. The chromatograms are obtained after development of the purification procedure, and they are from the last part of the sugar campaign. Figs. 2 and 3 are from the same purified juice, but the compounds are measured at 280 and 290 nm, respectively. Fig. 4 represents components from raw juice from another day and measured at 280 nm.

Several conclusions can be drawn from the chromatograms. A large number of compounds from raw juice are adsorbed on the alumina, purified, and recovered by desorption. Altogether, there are nearly 20 compounds of which 6-8 are predominant. The areas of the peaks vary day by day.

On the basis of the selected column and the solvent it can be concluded that the compounds in question are of a fairly high polarity.

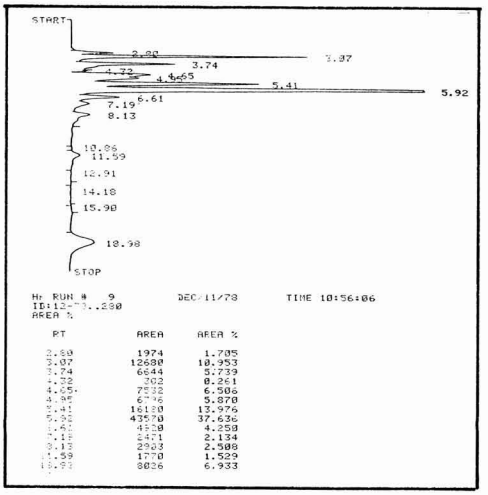


Fig. 2. Chromatogram of compounds from raw juice (RDS = 13.4) from Nakskov factory Dec. 11, 1978, separated by HPLC and detected at 280 nm

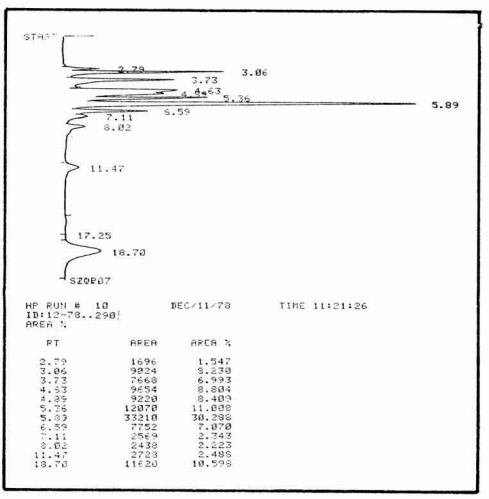


Fig. 3. Chromatogram of the same compounds as in Fig. 2 but detected at 290 nm

Fig. 5 shows compounds isoiated from juice from the top of a DDS diffuser. The sample was collected at about the same time as the raw juice shown in Fig. 4 was collected. As it turns out, a high content of compounds is found even at the end with juice with a low refractometric dry solids content (RDS). During the diffusion process the concentration of compounds does not follow the RDS value. Study of a number of chromatograms from several samples taken throughout the diffuser seems to indicate that some of the compounds can interchange from one of the isolated compounds to another.

As mentioned above, some of the compounds obtained by desorption from the alumina are reactive and can form coloured compounds. Demonstration of the presence of these compounds high in the diffuser is in accordance with the fact that addition of hydrogen

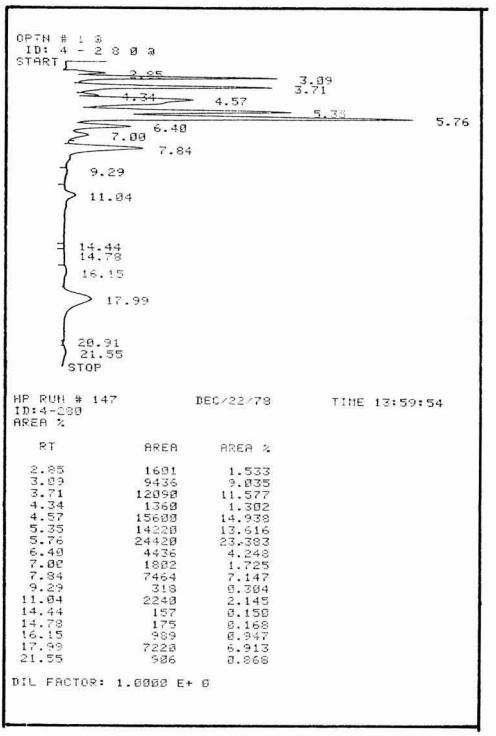


Fig. 4. Chromatogram of compounds from raw juice (RDS = 13.0) from Nakskov factory, Dec. 22, 1978, separated by HPLC and detected at 280 nm

peroxide at the same location will result in dark juice.

2nd carbonatation filtrate from our Nakskov factory was purified in the same manner as indicated for raw juice. The HPLC chromatograms proved that the eluate showed hardly any absorption within the wavelength range of 270-290 nm. The small peaks found were analysed, and it was concluded that they originated from compounds which are not predominant in the chromatograms obtained from raw juice.

Raw juice from Saxkjøbing, another of our factories, was purified and subjected to HPLC. A typical chromatogram is given in Fig. 6. On the basis of our preliminary studies we concluded that the variations in chromatograms of samples of raw juice between the two factories, Nakskov and Saxkjøbing, were greater than the day-by-day variations of samples from an individual factory. In this connexion it should be mentioned that the colour of thick juice in Saxkjøbing was about twice that of thick juice in Nakskov.

In connexion with a number of investigations we are making, such as, for instance, evaluation of beet quality, it is important to carry out digestion of samples from sugar beets in the laboratory. Our studies of chromatograms have revealed that the composition of compounds isolated according to the procedure outlined above shows many significant deviations between laboratory

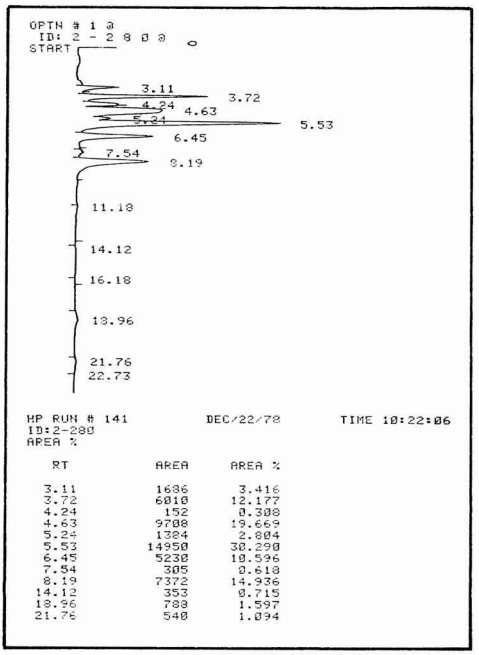


Fig. 5 Chromatogram of compounds from juice (RDS = 0.5) taken from close to the "upper end" of a DDS diffuser at Nakskov factory, detected at 280 nm. The juice was collected at about the same time as the raw juice of Fig. 4.

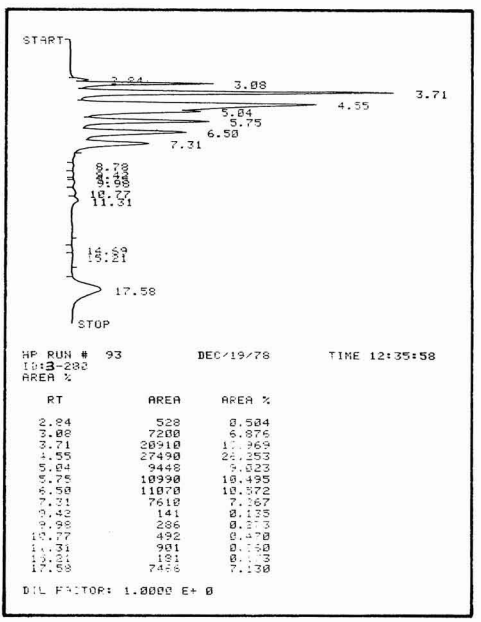


Fig. 6. Chromatogram of compounds from raw juice (RDS = 13.1) from Saxkjøbing factory, Dec. 19, 1978, separated by HPLC and detected at 280 nm

juice and factory juice. Moreover, evaluating juice from variable sources and obtained by a standardized method can reveal valuable information. As an example of juice obtained in the laboratory we took juice made from equal parts of green material, e.g. stalks from the beet crown, and water heated to 70°C for 30 minutes. A chromatogram of isolated compounds from this juice is shown in Fig. 7.

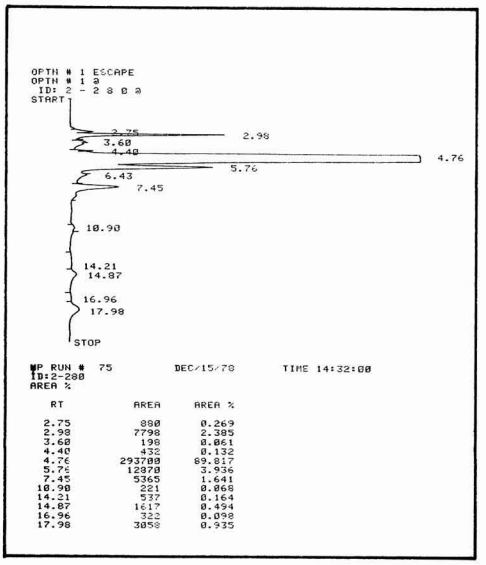


Fig. 7. Chromatogram of compounds from digestion juice extracted in the laboratory from green material (RDS = 3.0) at Nakskov factory, Dec. 15, 1978, separated by HPLC and detected at 280 nm

Notice the very big peak at a retention time of 4.76 min. The detector was monitored at the same value as on the other chromatograms. Detailed studies showed that by increasing the attenuation on the plotter, the peak was drawn within the range of the paper but no further peaks were found. The total area under the peaks in the chromatogram is almost a reflection of the amount of compounds purified. This amount is very high, especially compared with the content of RDS which is equal to 3.0. In considering the significance of this result it should be borne in mind that carrying out laboratory purification of the juice from the green material will give a 2nd carbonatation filtrate with a very high colour[1].

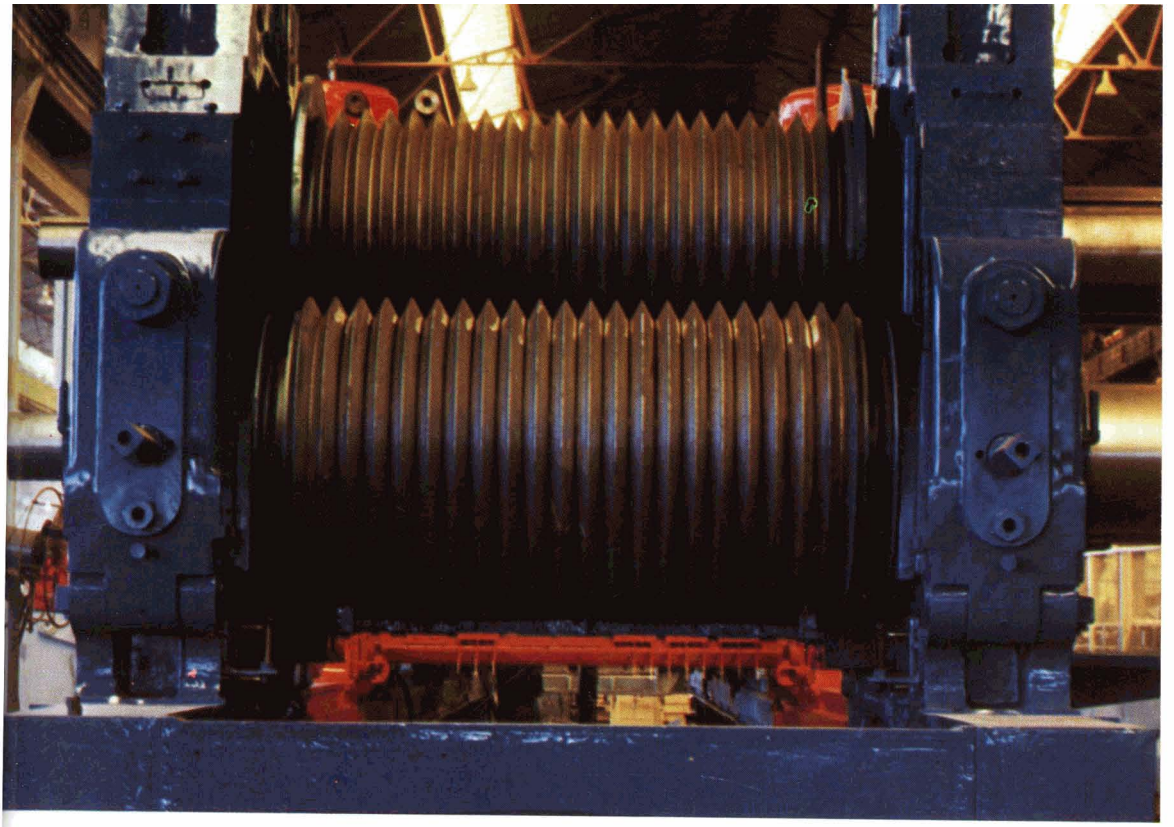
In connexion with our investigations of sugar beets we have also examined juice from red beet. Compounds isolated from this juice show a chromatogram with many similarities to juice from the green material.

Future studies are anticipated to include investigations of the various parts of the sugar beet during the growing season.

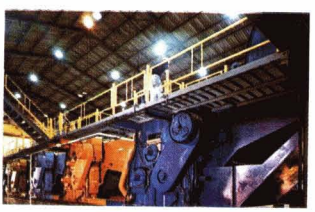
(To be continued)

Uganda sugar factory rehabilitation[2]. — Plans are to be announced shortly for reconstruction of the former Mehta Group sugar factory at Lugazi. It is anticipated that the factory could resume production within six months but the necessary investment would amount to some £2,000,000.

[1] *Sugar Tech. Rev.*, 1978/79, **6**, 49-115.
[2] F. O. Licht, *International Sugar Rpt.*, 1979, **111**, 441.



Trapiches Zanini, el dulce sabor del suceso.



La tecnología Farrel incorporada a los equipos Zanini está presente en los mayores centrales azucareros del mundo. Los trapiches Zanini - Farrel ya demostraron su eficiencia y rentabilidad en el Brasil, Argentina, México, Estados Unidos, Venezuela, República Dominicana, Colombia y otros países.

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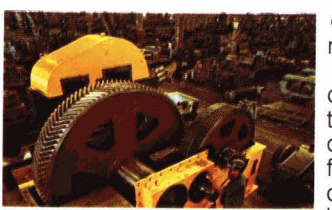

Su central azucarero merece los trapiches cuyos desempeños ya fueron probados y comprobados en las más diferentes regiones del mundo. Verifique y verá que detrás del suceso de los mayores centrales azucareros del mundo, está siempre la tecnología de Farrel. Y la calidad de Zanini.

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SUGAR CANE AGRONOMY

Aqua ammonia. Anon. *Producers' Rev.*, 1978, **68**, (6), 23. — The storage and application of anhydrous ammonia to cane is briefly discussed. The advantages of this form of nitrogen, very popular with cane farmers, include the possibility of applying it before planting, in wet or dry conditions. While past practice in Queensland has been to apply only one-third before planting, recent experience has shown that, in most situations, all of the total N requirement can be applied before planting, and is equally effective.

Rethink on sugar cane nutrition. Anon. *Producers' Rev.*, 1978, **68**, (6), 35-36. — The question of cane nutrients, other than N, P and K, which warrant closer attention than has been paid to them in the past is discussed. There is evidence that calcium and magnesium are or are becoming deficient over a wide area of north Queensland and are limiting both cane yields and response to applied N, P and K. Application of K to soil which has only low Ca and Mg contents may induce orange freckle (a symptom of Mg deficiency) and prevent uptake of both Ca and Mg. Copper deficiency is also briefly mentioned. The author stresses that a large part of the soil nutrient stock is removed with the cane crop, so that a new supply of nutrients will be needed for the next crop.

The influence of time of harvest on yields in the Burdekin district. K. C. Leverington, D. M. Hogarth and G. J. Ham. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 27-30.—Cane of four varieties was harvested on one of five dates, *viz.* July 6, August 7, September 18, November 13 and December 7. Tabulated data indicate that, while yield was not affected by the harvest date, the fibre content gradually increased with lateness of harvesting, while sugar content and yield followed the normal pattern for Queensland cane crops. On the other hand, cane and sugar yields fell with increase in lateness of ratooning of the previous crop. This is attributed to a number of factors, of which two important ones are the relative times of maximum growth and achievement of full leaf canopy, and the adverse effect on tillering of long periods of rain and the resultant waterlogging of the root system. Both factors have a marked adverse effect on cane ratooned in November and December.

Chemical ripening of cane—BSES experiments during 1977. G. Kingston, L. S. Chapman and A. P. Hurney. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 37-43.—While neither "Ethrel" nor "Polaris" had any beneficial effect on cane sugar production by comparison with the control when applied aerially or by spray boom, two other chemical ripeners, "Mon 8000" and XHM 148, did increase the sugar content in the top third or half of cane in small plot trials, best results being obtained with 0.45 $kg.ha^{-1}$; the lesser effects of 1.1 $kg.ha^{-1}$ were similar to the ripening activity of 4.25 $kg.ha^{-1}$ of "Polaris".

Herbicide trials—control of the common reed. A. I. Linedale. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 97-101.—See *I.S.J.*, 1979, **81**, 240.

Inorganic ash and cane topping. L. K. Kirby and G. Kingston. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 133-138.—Investigations of cane juice ash content showed mean values over a 9-week period of 0·41%, 0·43% and 0·45%, corresponding to low, medium and high cane topping. While high topping would increase the ash content by 20%, calculations based on previous data have shown that the inclusion of all cane tops would increase it by more than 50%. Juice phosphorus, potassium and chloride concentrations rose with increase in topping height, some similarity being found between the ash % Brix and K^+ concentration curves. Variation in irrigation water salinity accounted for 37% of the variation in juice ash. While there was no evidence of any simple relationship between the rate of fertilizer application and juice ash% solids, there was an indication of rise in juice ash (expressed as kg per cane plot) with increase in K_2O application.

Chemical ripening with "Polaris" under commercial conditions in north Queensland. A. P. Hurney and K. Schmalzl. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 139-144.—Trials in 1976 and 1977 are reported, in which "Polaris" was sprayed from the air at two sites. Results showed that treatment produced a good average increase in sugar content in both years at one site but in only one year at the other, where natural ripening conditions were more favourable. Optimum dosage rate was 5 $kg.ha^{-1}$; application to yellow spot-infected cane adversely affects the sugar content and is not recommended. Because of inconsistency in the results (about half of the values failing to reach a calculated break-even point), and because of the risk in cane yield reduction as a result of the desiccating action of the ripener combined with shortening of the internodes, the economics of the use of "Polaris" come into question, and further experiments are considered necessary.

Drip irrigation—an assessment. L. S. Chapman. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 145-152. — Drip irrigation trials showed that the cane and sugar yields from both plant and ratoon crops were generally about the same as or slightly greater than results with solid set or conventional spray systems. However, there are a number of factors which need to be considered in relation to its use in Queensland, and these are discussed.

Supplementary irrigation in the Herbert River district—preliminary investigations. N. R. Maclean. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 153-158.—Trials showed that meteorological observations may be used to indicate when irrigation is required on the basis of monthly rainfall variability and moisture deficits as well as the peak growth period. Cane and sugar yields were increased by irrigation, despite high annual rainfall. All varieties approved for planting in the district gave good responses, so that choice of variety was not considered important.

The problem of inadequate drainage in the Lower Herbert. C. W. Chardon and A. V. Rudd. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 159-163.—Investigations in 1976-77 in the Lower Herbert area of Queensland showed that, where plots were inade-

quately drained, the mean cane yield was only 66% of that where drainage was satisfactory; greatest yield decline was in two plots of Q 90 cane, where the results were only 21% and 35% of the yields on adequately drained soil. Overall poor drainage in the Ingham area is attributed to a low lateral hydraulic conductivity of the soil combined with the use of only shallow water furrows which do not remove excess water efficiently but rather dam the water. Advice is given on the installation of underground slotted, corrugated pipes, and the costs are set out.

Underground drainage in the central district using "flexible slotted pipes". L. K. Izatt. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 165-170.—Cane land in the central district of Queensland is affected by wet areas caused by spring and underground seepage. Three major types of seepage are described; the problems created by it include land preparation in two or more stages and delayed planting, disruption of cultivation when the fields are too wet, heavy weed growth and high soil moisture levels which make clean cane burns impossible, and reduction of plant cane yields as a result of late planting and extended periods of waterlogging. Use of high-density polyethylene drainage pipes which are slotted and corrugated has reduced excess groundwater in areas affected by seepage. Advice is given on installation of the pipes, and basic costs are estimated.

Physiological analysis of sugar cane growth under the climatic conditions of Uttar Pradesh in relation to phasic development. U. S. Singh. *Sugar News* (India), 1978, **10**, (1), 9-15.—Climatic conditions and cane physiological characters were recorded during two years in order to identify the limiting factors for yield potential as a guide for breeders. From the commercial aspects, the most important period of sugar accumulation and storage is during the elongation growth phase, and, to achieve highest yields, the cane variety should have higher photosynthetic and lower respiratory rates at this time, and should also be efficient in the movement of photosynthate to the stem. Thus, varieties should be capable of elongation, even under relatively low maximum and minimum temperatures, relative humidity and rainfall, as well as being more efficient in respect of photosynthesis per unit time and leaf area.

Sugar cane in relation to vacuum pan white sugar manufacture. G. Ramchandran. *Sugar News* (India), 1978, **10**, (1), 17-28.—The major elements present in sugar cane tissues are listed and their individual contributions to cane physiology described. Soil properties and analysis are also discussed, with an account of the rapid assessment of its N, P, K and Ca contents.

Maturity survey for harvest of sugar cane in sugar factory areas. D. G. Dakshindas. *Sugar News* (India), 1978, **10**, (1), 29-32.—Suppliers to the cooperative sugar factories of Maharashtra keep records of the planting or ratooning dates of their fields, and these are sampled 15 days or a month before harvest is due; where the Brix has reached the expected levels, the cane is harvested in accordance with the planting or ratooning sequence, while fields with lower than anticipated Brix are left until the next sampling period. Since the crop in Maharashtra can last for 160-200 days, a single sampling is less efficient than periodical sampling, because of variations in maturing of cane as a result of differences in individual fields, and recommendations include better sampling (more canes from more locations in the field), use of the hand refractometer for Brix measurement with occasional checks by laboratory measurements made without delay, adoption of a common date for commencement of Brix surveys, continuation of sampling until January, *i.e.* through much of the season, and harvesting of fields where the surveys show the start of deterioration.

Ripening of sugar cane through chemicals. K. Venkatamaran, M. R. Iruthayaraj, T. R. Srinivasan and T. K. G. Rao. *Sugar News* (India), 1978, **10**, (1), 33-34.—A number of ripeners were applied to cane at the Tamil Nadu Agricultural University, Coimbatore, 280 days after planting, and the c.c.s. and reducing sugars contents measured at 300, 320 and 340 days, after which the crop was harvested. The yield of cane at harvest was not significantly altered by comparison with the untreated control, and the initial gain in c.c.s. observed for the ripeners at 300 and 320 days had dissipated by 340 days.

Study on the availability of CDU to sugar cane. Y. Y. Chan. *Rpt. Taiwan Sugar Research Inst.*, 1978, (79), 1-13 (*Chinese*).—Nitrogen was applied to spring- and autumn-planted cane either all as ammonium sulphate or as a 1:1 mixture of ammonium sulphate and crotonylidene diurea (CDU). While a significant increase in cane and sugar yield was observed with autumn-planted cane as a result of N application, the CDU-ammonium sulphate mixture was more effective than ammonium sulphate alone, two applications of the mixture to give a total of 75 $kg.ha^{-1}$ N giving the same results as three applications of ammonium sulphate to give a total of 150 $kg.ha^{-1}$ N; at 300 $kg.ha^{-1}$ N, ammonium sulphate gave an average of 6·31 tonnes of cane per ha less than did the mixture. However, the effect of CDU on spring-planted cane was apparently affected by its low dissolution rate as well as climate and cane growth pattern; while the mixture gave a higher cane and sugar yield than the ammonium sulphate at 75 $kg.ha^{-1}$, at 150 and 225 $kg.ha^{-1}$ ammonium sulphate was more effective. In ratoon crops, the mixture was superior to ammonium sulphate at all application rates. Because of the lower leaching and mineralization rates of CDU in the soil, it is suggested that the mixture could be applied in just one or two lots.

Comparison of boron test methods for sugar cane soils in Taiwan. M. M. Kao and T. C. Juang. *Rpt. Taiwan Sugar Research Inst.*, 1978, (79), 15-27 (*Chinese*).—Of four methods used to determine soil boron, that based on extraction with curcumin and use of SS-589 filter paper showed highest correlation with the dry weight of pot-grown cane. While the amount of B extracted fell with increase in the extraction period from 5 min onwards (possibly a result of re-adsorption and B fixation by the soil), it rose with increase in the extractant:soil ratio. Liming acid soils reduced B availability, while sulphur application to neutral soils increased it; calcium sulphate had little effect on soil pH and B availability. There was a positive linear correlation between soil pH and organic matter content on the one hand and water-soluble B content on the other. The effect of B application to soil on cane growth depends on the soil properties; from regression analysis of cane total dry weight and B extraction from the soil, a soil B content of 0·44 ppm was found to be the critical level.

Conservation farming pays. C. T. Wise. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 129-130.—The author describes the measures he has adopted as a means

of soil conservation on his cane farm, particularly the use of 40-70 m wide strip cropping panels between contour roads. Water conservation is promoted by the presence of contour spillover roads, trashing, and harvesting in panels (to hold run-off from bare or newly cut fields and allow it to percolate through panels of cane of differing ages below).

Filter cake—a field and glasshouse evaluation. P. K. Moberly and J. H. Meyer. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 131-136.—Trials are reported in which filter cake was applied to various types of soil either broadcast at 50 or 100 tonnes.ha^{-1} or in the furrow before planting at 50 tonnes.ha^{-1}. Response varied according to soil type, but was maximum where soil P content was low and P fixation characteristics good. The combined plant and 1st ratoon yields were increased by 30 tonnes.ha^{-1} and the expected sugar yield by 2.5 tonnes.ha^{-1}. Cane quality was adversely affected by the N in filter cake, however. While 3 tonnes.ha^{-1} of a compost made up of "Cofuna" (containing cellulose-decomposing bacteria) and bagasse, with or without filter cake, gave better cane yields than did 45 tonnes of filter cake per ha, it is thought that the labour and costs involved in compost making do not justify its use. Filter cake contains sufficient moisture to improve germination and ensure good cane establishment under dry conditions, and was even beneficial under rain-fed conditions. The nematicidal effects of filter cake were limited. Glasshouse investigations indicated the possible advantage of using decomposed rather than fresh filter cake in respect of N availability.

"Destun", "Dual" and "Velpar"—three new herbicides for the sugar industry. P. E. T. Turner. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 146-149.—Trials on three herbicides recently registered for use in the South African sugar industry are reported. "Destun" ("Perfluidone") plus "Atrazine" at 2.5 + 1.0 kg.ha^{-1} as pre-emergence treatment was superior to the standard "Alachlor" + "Atrazine" in control of *Cyperus esculentus* and had a longer residual effect; it was equal to the standard in control of grass weeds, while control of broad-leafed weeds was good. "Dual" ("Metolachlor") + "Atrazine" at 2.0 + 1.0 kg.ha^{-1} was comparable to "Alachlor" + "Atrazine" at 1.92 + 1.0 kg.ha^{-1} in the control of all three categories of weeds. "Velpar" alone at 0.45 kg.ha^{-1} or in combination with 2.0 kg.ha^{-1} of "Diuron" was excellent as either pre- or post-emergence treatment in control of all three groups. It was better than the currently recommended herbicides in the control of *Panicum maximum.* In studies on phytotoxicity, it slightly reduced the yield of plant cane when used at the registered rate, but is considered acceptable for use in ratoon crops. None of the three herbicides effectively controlled *Cyperus rotundus.*

"Metolachlor" — a new pre-emergence herbicide for grass control in sugar cane. J. van der W. Jooste, J. J. van Biljon and P. C. van Blommestein. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 150-153.—Results of more than 80 trials over a 4-year period are reported. At 1.5 kg.ha^{-1} it controlled grasses effectively (2.0 kg.ha^{-1} being required for control of *Panicum maximum)* and was little affected by soil clay content. Addition of "Atrazine" or "Ametryne" at 1·0-1·5 kg·ha^{-1} improved its activity against broad leafed weeds, which was otherwise poorer than against grasses. At 2.0 kg.ha^{-1} it had varying success in control of *Cyperus esculentus* but was clearly superior to "Alachlor". It has little effect as a post-emergence herbicide, unless used in conjunction with another post-emergence chemical.

The application of agricultural chemicals by aircraft on sugar cane. C. A. Lang. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 154-159.—Various aspects of aerial application of herbicides, "Ethrel" ripener and fertilizers at Ubombo Ranches Ltd. in Swaziland are discussed. Advantages and disadvantages of aerial application are listed, and the economics are briefly mentioned.

Early- and late-season chemical ripening of sugar cane. M. St. J. Clowes. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 160-165.—Ripening with "Mon 8000" and "Roundup" was investigated, comparison being made with the performances of "Ethrel" and "Embark", already registered as ripeners in South Africa. At up to 0·6 kg a.i. per ha, both of the new ripeners were effective in increasing sugar content, the optimum harvest time being up to 6 weeks after application, after which there was a reduction in stalk weight. The ripening effects were similar to those of the established ripeners, but in addition, the new ripeners also caused accumulation of sucrose, particularly in the lower parts of the stalk, irrespective of the degree of natural maturity. (It is suggested that chemical ripeners may be classified either as "ripeners" or as "loaders", according to how sugar accumulation occurs in the stalk.) Moreover, "Ethrel" and "Embark" significantly increased the sugar content only when applied to immature cane, but stimulated growth rather than had a ripening effect in the case of mature cane; "Mon 8000" and "Roundup" were equally effective when applied early and late in the season. At above 0.6 kg.ha^{-1}, "Mon 8000" and "Roundup" produced some chlorotic regrowth, but chlorosis disappeared within 3 months; stunting was observed when 0.9 kg.ha^{-1} or more was applied

Post-harvest deterioration of whole-stalk sugar cane treated with chemical ripeners. M. St. J. Clowes and R. A. Wood. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 166-168.—Two trials, carried out to determine changes in weight, juice quality and recoverable sugar content of harvested, unburnt cane which had been treated with "Mon 8000" and "Ethrel" ripeners, showed that "Mon 8000" significantly reduced the rate of post-harvest deterioration by comparison with an untreated control in one trial, whereas "Ethrel" had no such inhibitory effect. Hence, it is necessary to minimize the delay between harvesting and milling if the advantages gained from ripener application are not to be lost.

The production of biomass by sugar cane. G. D. Thompson. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.,* 1978, 180-187.—Experiments carried out between 1962 and 1970 in South Africa in a study of cane biomass (total above-ground dry matter) production are discussed. Factors examined included: components of biomass (foliage, dead leaves and stalk) and the effect of cane age on trash distribution; amounts of biomass produced (roughly estimated at 0·8% photosynthetic efficiency under rain-fed conditions and 1·1% under irrigated conditions, representing growth rates in South Africa of 7.5 and 11 g.m^{-2}.day^{-1}, respectively; maximum productivity; crop development; varietal differences; and the effects of spacing, nitrogen application, water use in evapotranspiration, and season.

SUGAR CANE MECHANIZATION

Harvester evaluation methods. C. R. Henkel, T. G. Fuelling and D. Ridge. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 203-207.—In studies on harvester performance, evaluation was made on the basis of cane billet length (divided into six categories), billet damage (five categories) and extraneous matter (four categories). Results were analysed statistically to compare the effects of different harvesting speeds, type of cane (burnt or green) and dew effect (dry or wet cane) on the three factors. Coefficients of variation were established for four different cane varieties and four harvesters, demonstrating the greater variability in billet length and extraneous matter than in the proportion of sound billets.

Sugar cane harvester performance. T. G. Fuelling, C. R. Henkel, K. C. Leverington and M. K. Wegener. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 209-216.—The performances of five different harvester models (Massey-Ferguson MF 205, Toft 4000, 6000 and 6100 and the Claas 1400 machine) were assessed. Results indicated that speed of operation had little effect on cane quality where the machines were well maintained and had sharp knives; speed of operation also had no effect on the quantity of cane left in the field, which was mainly associated with lodging and ground conditions. All the harvesters, except the Toft 6100, were found to be capable of cutting erect crops of Q 90 cane in a green condition, giving levels of extraneous matter similar to those for burnt cane. Cane tops constituted the bulk of the extraneous matter in all tests; however, there are problems in designing an effective system to remove the tops without causing undue cane losses, while the ideal topping height for individual stalks in lodged crops is highly variable, so that it is virtually impossible to prevent tops entering the harvester.

An evaluation of cane harvester performance. V. Mason, D. H. Foster, R. A. James, R. N. Cullen and K. J. Meng. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 217-228.—Trials on Massey-Ferguson, Toft and Claas harvesters are reported, in which it was found that differences between cane varieties were the main factor affecting differences in extraneous matter levels, all of which rose, however, with increase in harvester speed. Extraneous matter levels were not necessarily higher in green cane than in burnt cane harvesting. The amount of cane left in the field was rarely below 2% and in some cases was about 10%. There is need for improvement (i) to harvesters so that leaf extraction from the chopped cane is better, (ii) to topper systems so that tops can be removed from cane in the row adjacent to the one from which the cane is being harvested, and (iii) to the cane collection system so that less cane is left in the field.

A mechanized method for weighing field trials. J. R. Reghenzani. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 229-233.—A mobile weighing device, designed for use in conjunction with the mechanical harvesting of cane in field trial plots, is described with the aid of photographs. Cane delivered to a 1·7 tonne capacity hopper is weighed by lifting the hopper clear of its support frame on two electronic, compression load cells. When the hopper is full, it and its support frame are tipped sideways and the contents discharged into field transport. Controls and digital weight display are located in the operator's cabin, allowing for one-man operation. Trials during 1977 gave satisfactory results; the weighing rate varied with conditions, but error distribution indicated suitability of the weigher in the field. Care was found to be necessary in lifting the weighing bin so as to avoid instability in the display, although generally engine vibration has not posed any problem.

New developments in cane transport. T. G. Fuelling. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 235-241.—A survey is presented of new developments in cane transport in Queensland, covering tipper bin and elevator bin performances, the use of transloaders, the size of bins and their transporters, factors to be considered in transport system selection, and implications of bin capacity and design for cane railway systems.

An instrumented wheelset on a cane railway bin. R. J. Dullow, R. A. James, C. R. Murry and R. D. Peirce. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 303-311.—Studies are reported in which an instrumented wheelset was used to determine the forces between cane train wheels and heads of the rails as part of an investigation of cane railway dynamics.

Proximity sensors for tramway crossing flashing lights. G. F. Pukallus and A. K. Roseler. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 317-320. Details are given of a sensor screwed into the rail of a cane train track which transmits a signal to a flashing light system at rail crossings when a train is approaching. The device senses any metal within 2 mm of its surface.

Mechanization of the sugar cane harvest. L. A. R. Pinto. *Saccharum* (STAB, Brazil), 1978, **1**, (1), 26-30 (*Portuguese*).—The types of mechanical harvesters developed in Hawaii, Australia and Louisiana in the past are briefly surveyed and account is given of the types of machine currently available in Brazil and elsewhere. Problems which arise on adoption of mechanical harvesting are discussed, *viz.* the need for level soil, exactly dimensioned fields, suitable varieties, well organized maintenance, availability of transport vehicles and coordination of transport and reception at the factories. Future trends which are anticipated are the development of a satisfactory harvester for green cane, in view of legislation against cane burning, machines of higher productivity and simpler maintenance, use of suitable varieties and other means of permitting earlier and later harvesting, and development of vehicles and systems for the continuous day and night delivery of cane to the factory to eliminate the need for cane yard storage.

The IISR tractor-drawn stubble shaver for ratooning of sugar cane. N. S. L. Srivastava. *Indian Sugar Crops J.*, 1977, **4**, 83-86.—Details and photographs are given of a stubble shaver designed at the Indian Institute of Sugarcane Research. In trials, its daily capacity was 1·5 ha per day and its operational costs were Rs.106.66 per ha compared with Rs.178.50 per ha using manual labour (30 men armed with spades). Conclusions drawn on operation and design of the equipment are listed.

CANE PESTS AND DISEASES

Chemical control of sugar cane rust. M. B. Bachchhav, D. G. Hapase, A. O. Patil and T. K. Ghure. *Sugarcane Pathologists' Newsletter*, 1978, (20), 33-35. – Spraying rust-inoculated cane with a mixture of 0.75% "Ferbam" (ferric dimethyldithiocarbamate) and 0.5% nickel sulphate as soon as symptoms of the disease appeared, and then at intervals of 21 days, reduced disease intensity by 37.5% (the average of three seasons) and increased cane yield by 5.55% by comparison with untreated controls.

Recrudescence of yellow spot disease in Mauritius. C. Ricaud, J. C. Autrey and S. Sullivan. *Sugarcane Pathologists' Newsletter*, 1978, (20), 36-39. – Yellow spot *(Cercospora koepkei)* was first reported in Mauritius in 1964; after replacement of B 3337, a widely cultivated but seriously affected variety, by a resistant variety, M 93/48, the disease was considered well under control, but it has again become serious in another variety, S 17. Island-wide surveys in 1977 and 1978 confirmed that the degree of infection varies with climate, the disease being virtually absent in dry localities but most severe in wet regions. Field trials were carried out to determine losses in S 17 cane due to the disease under varying ecoclimates at various altitudes. Comparison was also made with cane sprayed with "Benomyl" at 270 g a.i. per ha at weekly intervals. Results indicated that greatest losses occurred in high-altitude regions, a reduction of some 25% in sucrose content and a drop in juice purity from 89 to 83 being found at early harvest, although the disease did not cause a drop in cane yield. It is estimated that in 1977 the disease caused an overall loss of between 3000 and 5000 tonnes of sugar, while losses for 1978 were expected to be double the 1977 figure. Until the 1976 outbreak, S 17 had been rated as a resistant variety and was used as a control in screening trials. The change in reaction of the variety is thought to be a result of exceptionally humid conditions in January-June (especially April-June) during the past three years, and the possibility of a more virulent strain of the pathogen. Since S 17 has a high flowering potential, and no new leaves develop after flowering, the overall % leaf cover by spots continues to increase, leading to severe blighting and defoliation.

Evidence of an association between smut and leaf scald. R. A. Bailey. *Sugarcane Pathologists' Newsletter*, 1978, (20), 40-42. – In field trials, a marked association was observed between the incidence of smut (*Ustilago scitaminea*) and the expression of symptoms of leaf scald (*Xanthomonas albilineans*) in two varieties, N:Co 310 and N:Co 376, known to be susceptible to smut but considered resistant to leaf scald. In the trials, inoculation with smut caused increase in both diseases. It is not known whether the effect of smut infection was simply to favour the expression of latent leaf scald infection or whether synergism affected both the incidence of infection and the effects of both diseases on the plant. Since the two diseases are often observed to be more severe under unfavourable growing conditions, it is suggested that the systemic invasion of the cane by one pathogen can be regarded as a stress factor affecting the response of the plant to the other pathogen.

Thoughts on smut resistance testing. A. M. Whittle. *Sugarcane Pathologists' Newsletter*, 1978, (20), 43-48. Three factors which possibly explain the considerable differences found between countries or even within a country in smut resistance ratings for any one cane variety are discussed, *viz.* pathogen race differences, local environmental influences and methodology. It is considered necessary to determine both the number of whips developed and the yield response of an affected plant; the relative importance of both factors can vary with circumstances, and interpretation of screening trial results may be erroneous. In an appendix to the article, K. C. Alexander describes the inoculation technique used at the Sugarcane Breeding Institute at Coimbatore in India and discusses the question of varietal rating relative to infection levels in trials, and crop loss in relation to whip formation at different growth stages.

Varietal resistance to some diseases in Uganda. M. Simbwa-Bunnya. *Sugarcane Pathologists' Newsletter*, 1978, (20), 49. – Tables are given of results obtained in resistance trials for mosaic, smut, rust and brown spot carried out at the Disease Testing Unit in Uganda.

Sugar cane pests. B. E. Hitchcock. *Cane Growers' Quarterly Bull.*, 1978, 42, 4-28. – Descriptions are given of insect and animal cane pests that occur in Queensland, with information of the type of damage they cause and, in most cases, possible means of control. Colour photographs of the pest and/or cane damage accompany each section. The group of pests to which most space is devoted is the cane grub; nine species of white grub are known to damage cane – they vary in size but are otherwise similar in appearance. All have three stages, separated by a moult. The life cycles are given of *Lepidiota frenchi, L. mungomeryi, L. consobrina, L. crinita, Pseudholophylla furfuracea* (all of which have a 2-year life cycle), *Dermolepida albohirtum, L. squamulata, L. picticollis* and *Antitrogus mussoni* (which have a 1-year cycle). Guidance is given on recognition of grub damage and suitable methods of BHC application for control of the pest.

Sources of infection and modes of penetration of *Colletotrichum falcatum* Went in sugar cane in Cuba. F. Alonso. *Rev. Agricultura* (Acad. Ciencias, Cuba), 1976, **9**, (1), 65-69 (*Spanish*).–Results of studies in Cuba on the possible sources of infection and modes of penetration of *C. falcatum,* the causal organism of red rot, indicate that a direct mycelial connexion between an infected mother plant and others is rare. Young shoots become diseased more often from the latent infection in the buds of infected setts used as planting material which thereby carry the disease from one area to another. It was also noted that gaps in the cane rows arise principally from non-germination of the buds. Other sources of infection were the central vein and leaf lamina of affected plants; in general, the organism penetrated into the internal tissues by means of the channels opened up by stalk borer attack (*Diatraea saccharalis* Fab. and *Anacentrinus insularis* Buch. in normal growing plants and *Xyleborus affinis* Eichh. in plants moribund from other causes) or in the region of the node.

CANE BREEDING AND VARIETIES

Florida's 1977 sugar cane variety census. G. Kidder and E. R. Rice. *Sugar y Azucar,* 1978, **73,** (4), 46-47. A census of cane varieties grown by Florida farmers in 1977 is presented. By far the leading variety was CP 63-588, which was grown on 38% of the total cane area; this was followed by CP 56-59, representing 13.5% of the total area, after which came CI 41-223, accounting for 12.9% of the area. The fourth variety was grown on only 6.3% of the total area. The annual share of the area for the present leading varieties from 1968 to 1977, inclusive, is indicated, and the chief properties of the varieties are summarized.

New varieties to be released. C. Richard. *Sugar Bull.,* 1978, **56,** (15), 8. – The merits and demerits of two new US cane varieties, CP 70-321 and CP 70-330, are discussed.

Sugar cane variety outfield experiments in Louisiana during 1976. C. A. Richard, H. P. Fanguy, D. Garrison, W. Jackson and H. Robichaux. *Sugar Bull.,* 1978, **56,** (15), 14-18. – Trials held during 1976 are reported. The results, given in tabular form, refer to 11 varieties grown at a number of locations as plant cane and 1st and 2nd ratoons. The varieties were: CP 61-37, CP 65-357, CP 67-412, CP 70-321, CP 70-330, CP 70-401, L 60-25, L 61-67, L 62-96, L 65-69 and N:Co 310. The two experimental varieties, CP 70-321 and CP 70-330 (see preceding abstract), were significantly superior or equal to the commercial standard variety, CP 65-357, in terms of cane and sugar yield and sugar per ton of cane on light and heavy soils as plant cane and first ratoons, and both appeared to have a moderate degree of borer resistance as well as a moderate degree of mosaic resistance.

Prospects for productivity improvement through sugar cane breeding. B. T. Roach. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 11-18.—The contribution made by cane breeding to improvements in cane performance, particularly yield, and the value of field trials are discussed. Future prospects with regard to potential increases in cane yield and sugar content are examined, and recently introduced breeding techniques and ones that could be used in the future are surveyed.

Variety x environment interactions. J. S. Pollock. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 273-277.—The importance of the effect of interaction between variety and environment on the performance of any one cane variety is discussed. Data from 17 varieties in 39 trials carried out in 1971-75 were collected from seven farms. These showed that, on average, 87% of the difference in performance between two varieties in one trial was due to the interaction effects and only 13% to real differences between the varieties. Hence, it is considered more practical to evaluate varieties in north Queensland with a 2-year rather than the present 1-year planting programme. The significance of varietal "stability" is discussed, and practices widely employed to offset some of the interaction effects at early selection stages are described.

The application of selection information to early selection stages. W. M. Symington. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 279-286.—The author describes selection trials begun in 1973 at Macknade, where varietal selection is usually a 5-stage process involving about 10 years' work. Changes in population due to selection were observed at each stage. Initial selection was based on visual assessment. Results for yield and sugar content are discussed in some detail, and phenotypic correlations between these two factors are examined. The results indicate those areas where changes could be made in the selection programme.

Effects of suppressing competition between genotypes on the potential for selecting sugar cane cultivars. R. H. Farquhar. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 287-291.—In an experiment with cane seedlings, under a system in which expression of genotype could not be biased on the side of varieties exhibiting strong growth and tillering habits, it was found that the best progeny from two elite crosses (Co 270 x MQ 33-157 and Co 170 x MQ 33-371) as regards sugar yield did not appear to be among those with greatest ability to grow vertically or produce a large number of tillers. The results suggest that well-known commercial varieties of some repute may be less well selected than supposed, their reputation resting on superior competitive ability in small trial plots rather than to high potential in monovarietal culture.

The effects of frosting on varieties of sugar cane with commercial potential in New South Wales. R. E. Sloan and R. H. Farquhar. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 293-296.—Most of the assigned cane area at Harwood, in New South Wales, is threatened by mid-winter frosts, and even 2-year cropping is not always successful because of the occurrence of severe winters. Field trials were therefore carried out with 42 varieties in order to find an early-maturing variety which could be harvested when one year old, whether frosted or not. Tabulated results showed, however, that no variety classed as early maturing escaped deterioration, although N:Co 310 gave best results and had previously shown a slower rate of deterioration than had Pindar after artificial freezing to $-4^{\circ}C$ under controlled conditions. It is suggested that frost-affected areas may have to be reserved for relatively late-maturing varieties.

Studies of adoption patterns of some sugar cane varieties. C. W. Chardon, M. Alison and A. J. deBoer. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.,* 1978, 297-301.—In a study to evaluate the response of Queensland cane farmers to new cane varieties, a statistical analysis was made of the adoption pattern of some of the major varieties grown in Queensland since 1944; the area planted to each variety in each mill area during the period 1944-76 was used as basis. Results showed large differences in the adoption rates between environments and between sites in the same environment. The adoption patterns for a number of important Queensland varieties could be estimated by regression equations. One of the most important characteristics for which a variety is adopted is its ratooning ability.

CANE SUGAR MANUFACTURE

The electricity interconnexion agreement—a step towards efficient resource utilization. K. W. Watts, R. J. McIntyre and R. N. Cullen. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 31-35.—The conditions of an agreement between the Queensland sugar industry and the electricity supply industry are outlined. Practical and economic considerations are analysed, and it is concluded that, while it is technically possible to supply considerable quantities of power to the public grid, considerable capital outlay is needed; hence, future export of electricity from sugar factories will depend on government incentives without which the scheme would be profitable for the factory only if second-hand equipment were used in an area of high cane fibre content.

Computer model of a cooling crystallizer. S. M. R. Maudarbocus and E. T. White. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 45-52.—A computer model simulating the behaviour of a batch cooling crystallizer is described. Based on a pan boiling model developed earlier by Wright, it assumes that all material in the crystallizer is at the same temperature and has the same composition, that there is no false grain, that evaporation loss is negligible and that the crystal growth rate depends only on temperature and sucrose and impurity concentrations, but not on crystal size (no change occurring in crystal shape with growth). The validity of the model was established by comparison with results obtained by Ness & Stewart[1], good agreement being obtained between measured and predicted purity drops as a function of residence time. Application of the model to determination of the effects of changes in operating conditions is demonstrated in the case of residence time changes, cooling pattern, massecuite Brix, and crystal size and distribution. Optimum cooling profiles have been established which dictate an instantaneous temperature drop to 50°C followed by slow cooling at about $2^{\circ}C.hr^{-1}$; however, the authors question whether this can be achieved in practice in view of the constraints imposed by heat transfer and false grain.

The use of a model to determine flow patterns and efficiency of continuous crystallizers. L. K. Kirby and E.T. White. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 53-57.—The scale model of a Burnett crystallizer described earlier[2] has been used in tests to evaluate the performance of three crystallizers, including the Burnett eccentric coil design, and results applicable to design features are discussed.

Head loss through continuous crystallizers. E. T. White and S. M. R. Maudarbocus. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 69-78.—Conversion of a crystallizer station from batch to continuous operation usually involves modification of equipment levels to provide the necessary pressure heads for flow purposes. However, current methods used to estimate the required heads or to determine the necessary dimensions of baffles, weirs, ducts and channelling for each crystallizer seem to be based largely on intuition. The authors have developed mathematical expressions for calculation of flow rates in closed ducts and open channels, over weirs and through an obstructed orifice. Despite the complexity of flow patterns within a crystallizer, overall correlations are obtainable from tests on model or full-scale crystallizers on the basis of a constant value of the Lagrange number. This is demonstrated by values of head loss over a segmental baffle, for which the Lagrange number was based on orifice area and equivalent diameter, the heads being measured as the average between maximum and minimum levels. The results were greatly affected by moving the coils away from the baffle, but were only slightly reduced by increasing the rotary speed of the coils. There was little difference in the constants between the various coil designs tested; reduction in the baffle area (expressed as a percentage of the circle area) increased the head. Sample calculations are given.

***C*-sugar purity control.** K. F. Miller and P. G. Wright. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 79-84.—Tests on *C*-sugar purity control in continuous centrifugals on the basis of reflectance[3] are reported. A single sensing head was devised, comprising a photocell mounted in a stainless steel tube but retracted about 50 mm from the end. The tube was located near the sugar layer at the top of the conical basket; a light source in a second tube was welded to the photocell tube and angled to illuminate the sugar at the sighting point. A single-transistor amplifier was adjusted so that its output range represented the likely span of sugar purity encountered; this was achieved by varying the massecuite and water feed rates. Good short-term correlation was obtained between sugar purity and the scale on a two-term electronic controller. However, purity control by adjustment of the water flow rate at a given massecuite rate, for which the amplified signal from the reflectance photocell was used as input to the controller, proved unsuitable, since a change in the water flow rate to the feed probe caused a marked change in the massecuite flow; as a result, if the reflectance reading indicated a drop in sugar purity and the water flow was then automatically increased, the increase in massecuite flow prevented any improvement in purity. Introducing most of the water through a spray pipe to the lower part of the centrifugal screen, with only a small quantity fed to the feed probe by manual valve operation, did not provide any solution to the problem. A system of central massecuite feed at a flow rate independent of water flow proved more promising; regular washing of the photocell and lamp to prevent contamination would be necessary in any future design, while a focused light source and detector would allow the monitor head to be mounted further from the screen, thus also helping to prevent splashing and gradual calibration drift. Constraints imposed on a low-grade sugar purity control system are discussed, and the benefits of such a system indicated.

A comparative study of alcohol concentrations in green and burnt cane and the changes occurring during milling. J. D. Blake and K. E. McNeil. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 127-132.—Ethanol is the major end-product of carbohydrate fermentation by yeasts and occurs as a minor metabolite in cane juice as a result of action by bacteria such as *Leuconostoc mesen-*

[1] *I.S.J.*, 1976, **78**, 373.
[2] Strickland *et al.*: *ibid.*, 1978, **80**, 86.
[3] Wright: *ibid.*, 51.

teroides. Results of investigations showed that much less alcohol is produced in green cane (50 ppm) than in burnt cane (320 ppm) harvested under approximately comparable conditions. The ethanol content in first expressed juice, mixed juice and clarified juice from green cane was also lower than from burnt cane. The alcohol content in condensate from the 2nd effect of an evaporator (the richest source of ethanol in a sugar factory) was about 75–80% lower when green cane was processed. Ethanol in boiler feed water from 1st effect condensate fell gradually in the course of a day and was much lower from green cane; the same effect was found with maceration water. The ethanol content in final effluent was also 60–70% lower with green cane processing, which also significantly reduced the BOD content. Since climatic conditions have a marked effect on cane deterioration, caution in extrapolating the results to other cane-growing regions is necessary.

The continuous low-grade pan at Mossman. R. Broadfoot and P. G. Wright. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 171-177.—The performance of the continuous pan, designed and manufactured by Evans Deakin Ltd. in collaboration with the Sugar Research Institute, is discussed. An average production rate of 15.2 tonnes.hr^{-1} was attained at an average seed inlet rate of 5.5 tonnes.hr^{-1}; average heat transfer coefficient was 220 $W.m^{-2}.°C^{-1}$. The massecuite was of 62.3 apparent purity, and final molasses of 35·9 apparent purity. Little supervision was required. Comparison is made with the performances of other continuous pans in various countries, and a number of design aspects of the Mossman pan deserving special comment are mentioned.

Design of a molasses cooler. M. R. Player, E. A. Smith and J. N. Ness. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 183–189.—After ANPA coolers had proved inadequate to meet new capacity requirements of up to 30 tonnes per hr of molasses to be cooled from 60°C to below 38°C when Victoria factory increased its crushing capacity, trials were conducted on a finned-tube cooler designed by Senior Engineering Group (Aust.) Pty. Ltd. However, the performance of this cooler was very much below requirements, the most likely cause of the low heat transfer coefficients obtained being the tendency for the molasses to form a cold, heat-resistant film on the fin surfaces; the effect was cooling of the fin to approximately the temperature of the cooling water. Hence, it was decided that finned tubes were inadequate for the task, and the ANPA coolers were scaled-up to give 38% more heat transfer surface area than in the original coolers. These were expected, on the basis of the performances of similar ANPA coolers at other factories, to meet requirements.

The effect of mud solids loading on clarifier capacity. O.L. Crees, D.J. Hale and E. Whayman. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 191–194.—The theory of sedimentation propounded by Kynch[1] defines two types of sedimentation, *viz.* (i) free sedimentation where the particles settle completely independently of one another at a rate which is a function of particle size, shape and concentration, and which occurs usually only at low particle concentrations, and (ii) hindered settling, the rate of which is governed only by particle concentration; this occurs at higher concentrations and is usually characterized by a sharp upper interface between slurry and solution. Batch settling tests were carried out in which the solids concentrations and flocculant dosage rates were so adjusted that a constant flocculant: solids ratio was maintained over a range of concentrations; similar laboratory tests were conducted with bentonite slurry containing $CaCl_2$. The observations were in conformity with the theory of Kynch on hindered settling and illustrated the problems that can result from variable dirt levels in the cane supply and the advantages to be gained from a consistently clean supply. The relationship between settling rate, solids concentration and flocculant dosage rate was found to be complex.

The influence of pumping systems on the filtration characteristics of cane mud. A. G. Noble and G. A. Brotherton. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 195–202.—In investigations of the effect of pumping system used to transfer clarifier mud to a filter on the performance of the filter it was found that the filtration rate and mud solids output at two factories were higher when a centrifugal pump was used than with an air blowcase system. At a third factory, however, a Mono pump gave a higher mud solids output than did a centrifugal pump; on the other hand, the centrifugal pump gave a higher filtration rate, a fact which was difficult to reconcile with the lower mud solids output but for which a possible explanation is put forward. The system of mud transfer did not cause any significant difference in filter cake losses.

The simulation of process heating elements using the Sugar programme. W. McWhinney and A. J. Pinkney. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 243–248.—The Sugar programme developed for simulation of raw sugar factory by digital computer uses readily obtainable factory data in the preparation of mathematical models. It manipulates, in a sequential fashion, the output variables associated with a single block or set of blocks to minimize error terms which result from the difference between the outputs from a current solution step and those of the previous step. The authors show how the programme is applied to construction of a mathematical model for a single evaporator effect and for a juice heater, and how the models can be used to predict juice heater vapour requirements as a function of juice flow rate at a constant pressure: temperature ratio. Prediction of heat flux with changes in the ratio is also demonstrated.

Some aspects of bin design. R. J. Swindells, E. T. White and G. D. Dyne. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 259–266.—Means of measuring the flow properties of bulk solids are described and results of investigations to determine discharge rates from hoppers are reviewed. The calculated values given by an equation derived by Johanson[1], which defines the discharge rate in terms of hopper angle, effective angle of friction, angle of external friction and bulk density, were in closest agreement with measured values of sugar flow from a storage bin. Critical hopper dimensions have been calculated from shear cell test data. Three types of stresses exist in hoppers, *viz.* static, dynamic and switch (where there is a changeover from static to dynamic conditions); the first two have components in both vertical and horizontal directions, while the last acts only in a horizontal direction. The importance of stress in hopper design is indicated. Techniques for improving flow from bins are listed.

[1] *Trans. Amer. Soc. Mech. Eng.*, 1965, (March), 69–79.

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BEET SUGAR MANUFACTURE

Molasses sugar recovery by liquid distribution chromatography. M. Munir. *Şeker*, 1978, **28**, (106), 57-63 *(Turkish)*. – See *I.S.J.*, 1976, **78**, 100-106.

Selection of criteria for evaluation of the technological quality of sugar beet. W. Drewnowska and A. Butwilowicz. *Gaz. Cukr.*, 1978, **86**, 145-148 *(Polish)*. – Formulae derived by various authors for prediction of molasses sugar from molasses, beet or juice composition and for estimation of thick juice purity from beet analyses are examined. Comparison between calculated molasses sugar and experimental results showed that the closest agreement was obtained with the Vukov formula (molasses sugar = $0.65\ p + 1.71\ i + 1.7$, where p = conductimetric ash and i = invert sugar, both % on beet). The formulae derived by Wieninger, Reinefeld and Devillers gave almost identical values, although that of Wieninger based on beet potassium and sodium contents was considered the most suitable in the case of fresh beets having low invert content. The difference between the Wieninger molasses sugar and the true value was attributed to the effect of beet non-sugars not allowed for in the formula. However, inclusion of the melassigenic coefficient found for the test molasses in the formula resulted in close agreement between the calculated and experimental values of thick juice purity when the beet was of high quality, but not otherwise. Polish beets are characterized by high content of reducing matter, particularly invert sugar, which decomposes to form non-nitrogenous acids during processing and so affects the pH of juices as well as causing an increase in lime salts.

Preparation of beet for processing. H. Dabrowski. *Gaz. Cukr.*, 1978, **86**, 149-152 *(Polish)*. – A suggested scheme for pre-processing treatment of beet is examined, the individual pieces of equipment being described in turn. Particular stress is laid on the need to minimize losses in washing, for which a spray-type washer is recommended; at a water pressure of 0.5 MPa and a quantity of about 30% on beet, for a factory having a daily slice of 6000 tonnes of beet, a residence time of only 30 sec would be required to effect adequate washing at minimum losses of about 0.04% on beet. Addition of milk-of-lime to the wash water at about 0.2% CaO on beet to give a pH of 11-12 considerably increases the rate of sedimentation of soil, and in certain cases addition of calcium chloride to flume water is recommended.

New type of beet slicer: the RKE-15. R. Cisak and A. Andrzejewski. *Gaz. Cukr.*, 1978, **86**, 154 *(Polish)*. Details are given of a Polish-built horizontal-disc beet slicer which contains 24 knife blocks and has a daily throughput of 1500-2000 tonnes of beet at an optimum speed of 60-80 rpm. Tests are briefly mentioned.

Alfa-Laval equipment for the sugar industry. M. Pietrzak. *Gaz. Cukr.*, 1978, **86**, 155-157 *(Polish)*. – Details are given of Alfa-Laval heat exchangers, pumps, the "Alvotherm" process of molasses pre-treatment for fermentation, and the "Sugar-Flow" sugar melting system for liquid sugar production.

Largest in Hungary! Sugar factory at Kaba. A. Hanftwurcel. *Przem. Spozyw.*, 1978, **32**, (1), 28-30; through *S.I.A.*, 1978, **40**, Abs. 78-806. – A brief description is given of Kaba factory/refinery, built by Polimex-Cekop and intended to open in September 1979; processing 600 tonnes of beet per day, it will produce 90,000 tonnes annually of white sugar, 30% of this being refined sugar. Standard quality sugars are guaranteed from beet of 16.5 pol which contains 15% trash, with cell juice at 84 purity containing 0.8% reducing sugars on dry solids; limestone consumption should be approx. 1.8% on beet, and total sugar losses before molasses should not exceed 0.9% on beet. The main process, *i.e.* from beet slicing to sugar drying and pulp briquetting, is all housed in one building; for making molassed briquettes, molasses will be mixed with undried pulp. Storage facilities are: for molasses, two metal tanks of 32 m diameter and a height of 14 m; for sugar, four concrete silos each holding 20,000 tonnes; 30 ha for storing 120,000 tonnes of beet. Total water consumption will be about 160% on beet, and the total capacity of the water system is 900,000 m^3; the effluent will have a BOD below 75 $mg.litre^{-1}$.

Methods of determining sugar losses by measuring respiration: experiments carried out within the IIRB study group "Quality and Storage". P. Devillers. *Proc. 41st Winter Congr. Inst. Intern. Recherches Betterav.*, 1978, 159-169; through *S.I.A.*, 1978, **40**, Abs. 78-903. The determination of CO_2 released by beet enables the sugar consumed by respiration to be calculated. Tests were carried out at four European laboratories which have suitable equipment, including programmed CO_2 analysers: British Sugar Corporation Research Laboratories; I.R.S., Bergen Op Zoom; I.B.A.B., Tienen; and I.R.I.S., Villeneuve d'Ascq. For 10 kg samples of beet, the coefficient of variation of respiration losses was 11%. This method of measuring sugar losses is 10-100 times more sensitive than calculations based on the sugar balance in beet piles.

Measurement of air permeability characteristics in sugar beet piles. V. T. Serkin, K. D. Shuraeva and E. G. Baizhienov. *Tekhn. Nauki*, 1975, **16**, 147-150; through *S.I.A.*, 1978, **40**, Abs. 78-936. – Equations are developed to describe upward air flow through an isotropic pile, and results of aerodynamic experiments with 1:40 scale model piles are presented. The models consisted of piles of peas, 5-15 cm high and having a 40^{o} angle of repose, built above a static pressure chamber fitted with suitable ducts for air supply. Energy requirements for a given air flow Q were least for uniform (longitudinal ?) air distribution, which gave the lowest pressure loss $\triangle P$ and lowest value of n in the equation $\triangle P = xQ^n$; n would be 1 for laminar flow, and 2 for purely turbulent flow. Increasing the height of the pile increased $\triangle P$ but decreased n; covering the pile had little effect, while sucking the air from the pile to the chamber gave higher values of $\triangle P$ and n.

Sucrose inversion and invert sugar. A. Malý. *Listy Cukr.*, 1978, **94**, 182-184. *(Czech)*. – Manufacture of invert sugar in syrup or crystal form for use in the confectionery

industry is described, reference being made to various products manufactured in other countries, particularly the USA.

The IRD-2 milk-of-lime dosimeter. J.Záruba. *Listy Cukr.*, 1978, **94**, 185-186 *(Czech)*. — Details are given of a milk-of-lime metering system designed for small quantities (the range is not stated) which has no moving parts. Milk-of-lime is fed from a tank to the metering element proper; both inlet and outlet are in the bottom of the element but on opposite sides, and between them is an aperture diaphragm. Air is fed to the top of the element from a pressure distributor which receives signals from a regulator linked by signals to a flowmeter in the line after the element; the air pressure on the diaphragm is thus proportional to milk-of-lime flow and reduces or increases the amount able to pass through the aperture. A stable feedback characterizes the system, but one disadvantage is the narrow range in which the regulator operates in proportion to the working height of the aperture.

The effect of coke quality and quantity on lime kiln performance. L.Bazyński. *Gaz. Cukr.*, 1978, **86**, 169-170 *(Polish)*. — The effect of coke physical and chemical properties as well as size and quantity on lime kiln performance in terms of fuel consumption, lime quality and carbonatation gas CO_2 content is discussed.

Means of improving process operations. J. Poniecki. *Gaz. Cukr.*, 1978, **86**, 171-174 *(Polish)*. — Each operation and process in the beet sugar factory is examined and means of achieving optimum conditions indicated.

New molasses desugarizing plant at Klecina sugar factory. A. Kubasiewicz. *Gaz. Cukr.*, 1978, **86**, 175-177 *(Polish)*. Details are given of the Steffen plant installed at Klecina sugar factory in 1977 for continuous treatment of 70 tonnes of molasses per day. Recovery of sugar is rated at 88% of that in the initial molasses, which has a Brix of 80°and a purity of 62.5.

Acidification of diffusion water with sulphuric acid. M. Rogowska and Z. Wegrzynowski. *Gaz. Cukr.*, 1978, **86**, 177-178 *(Polish)*. — Details are given of a system for automatic continuous dosing of diffusion water with sulphuric acid to give a pH of 5.6 — 6.2. While the results obtained at Goslawice factory in 1977/78 were considered satisfactory, the pH being maintained within the range 5.2 — 6.8, modifications were to be made to narrow this range to the smaller optimum.

Use of a computer for payment to sugar beet farmers. K. Szczot and H. Jochim. *Gaz. Cukr.*, 1978, **86**, 185-189 *(Polish)*. — Details are given of the computerized accounting system used at Garbów sugar factory to process information on beet deliveries from nearly 9000 farmers, and to work out the individual payments.

New approaches to the application of ion exchange in the sugar industry. K. W. R. Schoenrock, A. Gupta and D. Costesso. *Proc. 1976 Tech. Session Cane Sugar Refining Research*, 118-130.—See Gupta & Schoenrock: *I.S.J.*, 1977, **79**, 83.

Tests on the automated FiLS-100 installation at Sambor sugar factory. M. I. Zhenchuk *et al. Sakhar. Prom.*, 1978, (9), 24-27 *(Russian)*.—Tests were conducted on treatment of 1st carbonatation juice in FiLS-100 filter-thickeners. Despite the processing of low-quality beet, the battery of six units gave satisfactory results; mud density averaged 1.19 $g.cm^{-3}$ and the filtrate required no check filtration. At a filtration rate of 10-12 litres. $m^{-2}.min^{-1}$, active filtration time was 9-12 min, a further 3-3·5 min being required for the ancillary operations. A 0·03-0·04% (on beet) reduction in unknown sugar losses and a 0·04-0·06% fall in molasses sugar as well as a reduction in lime consumption could result from use of the FiLS, but there is need to increase the volumetric capacity of both the juice feed tank and the filtrate tank.

Effect of colloids on the sugar content in molasses. N. P. Silina, E. A. Grivtseva, L. P. Reva, O. I. Mazur and V. G. Chernikina. *Sakhar. Prom.*, 1978, (9), 27-29 *(Russian)*. Investigations, in which colloids (obtained from molasses) were added to molasses of known purity and dry solids and sugar contents before addition of sugar of known sieve analysis and heating at constant temperature for three days, showed that increase in the amount of colloids relative to the initial molasses non-sugars caused an increase in molasses sugar (as determined by analysis of the mother liquor); however, the molasses sugar content was also affected by the composition of the colloid fraction (as represented by colouring matter and CaO + MgO) as well as that of the other molasses non-sugars, which differs with beet region.

Method for analogue measurement of the concentration of production sucrose solutions. V. I. Tuzhilkin, A. I. Lapkin and V. K. Tubol'tsev. *Sakhar. Prom.*, 1978, (9), 30-32 *(Russian)*.—While the electrical conductivity of sugar solutions is governed by purity, composition and temperature, so that there is no direct linear relationship between it and concentration, a method has been derived for measurement of Brix in which the conductivity is measured at a given temperature, after which the solution is diluted to approx. 29°Bx and the peak conductivity then measured at the same temperature. Using a calibration curve based on an equation relating Brix to the ratio between the two conductivities, it is possible to reduce the measurement error to ± 1·0-1·5% and apply the method to continous automatic control of the Brix of any product in the factory. A sample calculation given refers to evaporator thick juice.

A scheme for juice flow regulation at Kirsanov sugar factory. S. L. Nemirovskaya, E. G. Lipetsker, A. M. Samodurov and T. I. Chugunova. *Sakhar. Prom.*, 1978, (9), 36-39 *(Russian)*.—The flow of juice between individual stations, extending from the diffuser to the evaporator, is controlled by regulators receiving signals from level sensors in two adjacent tanks. Inert zones (of increasing frequency in the direction of complete valve closure) forestall reaction to brief and/or slight disturbances.

Reduction in molasses sugar content—an important task. Yu. D. Kot and L. N. Binevskaya. *Sakhar. Prom.*, 1978, (9), 44-47 *(Russian)*.—A survey of molasses losses in the USSR since 1950 shows a gradual, slight drop in thin juice purity and a similar slight drop in molasses purity but a gradual rise in molasses sugar content. The authors examine boiling house practices and make a number of recommendations, particularly concerning low-grade boiling and washing in centrifugals; introduction of 3-massecuite boiling in all factories is regarded as essential (at present, only 25% of the factories use it).

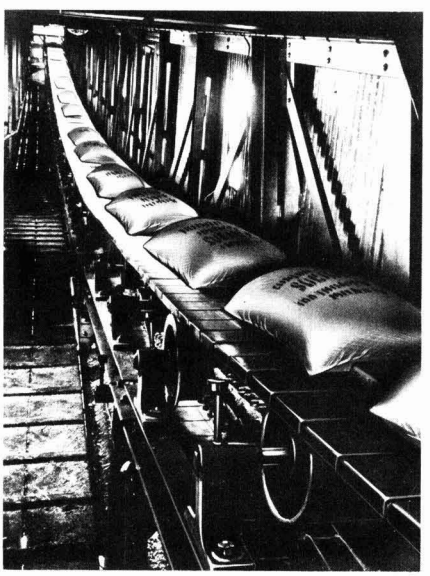
SUGAR REFINING

The effect of microbiological processes on the change in quality of cane raw sugar during bulk storage. N. V. Kostenko and V. Z. Nakhodkina. *Sakhar. Prom.*, 1978, (7), 19-23 (*Russian*). — Investigations under laboratory conditions and in a raw sugar warehouse at Odessa refinery showed that development of mesophiles, thermophiles, moulds and slime-forming mesophiles was governed by temperature and relative humidity, and that the micro-organisms caused rapid decomposition of the sugar, with generation of considerable quantities of heat, leading to possible changes in chemical composition and quality.

High polymers of cane raw sugar and their effect on technological processes. I. F. Bugaenko and A. I. Lapkin. *Sakhar. Prom.*, 1978, (7), 40-42 (*Russian*). — Methods used to determine high molecular weight polymers, including gums, albumins, polysaccharides, starch, silica and wax, in cane raw sugar are reviewed and typical concentration ranges given; the adverse effects of the non-sugars on refining processes are also indicated. The non-sugar separation efficiencies of affination and carbonatation are compared for gums, starch, silica and phosphate, and it is concluded that the combination of the two processes permits almost complete removal of the impurities.

Membrane separation for re-use of waste regeneration effluent from decolorizing ion exchange resin in sugar refineries. S. Kishihara and M. Komoto. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1978, **28**, 61-69 (*Japanese*). — Effluent from liquor decolorizing processes using resins poses problems in disposal because of its colour; separation of this colour from the salt content would permit reutilization of the effluent. The use of ultrafiltration (UF) and reverse osmosis (RO) for this purpose was investigated. UF was considered unsuitable, since at 40°C and a pressure of 4 kg.cm^{-2} colour retention by the membranes tested was inadequate, so that a certain amount still accompanied the NaCl. Even the best of the membranes reduced the colour content by only 81%. On the other hand, at 30°C and an operating pressure of 30 kg.cm^{-2}, the most suitable membrane achieved 90.5% NaCl permeation and 95% colour reduction. When the effluent was passed through the annealed AS-205 membrane, there was a gradual reduction in the apparent rejection of NaCl towards zero, while the apparent rejection of colour scarcely fell, indicating that the bulk of the salt solution can be recovered with very little colour. At feed: retentate volume ratios of 2, 4, 10 and 20, NaCl recovery was 45.3%, 70.0%, 86.5% and 92.6%, respectively. The permeate could be used to regenerate the resin to almost the same extent as fresh NaCl solution.

Still running sweetly after 45 years. — In handling bagged sugar for export from the Thames Refinery of Tate and Lyle Refineries Limited, Silvertown, London, total reliance is still placed on slat conveyors which have been in continuous use since 1934. Installed by Ewart Chainbelt Co. Ltd., of Derby, the conveyors are run dry to avoid contamination of the refined sugar by any form of lubricant, they are subjected to the abrasive effects of loose crystals and they are continually stopped and restarted under a load of several tonnes. Yet there is no record of the conveyor chains — twin strands of Ewart No. 500 Grey pin chain with K2 attachments, to which the heavy timber slats are bolted — ever having been replaced, nor of the conveyors having held up loading operations at any time over the years. Fifty kg paper and 100 kg hessian bags of sugar, chute-fed direct from the packing floors of the warehouse building, are carried some 900 ft (275 m) by the main export conveyor, then a further distance of more than 160 ft (50 m) out over a jetty, for loading on to ships. A second, similar conveyor serves barges. In each case, the conveyor runs in an elevated, weather-protective gantry-type structure, the bags of sugar moving in a near-continuous, nose-to-tail stream at a rate of 70 ft.min^{-1} (0.36m.sec^{-1}). Average loading rate is 45-50 tonnes.hr^{-1}, with peak capacity of 80-90 tonnes.hr^{-1}. The 30 in (760 mm) wide conveyors have 9 in (228 mm) diameter carrier rollers, one in four of which is flanged and mounted just outboard of the slats, to assure correct tracking. Added by Ewart in 1961 at the delivery end of each conveyor is a declined then horizontal length of roller conveyor, on an elevated platform. Four men — two either side of this slat-fed roller table — transfer the bags to slings, 16 or 20 to a load, for lifting aboard. Also, for loading barges, the bags can be diverted instantly to a chute, when required. Using the more common slinging method, stopping of the conveyor on completion of each load then restarting it a short time later places tremendous demands on the chains. While partially relieved by stepped starting of motors, the stresses are regarded by Tate and Lyle engineers as "more than any other type of conveyor could possibly cope with". It is a view to be respected, coming as it does from a company which makes such extensive use of all types of conveyor in off-loading raw sugar from incoming ships at 700-800 tonnes.hr^{-1}, storing some 20,000 tonnes, and refining this sort of quantity weekly.



LABORATORY STUDIES

Rapid method for determining marc. H. Gruszecka. *Gaz. Cukr.*, 1978, **86**, 130-131 *(Polish)*. – Apparatus for use in rapid determination of beet marc content is described. A 5-g sample of beet brei is placed in a vessel over a dish containing 100 cm^3 of water which is electrically heated to generate steam (complete evaporation taking 3 min). The steam passes into the brei and condenses, entraining the soluble components, including sucrose. The brei is then washed 4-5 times with 95% alcohol to remove all water, after which the vessel and its contents are dried for 35-40 min at 90-95°C to constant weight. The solid residue (marc) is then cooled in a desiccator and weighed. The new method gave an average value of 5.85% on beet for 49 samples, compared with 5.93% with the conventional method, which takes 6 hours; the differences between the values ranged from −0.174 to +0.30 (averaging +0.070) units. After ashing at 650°C, the residue with the standard method averaged 0.271% on beet, compared with 0.240% on beet with the new method.

Purification of intermediate and low-grade sugar solutions with lime and carbon dioxide. K. Bara. *Cukoripar*, 1978, **31**, 64-70 *(Hungarian)*. – Laboratory experiments were conducted on treatment of 60°Bx sugar solutions with lime and CO_2 in a special apparatus. The initial purities ranged from 92.6 to 98.6 and the colour contents from 185.0 to 15.7 °St/100°Bx. Best results were achieved with 2-3% CaO/100°Bx at a temperature of 90°C to give a pH in the range 8.5-9.0 followed by gassing to a final pH of 7.5; this gave a 30 - 60% colour reduction, a 15-55% lime salts decrease and a 0.5 - 1.5 units increase in purity. A greater amount of lime was unpractical in view of the fall in specific adsorptive capacity.

Spectrophotometric determination of iron at the parts-per-million level in sugar samples with 5-dimethylamino-2-nitrosophenol. -. Korenaga and -. Takashi. *Mikrochim. Acta*, 1977, II, (95-6), 419-424; through *Anal. Abs.*, 1978, **35**, Abs. 2C 21. – A solution of the sample (2-20 g) in 40 cm^3 water is treated with 2 cm^3 of 1:1 diluted HC1 and 1 cm^3 aqueous 10% hydroxylammonium chloride, and is concentrated to about 20 cm^3 by boiling. To the cool solution is added 3 cm^3 of a 0.2% solution of 5-dimethylamino-2-nitrosophenol hydrochloride in 0.1M HC1, the pH is adjusted to about 9.2 with aqueous 3M ammonia (6 cm^3), the solution is diluted to 50 cm^3 and the absorbance measured at 750 nm ($\epsilon = 4 \times 10^4$) in a 10- or 50-mm cell; the calibration graph covers the range 5 - 50 μg of Fe^{++}. The amounts of Ni, Co and Cu in sugars are too low to interfere. Results are reported for the determination of about 0.018 to 0.64 ppm of Fe in dextrose, levulose, maltose and sucrose and about 1.25 ppm dextrin. Coefficients of variation for the determination of Fe in sucrose were 1 - 3% (3 - 8 determinations).

Reduced boiling house recovery: a new concept. R. T. Patil and J. B. Chavan. *Maharashtra Sugar*, 1978, **3**, (8), 15-17. – See *I.S.J.*, 1975, **77**, 375.

Dextranase. IV. The effect of cane dextran on the filtrability of sugar. R. P. Fulcher and P. A. Inkerman. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 111-118.—The effects of addition of purified cane dextran and B-512 dextran on the filtrability of raw and refined sugars were investigated, and the results confirmed by experiments on enzymatic removal of dextran from raw sugar. Contrary to popular belief, addition of native cane dextran to sugar had little effect on filtrability, whereas native B-512 dextran caused a significant reduction in refined sugar filtrability and, to a lesser extent, in that of raw sugar, although the effects were not as marked as those reported by other authors (probably, it is suggested, because of incomplete dextran solubilization by them). The overall effect of dextran on filtrability appeared to be related to its molecular size, *i.e.* the higher the M.W. the greater was the reduction in filtrability.

Viscosity increases in concentrated sugar solutions and molasses due to dextrans. G. L. Geronimos and P. F. Greenfield. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 119-126.—See *I.S.J.*, 1978, **80**, 227-232.

A system for continuous bagasse moisture analysis. R. W. A. Luxford. *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 179-182.—A bagasse sampling device is described which collects small quantities of bagasse from a conveyor and presents them in a suitably prepared form and manner to the sensing head of an Anacon Model 106 moisture analyser operating on the principle of infra-red reflectance. The rotary arms of the sampler pass through the bagasse mat against the direction of belt travel and pick up a sample, which is then carried to above a chamber into which it falls. A pusher at one end of the chamber forces the sample into a rectangular chamber about 150 mm long; the sectional area of the chamber is constant for the first half of its length, while the floor section in the second half is not attached to the wall but is sprung upwards to form a slight convergence. Once sample compaction has begun, and the bagasse moves through to the exit, the sprung floor is forced down to reduce convergence and maintain a reasonably constant compaction. The discharged sample is then easily collected at the exit for laboratory analysis; sampling rate is 15 per min. The output signal from the analyser is fed to a computer, readings being accumulated at 5-sec intervals and a print-out of the mean and standard deviation being available for any desired period. Comparison of analyser readings with oven moisture determinations showed a difference of ± 2·1%, which is considered satisfactory for most control and monitoring purposes. An as yet unidentified variable has been found to influence moisture determination by the analyser.

A laboratory investigation of the effects of tops and trash on extraction, juice quality and clarification. R. P. Scott, D. Falconer and G. R. E. Lionnet. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 51-53.—An account is given of laboratory experiments conducted over a 2-year period on two cane varieties. Juice was extracted from 1 kg of shredded cane by pressing in the absence or presence of up to 30% by weight of shredded and thoroughly mixed tops or trash. After $2\frac{1}{2}$ minutes' pressing, 250 g of distilled water (25% on clean cane) was poured uniformly over the surface of the bagasse,

and pressing then carried out for a further 2½ min. The bagasse was then released, and again pressed (this time dry) for a further 2½ min, the procedure yielding about 1 litre of juice having a Brix and purity similar to those of factory mixed juice. Bagasse and juice were then weighed and the juice analysed for pol, Brix, reducing sugars and ash. The juice from one of the varieties was also subjected to laboratory clarification, the clear juice then being analysed for optical density; mud volume and weight were also recorded. Juice purity was reduced linearly by both forms of extraneous matter, tops doing so by increasing the Brix extraction while trash reduced the quantity of pol extracted. While both increased the quantity of impurities extracted in the juice, tops generally contributed double the impurities yielded by trash, although the latter did give considerable quantities of ash. Non-pol (Brix minus pol), reducing sugars and ash all increased linearly with increase in tops. Trash has a linear reducing effect on extraction. A relatively large difference was noted between the pol extractions for the two varieties. Tops did not appear to affect extraction or bagasse moisture but did cause a slight increase in bagasse yield. Both tops and trash caused a fall in pressed juice pH, so that more lime was needed to give a desired clear juice pH of 7·3; lime consumption rose by about 2% for every 1% extraneous matter. Neither trash nor tops affected the initial juice settling rate; however, trash had a significant slight effect on mud volume, weight and hence density, which fell as the quantity of trash rose. However, since the settling characteristics were not typical of those under factory conditions (because of absence of sand and soil), direct comparison with factory conditions was difficult. While the extraneous matter caused an increase in clear juice reducing sugars by comparison with clean cane, and caused a rise in ash (directly attributed to the increased lime consumption), the most deleterious effects were on juice colour and turbidity, trash having considerably greater effect than tops.

A comparison of the estimation of sucrose in sugar cane mixed juice by polarimetric and gas-liquid chromatographic methods. M. A. Brokensha, R. H. Niemeyer and K. Schäffler. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 54-58.—Parallel determination of mixed juice pol and sucrose content (the latter by gas-liquid chromatography) at Empangeni during most of the 1977/78 season showed a pol:sucrose ratio of 99·7% with a standard deviation of weekly average ratios of ± 0·64%. At Mount Edgecombe, however, the corresponding ratios were 98·4% and ± 0·47%. The relatively small variation in the pol: sucrose ratio within any one week permitted a considerable reduction in the frequency of determination without serious loss of precision. The GLC method used[1] has proved to be a practical procedure applicable to routine sugar laboratory practice.

True sucrose *versus* pol — the effect on cane quality and factory balance data. K. J. Schäffler and I. A. Smith. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 59-63.—Comparison of pol values with sucrose contents as determined by gas-liquid chromatography in mixed juice and molasses at Mount Edgecombe and Empangeni has shown widely varying differences between the factories and throughout the season at the same factory. As to be expected, the difference was greater in molasses than in mixed juice. The polarizing properties of the non-sucrose component can change during processing, giving rise to errors of up to 1 unit in the estimation of undetermined losses from the pol balance. The use of pol can sufficiently distort recovery and overall performance values that the Factory Performance Index may give a totally erroneous picture of controllable performance. Hence, losses could occur which were not reflected in any of the routine control figures. While use of GLC would provide a partial solution to the problem, any error due to molasses exhaustibility differences could only be removed by consideration of the impurities. The possibility of extending GLC to determination of juice reducing sugars is suggested. (See also *I.S.J.*, 1979, **81**, 188.)

Preliminary studies on the exhaustion of low-grade massecuites. G. R. E. Lionnet. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 80-84.—Factorially designed experiments were conducted in a 80-litre mixer, provided with a water jacket and blades rotating at 0·25–2·0 rpm, mounted directly above a crystallizer and connected to two low-grade pans at Darnall factory. Values of massecuite Brix, total solids, true purity and the difference between target purity and true purity were found and then analysed by computer, using final Nutsch true and target purities as measures of exhaustion. Of the factors investigated, massecuite total solids or Brix was found to be the most important (the higher the solids the lower was the final true purity), whereas massecuite purity had no statistically significant effect, since the non-sucrose:water ratio had a much greater effect on the total solids than on purity; the non-sucrose:water ratio is more significant than total solids, as it includes the relatively smaller effect of purity with that of total solids. Retention was also statistically significant in that the longer the retention, the better was the exhaustion. Cooling rate had no significant effect, while difficulties in quantifying stirring led to inconclusive results regarding the possible effect of stirring rate.

The selective removal of final molasses components by ethanolic precipitation. A. D. Robertson. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 85–88.—Addition of ethanol to molasses of known solids contents causes initial floc formation at an ethanol:water ratio of 1:1 by weight, after which further addition of ethanol increases the viscosity of the precipitant phase and causes formation of a fluid mass which then becomes a sticky black substance. Laboratory investigations, in which the ethanol and molasses were stirred together for about 30 min until a clear supernatant was formed, showed that liming the molasses to pH 8 increased the purity rise in the supernatant resulting from the ethanol treatment. At an ethanol:solids:water ratio of 35:10:18, purity rise was maximum at 8–9 units and the reducing sugars:ash ratio rose by 75%, representing up to one-third reduction in molasses losses. However, there would be a 35% loss in the revenue gained from molasses sold to processors, while ethanol recovery from both supernatant and precipitate would necessitate substantial capital investment in equipment; moreover, even with the best recovery plant, there would still be a minimum loss of 1% ethanol on solids treated, representing a substantial monetary loss, so that the recovery method is not economically sound.

An application of the fractional factorial experiment to continuous pan boiling. G. A. Matthesius, W. S. Graham and J. V. Pillay. *Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 89-92.—See *I.S.J.*, 1979, **81**, 214.

[1] Schäffler: *I.S.J.*, 1977, **79**, 57.

BY-PRODUCTS

Norms for automation of alcohol distilleries. V. I. Petrunya, M. L. Mandel'shtein, G. S. Trinchuk and I. M. Glozman. *Ferment. Spirt. Prom.*, 1976, (7), 26-32; through *S.I.A.*, 1978, **40**, Abs. 78-837. "Pishchepromavtomatika", in collaboration with other institutes, has developed norms for the extent and technical level of automation at alcohol distilleries processing starchy raw material or molasses. Diagrams are given of suitably automated preparation and fermentation sections for each type of distillery; selected features, classified as obligatory, recommended and allowable, are explained.

Corrugated roofing panels from agricultural residues. B. S. Bryant. *Appropriate Technology*, 1978, **4**, (4), 26-28; through *S.I.A.*, 1978, **40**, Abs. 78-866. – A simple process for making corrugated roofing boards from bagasse has been tested; it is suitable for use in developing countries. The bagasse is hammer-milled, partially depithed, and soaked in dilute NaOH for 1-2 hr before defibrating in a pulp-type beater; it is then washed and screened to remove the remaining pith. 1% on dry fibre of a phenol-formaldehyde resin binder is added. Mats containing partially oriented fibres are formed by pouring a slurry of the fibre into a commercial laundry centrifuge. The mat is then placed between screens and corrugated dies and pressed in a steam-heated press at 300-350°F for 6-10 min. The boards are trimmed and coated or impregnated with asphalt, and finally painted with aluminized asphalt paint. Their stiffness and load-carrying properties are comparable to those of corrugated galvanized iron sheets.

Criteria for the economic production of furfural. W. Jaeggle. *Chem. Age India*, 1976, **27**, (9), 818-824; through *S.I.A.*, 1978, **40**, Abs.78-867. – Furfural can be made from any pentosan-containing fibrous raw material, but the process is not necessarily economical; the preferred raw materials include bagasse and corn cobs. The main costs are for the supply and storage of the raw material and for steam. Continuous processes are coming into use; they have the advantage that the formic and acetic acids formed *in situ* act as catalysts, avoiding the need to add mineral acids. The furfural-containing condensate contains 2-4% acetic acid, which can be separated to provide an additional product. The solid residue may be used as fuel, as fodder for ruminants or as a fertilizer for alkaline soils. A flow diagram for the integrated production of furfural and acetic acid from bagasse is shown.

Action of ultrasound on the alcoholic fermentation of beet molasses by *Saccharomyces cerevisiae*. J. le Mao and R. O. Prudhomm. *Ann. Tech. Agric.*, 1978, **25**, 117-124; through *S.I.A.*, 1978, **40**, Abs. 78-840. – The effects of low-frequency ultrasound (20 kHz) at acoustical powers of 1.9, 2.3 and 3.9 $W.cm^{-2}$ and of high-frequency ultrasound (800 kHz) at an acoustical power of 1.3 $W.cm^{-2}$ on the alcoholic fermentation of a solution of beet molasses containing 12.5% sucrose by *S. cerevisiae* were studied. Ethanol yield was increased by the low-frequency treatment, especially at medium power (2.3 $W.cm^{-2}$). A short treatment time was required, corresponding to the start of fermentation (approx. 4 hr). At high frequency, fermentation was inhibited; this is ascribed to the cytolytic effect of ultrasound. The effect of low-frequency ultrasound has not been satisfactorily explained.

Possibilities for the use of certain complex culture media for biosynthesis of valine by the mutants *Br. flavum* 160 (leu^-) and *Br. Flavum* 113. Zh. Popova and I. Murgov. *Nauchni Tr. Vissh Inst. Kranit. Kvusova Prom.*, 1976, **23**, (1), 269-276; through *S.I.A.*, 1978, **40**, Abs. 78-842. These *Brevibacterium* mutants were cultured at 28-30°C for 60 hr in media at pH 7.5 comprising 3% $CaCO_3$, 3 or 4% $(NH_4)_2SO_4$ and either (a) 20% beet molasses and up to 2.5% maize extract, or (b) 10-25% hydrol, up to 2.5% maize extract, 30 μg biotin per litre and 200 μg thiamine per litre. Maximum valine yield, obtained from mutant 160 (leu^-) on 20% hydrol + 1.5% maize extract, was 12 $g.litre^{-1}$, yields from four molasses samples were ⩾ 7.5 $g.litre^{-1}$, and varied widely. The best yield from mutant 113 was obtained on molasses + 0.25% maize extract, being 6 $g.litre^{-1}$ for one molasses but only 3.3 $g.litre^{-1}$ for another; on hydrol without biotin and thiamine, this mutant yielded alanine and glutamic acid rather than valine.

Cellulosic substrates for enzymatic saccharification. R. K. Andren, R. J. Erickson and J. E. Medeiros. *Proc. Biotech. Bioeng. Symposium*, 1975, (6), 177-203; through *S.I.A.*, 1978, **40**, Abs. 78-868. – More than 80 cellulosic raw materials were tested in the laboratory for their suitability for enzymic conversion to simple sugars. In the case of bagasse, previous alkali treatment or ball milling increased the % saccharification after 48 hr from about 10% to about 50%; the syrup produced from the ball-milled bagasse contained 34.1 mg total sugars per cm^3, consisting almost entirely of glucose and xylose.

Studies on sugar press mud. V. C. Mehta and S. D. Gomkale. *Chem. Eng. World.*, 1976, **11**, (11), 63-67; through *S.I.A.*, 1978, **40**, Abs. 78-871. – Filter mud from cane factories using the carbonatation or sulphitation process contains approx. 60-70% $CaCO_3$; the feasibility of recovering this $CaCO_3$ was tested in the laboratory. Mud fractions of different particle sizes were separated by dry and wet sieving and by elutriation. With decreasing particle size, the % $CaCO_3$ in the fractions increased, reaching a maximum of 85%, and in general the % organic matter decreased. Bleaching with chlorine improved the brightness of the product. If the cane wax were removed by solvent extraction, the $CaCO_3$ content could be increased to 92%.

Method for measuring the texture of dried pulp. R. Vanstallen. *Rev. Inst. Int. Recherches Betterav.*, 1977, **7**, (2), 29-33; through *S.I.A.*, 1978, **40**, Abs. 78-904. – The method described involves soaking the pulp in water followed by wet sieving; particles in each size range are dried and weighed. Wear of the pulp press had no significant effect on the texture of pulp pellets. Dark and light-coloured pellets from the same batch had about the same texture, but differed in hardness.

Guatemala sugar statistics[1]

	1978		1977	
	tonnes, raw value			
Initial stocks		8,809		37,547
Production		445,931		486,894
		454,740		524,351
Exports:				
USA	140,539		293,610	
USSR	12,003		0	
		152,542		293,610
Consumption		215,671		221,932
Final stocks		86,527		8,809

Colombian alcohol fuel programme[2]. —The Colombian Government has started a programme aimed at reducing oil imports by adding ethyl alcohol to gasoline used in vehicles, according to the State oil company, ECOPETROL. By 1982 8% of the fuel used will be alcohol, saving $230 million's worth of oil annually at current prices.

Cane rust in Louisiana[3]. — Rust disease of sugar cane was discovered in Louisiana in June 1979 on a farm near Jeanerette. The organism responsible has been identified tentatively as *Puccinia melanochephala.* It was subsequently observed on a considerable number of varieties — released and unreleased — in most of the outfield test and experimental stations in the state and is believed to have been spread by wind-borne spores.

Molasses amino-acid plant in Yugoslavia[4]. — Construction of a plant is to begin soon at Zitiste (Vojvodina) for the production of lysine from molasses supplied by two sugar factories in the area. Local manufacture of this amino-acid will reduce the need for imports of proteins for animal fodder.

Malawi smallholder cane growing project[4]. — The Commonwealth Development Corporation has agreed to lend £1,530,000, repayable in 1981/97, to the new Smallholder Sugar Authority, established by the Malawi Government during the year, to raise finance and procure management for growing of 1630 acres of sugar cane by smallholders settled on 5-acre plots. The cane will be sold to the Dwangwa Sugar Corporation. CDC has been appointed managers of the scheme. At December 31, 1978, £750,000 had been advanced and settlement of the first 29 smallholders had begun while selection and training of a further group of smallholders for settlement in mid-1979 was in progress.

Canada HFCS plant[6]. — Labatt Ltd. and Redpath Industries Ltd. began last summer to construct a new high fructose corn syrup plant at London, Ontario, which is expected to be completed in mid-1980. The new plant is intended to provide part of the needs of the Canadian food industry. Estimated capital cost at the start of the project was US $60 million. The annual HFCS output of the plant is given as 115,000 tonnes. Additionally, the plant will produce 10,000 tonnes of 60% protein feed, 36,000 tonnes of 21% protein feed and 5000 tonnes of corn oil. It is estimated to use around 203,000 tonnes of corn, provide more than 100 skilled jobs and reduce the need for sugar and corn oil imports.

Fiji sugar production. — The total cane crushed at the four sugar factories for the 1978 season was 2,849,378 tonnes, the third highest on record, according to the Annual Report of the Independent Chairman of the Fiji Sugar Industry. The highest tonnage was the 2,885,841 tonnes crushed in 1970. Sugar made in 1978 totalled 346,690 tonnes, against 362,375 tonnes in 1977; this reduction resulted largely from adverse weather effects on the crop since dry conditions prevailed during the second half of 1977 and continued into early 1978, hampering cane growth and ripening. Despite the remarkable recovery of the crop later in the season, the overall sugar recovery was comparatively low with a TCTS ratio of 8.22, against 7.38 in 1977. Exports included 173,731 tonnes to the UK, 48,255 tonnes to New Zealand, 16,000 tonnes to Singapore, 24,000 tonnes to Malaysia and 39,474 tonnes to the USA, while local sales, including those to neighbouring Pacific Islands, amounted to 28,500 tonnes. Prospects for 1979 and 1980 are above normal, given stable conditions, and the 1979 crop is estimated to be a record.

Indonesia sugar imports[7]

	1978	1977	1976
	tonnes, tel quel		
Australia	87	75	38
Brazil	72,285	48,705	0
Cuba	59,395	66,135	0
Czechoslovakia	23,098	0	11,550
France	33,000	0	0
Germany, West	16,501	2	4
Holland	8	50	25
Hong Kong	0	4	5
India	133,169	93,184	160,783
Japan	3	0	0
Korea, North	9,470	0	0
Korea, South	14,315	0	0
Malaysia	200	80	26
Poland	42,028	0	0
Singapore	24	77	19
Switzerland	1	11	5
Taiwan	8,000	0	25,976
Thailand	12,500	2,250	0
UK	0	6	3
US	39	34	19
Vietnam, North	5,701	11,250	3,100
Other countries	2	2	0
	429,826	221,865	201,553

Süddeutsche Zucker-AG Annual Report 1978/79. — The beet area serving the company's seven sugar factories was reduced by 5.5%, from 109,000 to 103,000 hectares in 1978. Yield was lower, however, at 49.3 tonnes.ha^{-1} against 52.9 in 1977/78 but sugar content was high, averaging 17.43%, (*vs.* 16.12% in 1977/78) so that sugar yield per hectare was 7.4 tonnes in 1978/79 against 7.2. Thus, 758,900 tonnes of white sugar were produced from beet and raw sugar, against 786,000 tonnes in 1977/78, while the beet crop was 5,076,700 tonnes, against 5,767,600 tonnes. Capital investments in 1978/79 totalled DM 66.3 million with emphasis on beet reception and washing, improvement of extraction plant, energy savings and environmental protection.

Cane alcohol economics in Australia[8]. — A major report on whether Queensland could produce enough power alcohol to cut petrol consumption by 10% is being prepared for the State Government. The report concentrates on the economics of obtaining sufficient alcohol from sugar cane and cassava. The Industry Minister said he expected to receive the report by the end of the year. He said that initial research showed motorists could use a mixture of 90% petrol and 10% power alcohol without affecting vehicle performance. This would mean savings of 300,000 kl of petrol from the present consumption in Queensland, but to produce this amount of alcohol would require 60,000 hectares of cane land, about a quarter of that currently devoted to sugar production.

Mauritius strike. — Three of the six Mauritius sugar factory unions went on strike for two weeks in August, bringing 17 of the island's 21 factories to a standstill[9]. The unions were demanding official recognition by the Mauritius Sugar Producers' Association, a 40-hour week, compensation for inflation during the past year, a productivity bonus and continuation in operation of two factories due for closure. The industry is in great difficulty with a deficit of 90 million rupees expected in 1979 after losses of 44 million and 60 million over the past two years.

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1 I.S.O.: through C. Czarnikow Ltd., *Sugar Review,* 1979, (1452), 155.
2 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 440.
3 *Sugar Bull.*, 1979, **57**, (19), 3.
4 *Westway Newsletter*, 1979, (69), 17.
5 CDC Report and Accounts, 1978.
6 *World Sugar J.*, 1979, **2**, (2), 39.
7 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, S179.
8 *Queensland Newsletter,* August 8, 1979.
9 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 473, 501.

International Society of Sugar Cane Technologists

17th Congress 1980

Details have now been announced of the arrangements for the 17th Congress of the ISSCT to be held in Manila, Philippines, during February 1 - 11. Members will register at the Philippine International Convention Center, venue of the meetings, during Friday February 1 and will be entertained at a welcoming cocktail party in the evening. After spending the night at their hotel (the Philippine Plaza, Silahis International, Holiday Inn Manila and Century Park Sheraton have been chosen to house members), they will depart on Saturday morning for the factory or field tours.

The factory group will depart at 6.30 a.m. to Bacolod, one hour's flying time from Manila, where they will visit the Aidsisa, Hawaiian-Philippine and Victorias Milling Co. plants, all on the island of Negros, returning the same day to Manila. On Sunday morning at 6.30 a.m. the Factory Group will travel by bus to Central Azucarera Don Pedro, at Nasugbu, where they will be able to inspect the 24-tonne liquid CO_2 plant, the new 300,000 lb.hr^{-1} Foster Wheeler pin-hole grate boiler and what will be the biggest suspension-type bagasse dryer in the world. After this visit the members will return to Manila.

The field group will leave Manila at 7 a.m. on Saturday by bus for Canlubang in Laguna to witness demonstrations of mechanical harvesting, mechanical cultivation and fertilizer application, mechanical trash chopping, stubble shaving, ploughing, harrowing, furrowing and planting. The demonstrations will be conducted by various machinery and equipment dealers, including Massey-Ferguson, Metcon (Australia) Pty. Ltd., Toft Bros. Industries Ltd., Santal Equipamentos S/A., G.A. Machineries Inc., F.W. McConnel Ltd., U.S.I. (Philippines) Inc., Cane Machinery & Engineering Co. Inc., and Aboitz & Co., local representatives of John Deere. The group will return to Manila the same day and depart at 6.30 a.m. on Sunday to the University of the Philippines at Los Baños, the former College of Agriculture which is a centre for both education and agricultural and rural development. Following their visit to the University campus, field members will visit the adjacent International Rice Research Institute, a non-profit research organization established in 1960 by the Ford and Rockefeller Foundations, before returning to Manila.

The opening ceremonies of the Congress will take place on the morning of Monday February 4, at the Convention Center, commencing at 10 a.m., while the technical sessions, in designated rooms of the Center, will take place through the next five days, with a free afternoon on Thursday, February 7. Saturday afternoon and all day Sunday will be free, while on Monday, February 11, the final Plenary Session will be held and the Congress brought to an end. A "Barrio Fiesta" will be given for members on Tuesday evening, and the Farewell Banquet will take place on the evening of February 11.

Ladies programme

The Ladies Programme will begin at 8.00 a.m. on Saturday February 2 when a tour is organized of Manila City and its suburbs, including the Rizal Park, the old Walled City, Fort Santiago and the Church of San Agustin. After lunch, the ladies will visit the Nayong Pilipino or Philippine Village near Manila International Airport where the diverse cultures of the Philippines are brought together. On Sunday, the ladies will travel by bus to Laguna, past housing development projects and a large bay used as fishpens, to Canlubang Sugar Estate and thence to a replica on the original site of the house of Dr. Jose Rizal, national hero of the Philippines. In the afternoon a visit will be made to the National Arts Center, set in the Forest of Makiling, and then to a flower garden show on the Los Baños campus of the University of the Philippines, before returning to Manila.

A shopping tour will be arranged for the afternoon of Monday, February 4, while the following day will be devoted to a cultural tour of selected museums with shell and butterfly collections, folk culture exhibits, a centre for the theatre and other performing arts, rare Philippine prints and historic documents, paintings, etc. On February 6 the ladies will be taken for a whole-day tour to the Pagsanjan Falls, the highlight being a ride in a native dug-out canoe through the waterfall-laced Pagsanjan Gorge and its 14 exciting rapids. The next day will include a visit to Las Piñas Church to see the unique "Bamboo Organ", built in 1818, to the "Sarao" factory making the colourful jeepneys used as taxis in Manila, and so to Tagaytay, a city 1150 feet above sea level which commands a panoramic view of Taal Volcano.

On February 8 the ladies will travel by road to Baguio, the summer capital of the Philippines, where they will stay overnight, returning the following day. This city, 5000 feet above sea-level, is cool and set among pine trees; the ladies will be able to visit some of the official residences and the market for handicrafts, local delicacies and souvenirs.

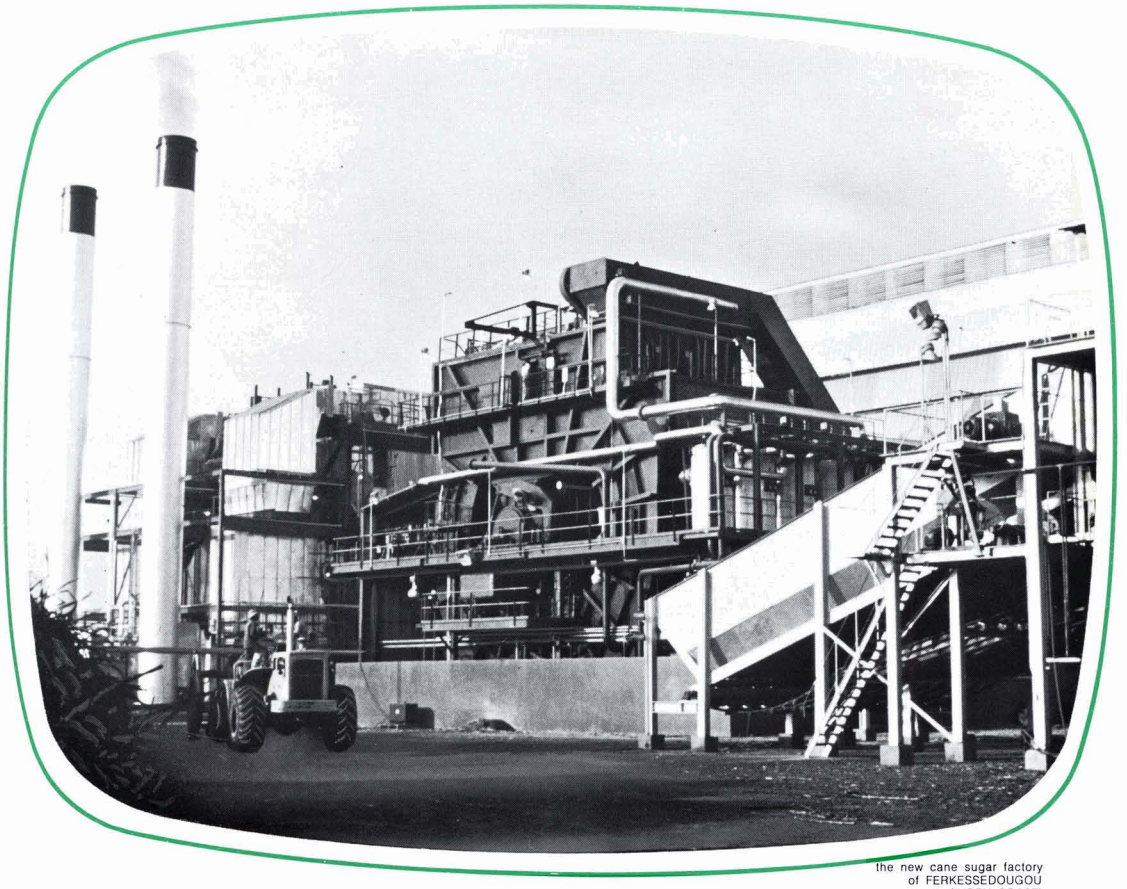
Post-Congress tour

Three alternative arrangements will be possible for members visiting Indonesia after the Philippines meetings. All will arrive in Jakarta on February 12 and between then and departure on February 19 will visit Surubaya-Pasuruan where they can see the famous sugar experiment station, and also Den Pasar on the island of Bali where a farewell party will be given on February 18. The alternative tours will include, respectively, visits to the tourist centre of Yogyakarta (Borobudur), South Sulawesi – Bone, site of a new sugar factory, and visits to Toraja-Ujung Pandang and South Sumatra.

Further information concerning the 17th Congress may be obtained from the General Secretary-Treasurer, Mr. Carlos Bell Raymond, P.O. Box 70, U. P. Diliman, Quezon Cty, Philippines.

Tanzania sugar project[1]. – Work on the new sugar factory at Kagera, which was interrupted by the invasion of Ugandan troops in October 1978, will re-start in October 1979. The Chairman of the Sugar Development Corporation said that material worth $5,000,000 had been destroyed at the existing Kagera factory while material valued at $1,000,000 had been lost at the site of Kagera Two. The new plant should begin operations in late 1981, a year behind schedule, and, starting at 20,000 tonnes a year, output should reach between 55,000 and 65,000 tonnes annually in three years.

[1] F. O. Licht, *International Sugar Rpt.*, 1979, **111**, 440.



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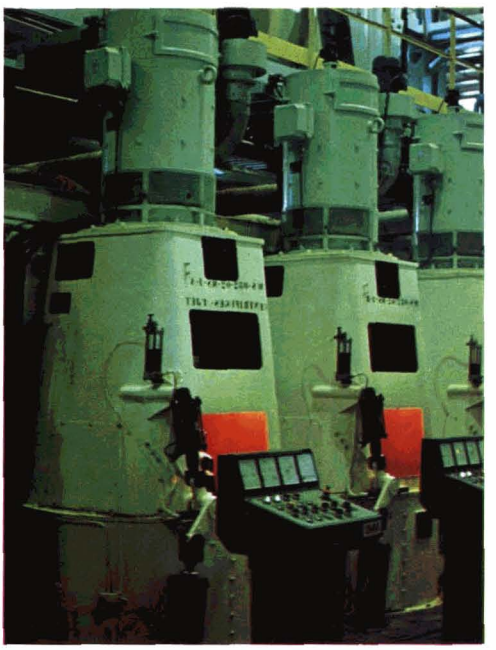
— vacuum pumps and compressors.

A battery of six Bosco B5 continuous centrifugals for low grade affination and second strike massecuites. KSAR EL KEBIR SUGAR FACTORY (MOROCCO) PROCESSING CAPACITY: 4000 TBD



View of a battery of five Bosco B7 fully automatic batch centrifugals. D.C. driving system, for white sugar. KSAR EL KEBIR SUGAR FACTORY (MOROCCO) PROCESSING CAPACITY: 4000 TBD

bosco

an active presence in the sugar industry

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agro industrial division

biological engineering

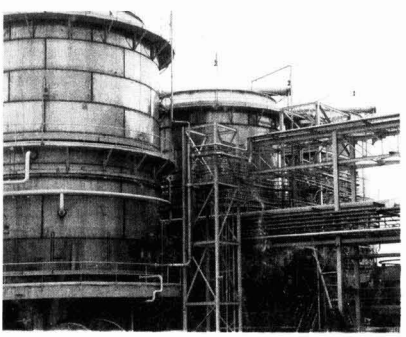
• Single Cell Proteins: Lefrançois Patents - Speichim Processes, form cane, beet, molasses, hydrolyzates and pre-hydrolyzates, paraffin, etc.
• yeast products • amylaceous materials enriched with proteins • complete treatment of lactoserum (Bel Process)
• industrial fermentation realized from industrial experimented processes • enzymatic transformations
• complete treatment of amylaceous products (starch and glucose plants, high fructose content syrup (H.F.C.S.)

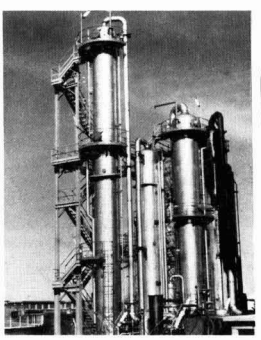
distillery

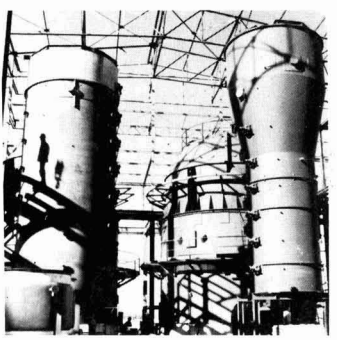
• treatment of all sugared or amylaceous raw materials (fruits, beets, cane, molasses, grains, potatoes, etc.)
• classical and continuous fermentation (recuperation of yeast and CO2) • distillation, rectification and deshydratation with high yields and low energy consumption (brandy, rums, extra-neutral alcohol, E.N. Surfine alcohol, fuel alcohol)
• by-products valorization, waste concentration, waste incineration

extraction dewatering refining

• complete treatment of oleaginous and proteaginous
• seed oil-mills (soybeans, rapeseed, sunflowerseed, groundnuts, palm kernel, etc.) • palm and coprah oil-mills
• refining • treatment of press-cakes (flour, extracted proteins, concentrates, isolates, etc.)
• pressing and solvent extraction processes (oleaginous seeds, meat flour, fish flour, etc.)
• screw presses for palm, seeds, dewatering fodder, apples, draffs, animal wastes, etc.







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