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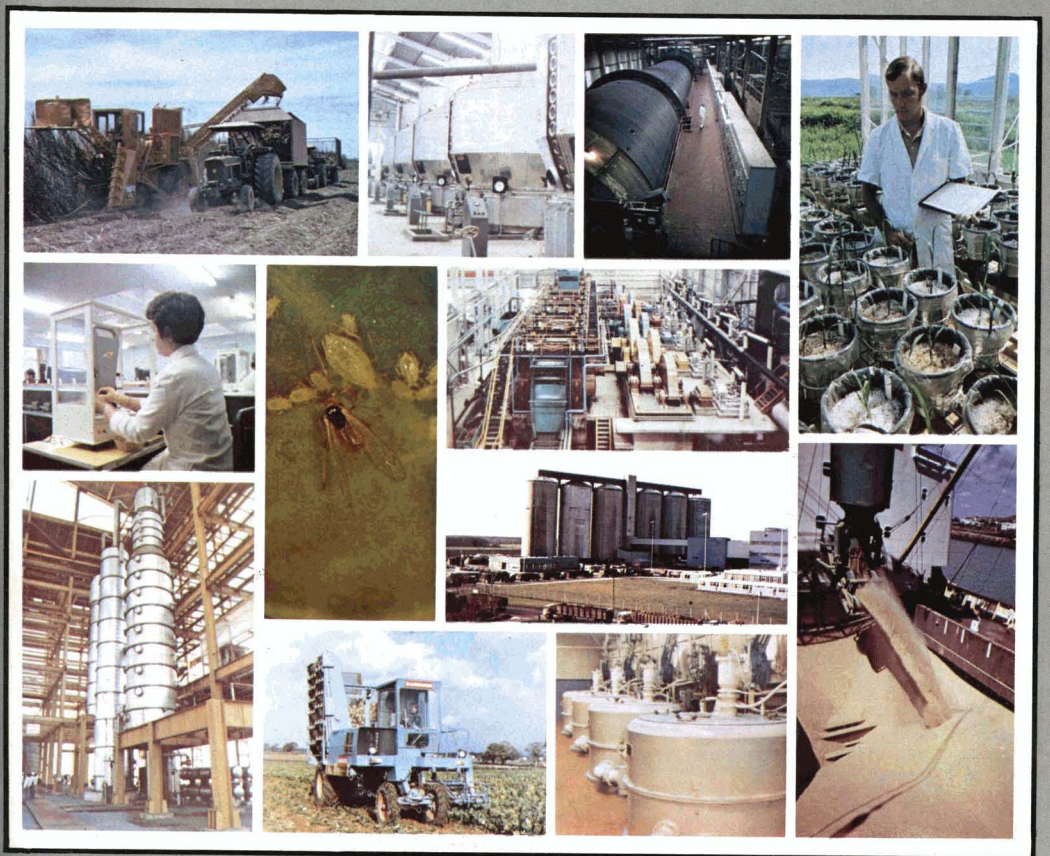

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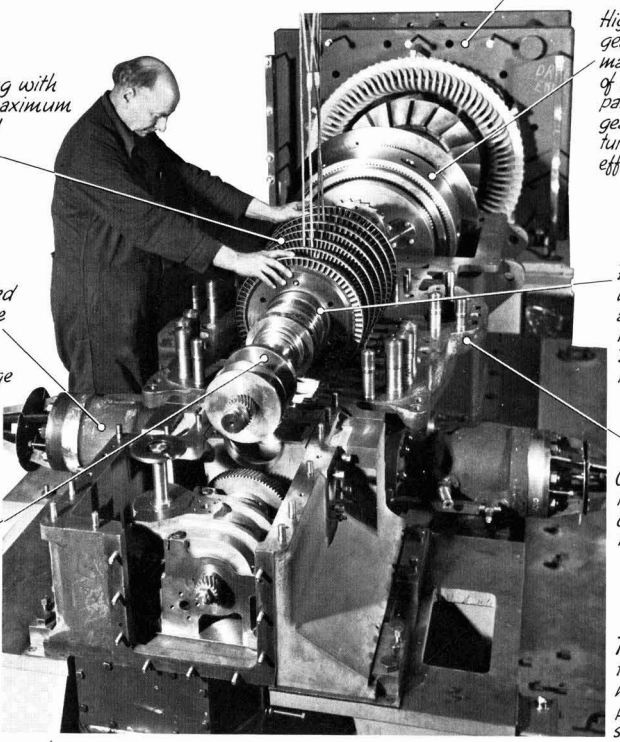

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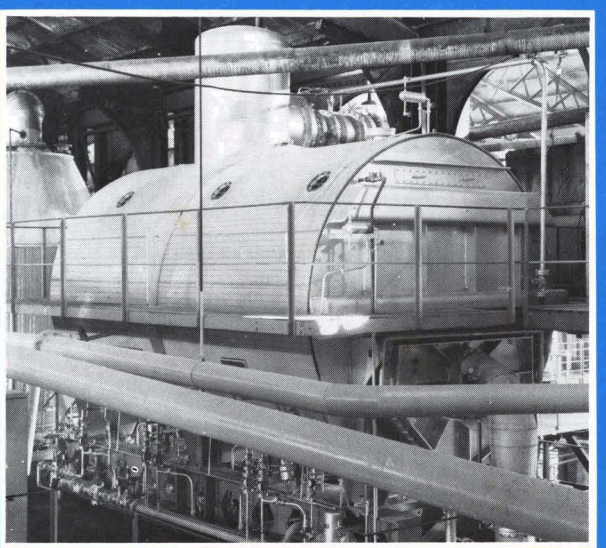

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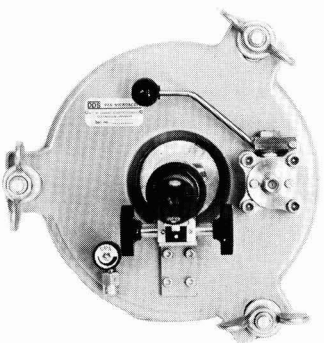

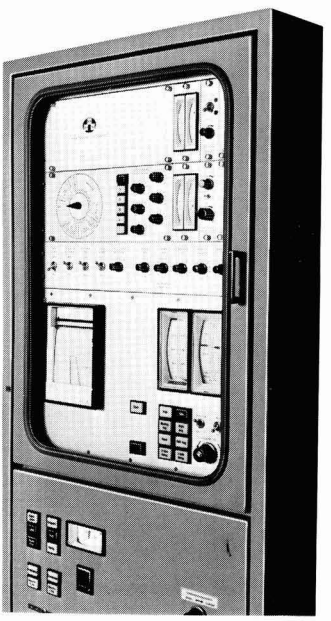

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Editor and Manager:
D. LEIGHTON, B.Sc., F.R.I.C.

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M. G. COPE, M.I.L.

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NOTES AND COMMENTS

EEC beet and sugar price proposals

The twelve months July 1979–June 1980 are the last in the five-year period before a new regime of Common Agricultural Policy comes into effect. The new arrangements for 1980 onwards will be the subject of study and negotiations in future months but for the year from July 1979 the Commission of the European Economic Community has made its proposals which were to be studied by the Council of Ministers at their meeting in February. The Council make the decisions and invariably reach agreement but, being politicians, are swayed by reasons other than economic ones so that they usually amend the Commission's proposals. As C. Czarnikow Ltd. have noted[1], "So it has gradually emerged that what was once to have been a Common Market, with production concentrated in the most economical regions, has become fragmented with national quotas and a system of internal exchange rates for agricultural produce to ensure that market forces, so carefully enshrined in the Treaty of Rome, have only a marginal effect on production and farmers' incomes".

The Commission has proposed that, for 1979/80, a complete freeze should apply to all guaranteed farm prices in terms of the Community's units of account. Reductions are proposed in the monetary compensation amounts for member countries with the weaker economies, with corresponding revaluations of the "green currencies" so as to permit higher incomes in the local currency for farmers in these countries. In the countries with stronger currencies the prices and farmers' incomes would remain the same as in 1978/79.

For 1978/79 the Commission had proposed that the B-quota for sugar should be reduced from 35% to 20%, but the Council of Ministers halved this decrease. The Commission now proposes that the second half of the decrease, from 27½% to 20%, should apply in 1979/80. Another proposal is that high fructose corn syrup should be included in the sugar regime.

US sugar industry restructure possibility

The US Secretary of Agriculture, Mr. Bob Bergland, spoke twice in December 1978 about changes in the country's sugar industry. He was reported[2] at the beginning of the month to have warned that the Louisiana industry might die within 20 years unless it could adapt to a changing world, and pointed out that cane could be grown at lower cost in several other states, that sugar beets and corn syrup provided less costly sweeteners, and that the foreign sugar market could provide its product cheaper. Although sugar cane has been a major crop in Louisiana for decades, the numbers of farmers and mills have declined steadily during recent years because of increased competition and soaring costs. The USDA is to investigate the possibility of converting Louisiana sugar cane farms to vegetable production or other crops, and will spend up to $15,000,000 to study whether alcohol instead of sugar can be produced from cane for replacement of gasoline and other fuels.

Speaking at a meeting of American beet growers later in the month[3], he said that, despite recent price improvements, the industry continued to face economic problems, especially in areas where production costs are considerably higher than average. He said that the business and industrial loan guarantee programme of the farmers' home administration would probably be able to help some plants convert to other business.

He told the group that the Carter administration has no intention of bringing about the economic collapse of the domestic sugar industry. "I know we would be subject to much greater price variations if we were totally dependent on imports", he said. Mr. Bergland said that US sugar consumption is declining and there is greater competition from high fructose corn sweeteners. However, it is in the national interest to have a viable domestic sweetener industry to meet a large proportion of domestic needs, and a healthy world industry to meet the balance.

Sugar and alcohol in Brazil

World Sugar Journal recently reported[4] that Brazil produced its biggest sugar crop so far of 8,756,566 tonnes, raw value, compared with 7,598,216 tonnes in 1976/77. The increase in total consumption, however, remained almost unchanged from 1975/76 to 1977/78 inclusive, resulting in reduced consumption on a per caput basis. From monthly data issued by the Instituto do Açúcar e do Alcool it may be noted, however, that during the first quarter of the 1978/79 season, the cumulative consumption total exceeds those of the corresponding periods in 1977/78 and 1976/77 (1,196,000 tonnes *vs.* 1,089,000 and 1,157,000 tonnes, respectively) which is encouraging and, if continued through the whole season, would give a total consumption for 1978/79 of 5·6 million tonnes.

Consumption in Brazil during the ten-year period preceding 1975/76 had increased at an average of 217,000 tonnes per annum. The factors which contributed to a stagnation in consumption during the past three crop years are difficult to explain, especially in view of the fact that supplies, measured in terms of the amount produced and stocks carried forward, were at record high levels.

For many years, it has been a practice to establish an alcohol distillery alongside a sugar factory for utilization of the molasses produced[5]. This suffered from competition with alcohol produced from residual materials of petroleum refineries. The end of the period of low-priced oil brought an energy crisis to Brazil and, as part of a national policy to maximize usage of domestic resources, it was decided to expand the use of carbohydrates for processing into fuel. As a result of this there is now a total of 195 such enterprises in Brazil, of which 183 use sugar cane (juice or molasses) as their raw material, 11 manioc and one a palm-tree product. A further 44 installations will come on stream during the next 2-3 years.

Production of alcohol from cane, according to *World Sugar Journal*[4], rose from 5,556,270 hl in 1975/76 to 6,684,640 hl in 1976/77 and 14,728,310 hl in 1977/78. In

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[1] *Sugar Review*, 1979, (1425), 21.
[2] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (35), 14–15.
[3] *Public Ledger*, December 16, 1978.
[4] 1978, **1**, (6), 14–15.
[5] C. Czarnikow Ltd., *Sugar Review*, 1978, (1417), 234.

the first quarter of 1978/79 alone, production is recorded as 9,232,190 hl. Such a production rate, if continued throughout the year, would result in a production of some 37 million hl or 152% more than in 1977/78 which was itself a 120% increase over production in 1976/77. *World Sugar Journal* comments: "It is highly unlikely that additional cane production would be used for the production of sugar as long as Brazil's exports of sugar are subject to quantitative controls under the International Sugar Agreement. The flexibility which this additional usage of sugar cane provides is bound to remove pressure from the sugar industry, particularly at times of surplus which, in return, should contribute to better supply management on the world sugar market".

World sugar prices

Quiet conditions prevailed again in the raw sugar market during January and the London Daily Price, after an initial rise from £95 to £96 per tonne, slid gently to £93. At the very end of the month, talk of bad weather affecting the Cuban crop, and optimism about the establishment of sugar legislation in the US, as well as rumours of purchasing interest by the USSR, resulted in a rise to £96 again by February 1.

For a time the EEC Commission reduced the rate of release of white sugar but part-way through January the rate returned to its customary level and it became apparent that the EEC's "parallel regime" to that of the ISA was not leading to appreciable restraint on exports. The LDP(W) dropped and there was, for a time, a negative premium over the raw sugar price. By the end of the month, however, the premium had been re-established as a positive amount of £2.00 per tonne.

US sugar import fee

As mentioned in our last issue[1], President Carter issued a Proclamation on December 29, setting a new import fee of 3·35 cents/lb for raw sugar and 3·87 cents/lb for refined sugar, up 0·65 cents/lb from the previous levels. The fees will be reviewed quarterly and adjusted if necessary on the basis of the average world price, brought to a delivered US equivalent, for the 20 market days prior to the 20th day of the month before the quarter in which the fees will be applied. The intention is for the fee to be a balancing figure which, added to this average price, will give a market price of 15 cents/lb for raw sugar. Should the average world price differ by 1 cent/lb or more during any 10-day period from the market price objective, fees will be revised within 3 market days.

The adjusted world market price for the 20 days before December 20 was 8·84 cents/lb, including 0·9 cents/lb for freight, insurance, weighing and sampling; with the import duty of 2·81 cents/lb this gives 11·65 cents/lb, so requiring a fee of 3·35 cents/lb to bring the market price to 15 cents/lb. During the first quarter of 1979, should the world raw sugar price, brought to a delivered US basis, plus 2·81 cents/lb duty and 3·35 cents/lb fee, exceed 16 cents/lb or be under 14 cents/lb for 10 consecutive market days, the fee will be adjusted by 1 cent/lb, the same adjustment applying to the refined sugar import fee.

Cuba sugar expansion plans

Speaking at a luncheon of the Sugar Club in New York in December, Sr. Emiliano Lezcano Viquiera, President of Cubazúcar, outlined Cuba's plans for expansion[2]. During recent years Cuba has succeeded in steady production increases: 6·2 million tonnes in 1976, 7·0 million tonnes in 1977 and about 7·5 million tonnes in 1978. By 1980 Cuba intends to be the largest cane sugar producer and during the 1980's to become the largest sugar producer in the world.

Cuba plans construction of four new sugar factories which are expected to commence production in 1979/80 with a daily crushing capacity of 7000 tonnes each, as well as enlargement of old factories. In 1979 Cuba will have seven mechanical bulk loading installations. During the 1978/79 harvest 50% of cane cutting will be mechanized. This percentage is expected to increase steadily using harvesters being built at a plant in eastern Cuba.

"The reasons for these plans of enlargement and investment in the Cuban sugar industry are the limitations of natural resources in our country for our economic development. That is why Cuba, for a very long period, will continue being the largest sugar exporter in the world, thus justifying this expansion policy".

US sugar legislation

In early January, Dept. of Agriculture representatives met various US sugar industry groups to discuss new sugar legislation in the form of a draft Sugar Bill setting a domestic price objective of 15 cents/lb and providing for direct payment to producers and refiners based on the weighted average cost of production. The industry groups considered the draft inadequate and called instead for restrictions on imports and more realistic quotas and import fees.

A Bill was introduced by Senators Dole and McGovern on January 15, requiring the Secretary of Agriculture to set the price support loan level at a percentage of parity equal to 16·5 cents/lb, while Representative Ullman, chairman of the House Ways and Means Committee, had earlier said he would introduce a bill in the new Congress to provide an extensive domestic sugar legislation programme. Senator McClure and Reps. Syms and Hansen introduced a further bill which relies on import quotas and fees to set an unspecified domestic price objective, with domestic consumption and production determined by the US Dept. of Agriculture and the balance provided by foreign suppliers.

Thus it may be seen that there is likely to be some delay before a bill acceptable to all parties is worked out and approved by Congress for submission to the President.

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[1] *I.S.J.*, 1979, **81**, 34.
[2] *Lamborn*, 1978, **50**, 199.

The simulation of a sugar factory

By H. PEREZ DE ALEJO* and P. FRIEDMAN†

Introduction

ALTHOUGH engineers have been able to describe the unit operations present in process plants for many years, it has only been possible to provide a mathematical description of a complete process plant in the last 10–15 years. Thus, along with the rapid development of the modern digital computer, simulation languages were written[1,2,3,4] which offer the engineer a system capable of: reading the data, carrying out mass and energy balances in complex recycle processes, and providing reports of the simulation, all with a minimum of programming effort by the user.

The use of simulation languages for the design of new plants and for the analysis of existing ones has been reported in the literature for many different processes[5,6,7].

However, in the case of the sugar industry, although mathematical models have been developed for some of the operations and equipment such as the crushing train[8,9,10], multiple-effect evaporators[11,12,13], and vacuum pans[14,15,16], a simulation of the total raw sugar production process has not been previously reported.

It was felt that such a simulation would be useful since the total system consists of more than 10 different types of equipment or subprocesses and at least 40 process streams, with a minimum of 4-5 components in each stream, thus making it very difficult to describe the total process, with its many interactions, by the available manual methods.

The strategy used in the development of the total process model was first to develop a simple model of the process which could be used to calculate approximate mass and energy balances considering not only the total stream flows but also those of the principal stream components.

The second step was to develop an SOA (State of the Art) model based on the best available descriptions of the process such as the individual equipment models previously mentioned and a recent study on the prediction of physical properties of sugar solutions[17]. GEMCS, a general engineering and management computation system[1], was used for the process simulation.

GEMCS requires that the process flow diagram be translated into an information flow diagram, as shown in Fig. 1. In the real plant, mass and energy flow to and from different equipment, while in the process simulation, information flows between the different process models. Each stream in this diagram contains information on the stream properties as shown in the stream list of Table I.

Table I. Stream list

Stream Number	*Element*	
1	Stream Number	
2	Zero (not used)	
3	Total flow	lb.hr^{-1}
4	Temperature	°C
5	Pressure	psia
6	Flow of water	lb.hr^{-1}
7	Flow of sucrose	lb.hr^{-1}
8	Flow of non-sucrose soluble solids	lb.hr^{-1}
9	Flow of fibre	lb.hr^{-1}
10	Flow of non-fibre insoluble solids	lb.hr^{-1}
11	Flow of sucrose crystals	lb.hr^{-1}

The information is modified by the unit computations or modules, which are computer programmes that describe the real equipment or subprocess by means of mathematical equations based on the fundamental laws of chemistry and physics or by empirical equations derived from process data. The unit computations also include the mathematical techniques necessary to solve the set of mathematical equations.

Description of the SOA simulation model

As mentioned previously, a simple "base case" model was first developed to study the problem of convergence and the sensitivity of the system. The unit computations used in this model carry out simple linear operations such as splitting or combining flows, changing the value of (or converting) one or more components of a stream, etc. This type of model can be used for simple mass and energy balancing and for preliminary cost analysis in the design of new installations. The results of the simulation runs with the base case model are shown in Tables V, VI and VII.

The modules for the mill train, heaters, clarifier, filter, evaporator, etc., are all continuous steady-state models, as is the process they describe. Since the operation of the vacuum pans, centrifugals and crystallizers is not continuous but of a batch nature, a different modelling technique must be used. The PAN3 module is a description of the boiling house which is compatible with the previous modules since it represents the distribution of soluble solids in the boiling house, analysed from a steady-state point of view. Linear programming is used to calculate the optimum distribution of these soluble solids.

The information flow diagram for the SOA simulation model is shown in Fig. 1. The modules or unit computations used are listed in Table II and the description of the streams is shown in Table III. A short description of the unit computations will now be given.

* Facultad Azucarera, Instituto Superior Politécnico "José Antonio Echavarría", Marianao, Habana, Cuba.
† Centro de Sistemas Automatizados de Dirección, Ministerio de la Industria Química, Vedado, Habana, Cuba.

[1] Johnson: "GEMCS, a general engineering and management computation system" (McMaster Univ.), 1970.
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[3] Motard *et al.*: "CHESS, chemical engineering simulation system" (Univ. of Houston), 1968.
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[5] Crowe *et al.*: "Chemical Plant Simulation" (Prentice-Hall), 1971.
[6] Johnson: *BCE Process Technology*, 1972, **17**, (1).
[7] *Idem ibid.*, (2).
[8] Murry & Holt: "The mechanics of crushing sugar cane" (Elsevier, Amsterdam), 1967.
[9] Russell: *CubaAzúcar*, 19??, (April/June)
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[14] Wright & White: *Proc. 13th Congr. ISSCT*, 1968, 1697–1710.
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[16] Díaz & Friedman: *CubaAzúcar*, 1975, (Oct./Dec.).
[17] Díaz: Master's Thesis, Universidad de La Habana, 1974.

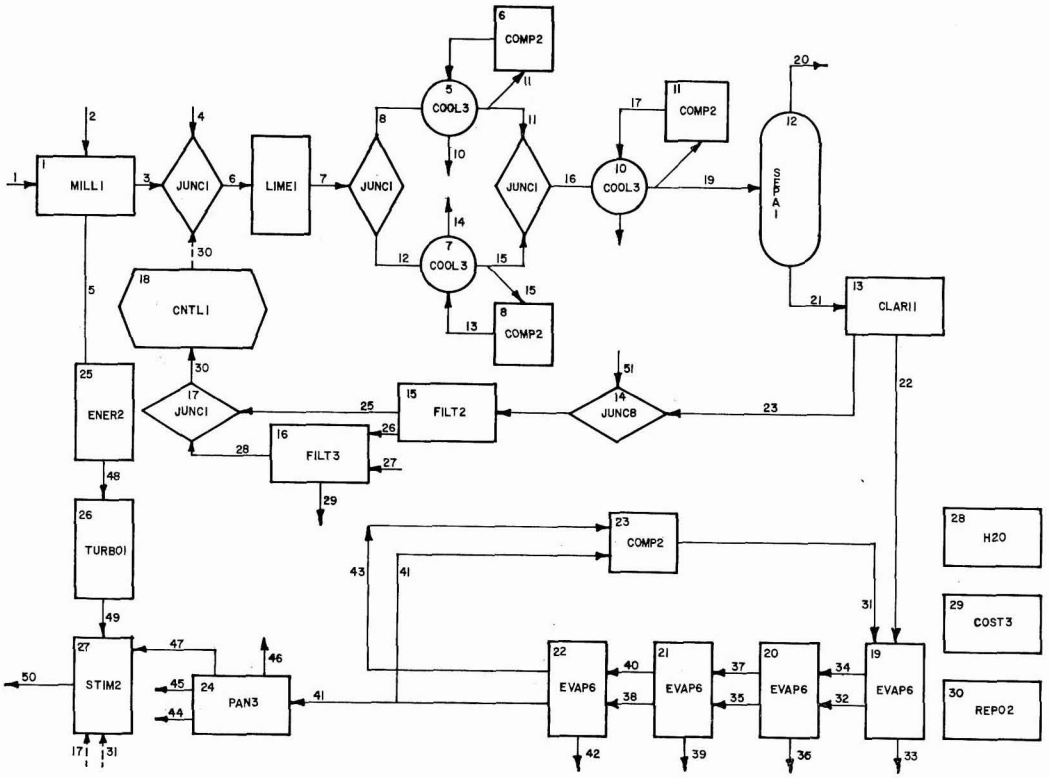

Fig. 1. Information flow diagram of the SOA simulation model

Table II. Modules used in "State of the Art" simulation model

Equipment or subprocess	*Module*
Mill train	MILL1
Liming	JUNC1, SEPA1
Heaters	COOL3
Flash tank	SEPA1
Clarifiers	CLARI1
Filter feed tank	JUNC8
Rotary filters	FILT2, FILT3
Automatic controls	COMP2
Evaporators	EVAP6
Boiler house	PAN3
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MILL1

This module is based on the work of several authors[8,9,10] and uses the concept of a volumetric extraction process, calculating the mass balances from the volume and density of the extracted juice. The mill train is divided into two sections: the first dry, and the second wet, owing to imbibition. Because of the countercurrent nature of the operation, the calculations must be carried out in an iterative manner[18]. The experimental parameters for the model, reabsorption and imbibition coefficients, are calculated using correlations developed for a Cuban sugar mill[19].

COOL3

This module represents the sugar cane juice heaters. It is based on the most common arrangement in the Cuban sugar industry where three 1-2 heat exchangers are placed in series. The computer algorithm uses the concepts of heat transfer effectiveness and number of transfer units, as described in the literature[20].

CLARI1

Little work has been done on the mathematical description of the clarification subprocess. Thus, this module is only a very approximate one and does not provide an exact representation of the real process. It is based on a single-tray design concept and takes into account the destruction of sucrose, using data from the literature[21]. The carry-over of solids is calculated by the procedure of Talmage & Fitch[22] using experimental settling data from a Cuban sugar factory[23].

FILT2—FILT3

The FILT2 module describes the filtering zone and the FILT3 module describes the washing zone of the continuous rotary vacuum filter. Once again, these modules are preliminary in nature and use experimental inform-

[18] Sevilla & Friedman: *Control Cibernética y Automatización*, 1976, **10**, (2).
[19] *Idem*: *CubaAzúcar*, 1977, (April/June).
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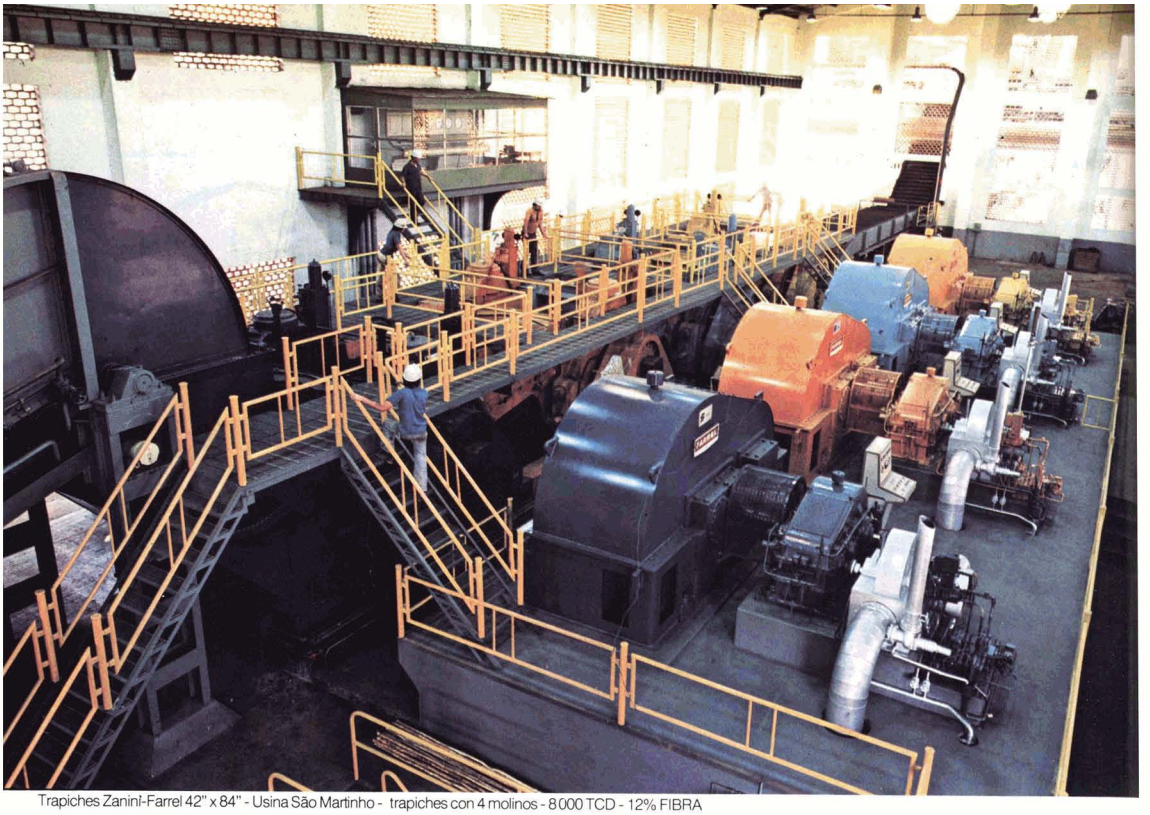
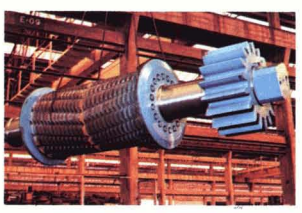


Trapiches Zanini-Farrel 42" x 84" - Usina São Martinho - trapiches con 4 molinos - 8000 TCD - 12% FIBRA

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



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

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

Y esta eficiencia es garantizada por el alto nivel tecnológico conseguido a través de una asociación que reunió en una única fuente, la experiencia, la tradición y el "know-how" de Zanini y Farrel.

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

TRAPICHES ZANINI-FARREL:

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

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

pero también puede suministrarlos en tamaños especiales.

GARANTÍA:

Los trapiches Zanini - Farrel ofrecen una garantia total valedera por dos (2) años, contra cualquier defecto de fabricación.

zanini s/a
equipamentos pesados

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

ation from a Cuban sugar factory[23] in the first case and a mechanism developed by Silverblatt *et al.*[24] for FILT3.

Table III. Description of streams in information flow diagram of SOA model

No. in IFD	Description	No. in IFD	Description
1	Sugar cane	31	Steam for evaporator
2	Imbibition water	32	Syrup from effect 1
3	Mixed juice	33	Condensate from effect 1
4	Milk of lime	34	Evaporation from effect 1
5	Bagasse	35	Syrup from effect 2
7	Limed juice	36	Condensate from effect 2
9	Steam for heaters	37	Evaporation from effect 2
10	Condensate	38	Syrup from effect 3
11	Juice from heaters	39	Condensate from effect 3
13	Steam for heaters	40	Evaporation from effect 3
14	Condensate	41	Syrup from effect 4
15	Juice from heaters	42	Condensate from effect 4
17	Steam for heaters	43	Evaporation from effect 4
18	Condensate	44	Final molasses
19	Juice from heaters	45	Commercial sugar
20	Evaporation from flash tank	46	Evaporation from vacuum pans
21	Juice to clarifier	47	Steam for vacuum pans
22	Clarifier juice	48	Superheated steam produced in boilers
23	Clarifier mud	49	Saturated steam from turbogenerator
24	Filter makeup	50	Steam in excess or deficit
25	First filtrate	51	Bagacillo for filter aid
26	Filter cake (not washed)		
27	Filter cake wash water		
28	Second filtrate		
29	Final filter cake (cachaza)		
30	Combined filtrate		

EVAP6

This module describes the operation of a single-effect evaporator by means of mass and energy balance equations and empirical correlations for the physical properties, as described in the literature[11,12,13]. The calculations are iterative owing to the structure of the information flow.

PAN3

As mentioned above, operation of the vacuum pans, centrifugals, and crystallizers is not continuous but of a batch nature, and so cannot be described by the same techniques used in the previously mentioned modules. This module represents the distribution of soluble solids in the boiling house and uses the technique of linear programming to calculate an optimum distribution of these soluble solids, minimizing the use of the process equipment and storage tanks. This optimum solution can then be compared with the available capacity, and the boiling house operation can be evaluated.

A diagram of the model for the "new three-boiling" system is shown in Fig. 2. The results listed in Table IV show a reduction in the capacities required as compared with data from the literature[25].

Table IV. Results of boiling house model*

Stream	Variable No.	Results from Literature (26)	Model Results
Commercial sugar	X_{17}	80·00	80·00
Final molasses	X_4	20·00	20·00
A-strike	X_7	111·12	115·83
B-strike	X_{12}	27·61	15·15
C-strike	X_{15}	41·63	40·82
Total		180·33	171·80
Seed to *A*-strike	X_1	18·18	19·83
A-sugar	X_2	67·35	71·82
B-sugar	X_3	12·65	8·18
Syrup to *C*-strike	X_5	0·81	0·63
Syrup to *A*-strike	X_6	92·94	96·00
A-molasses	X_8	43·77	44·02
A-molasses to *B*-strike	X_9	17·94	10·80
Syrup to *B*-strike	X_{10}	6·25	3·37
A-molasses to *C*-strike	X_{11}	25·83	33·21
B-molasses	X_{13}	14·96	6·97
Seed to *B*-strike	X_{14}	3·42	0·98
Total seed	X_{16}	21·60	20·82

* Results expressed as weight % syrup
Purities: syrup 85, final molasses 33, sugar 98.

TURBO1

A simple description of a turbogenerator.

ENER2

This module simulates the boiler operation.

H2O

Carries out a water balance for the entire sugar factory, including condensate, boiler water, etc. For the purpose of clarity in Fig. 1, however, the information flow streams to this module have not been shown; this is also the case for modules REPO2 and COST3.

STIM2

Carries out an energy balance for the entire sugar factory.

REPO2

This module translates the results of the simulation into terms (units) familiar to users in the sugar industry.

COST3

The total process costs are calculated and a sensitivity analysis is made.

Results

The results of test runs of the base case and SOA simulation models are shown in Tables V, VI and VII. Typical results from the literature and from 10-day reports from a Cuban sugar factory[26] are also given; in general, fairly good agreement has been obtained.

TableV. Comparison of selected streams (weight % cane)

Stream	Parameter	SOA Model results	Base case results	Range of typical values
Sugar cane*	Total flow	100	100	100
	Pol	16·33	13	13·5–17·0
	Fibre	12·14	12·14	10–13
Mixed juice	Total flow	98·05	96·85	94·98
	Brix	16·79	15·19	13–14
	Purity	84·91	84·01	80–87
Bagasse	Total flow	24·14	26·15	24–27
	Pol	1·50	2·75	2·3–3
	Fibre	50·22	46·36	46–50
	Water	47·27	48·70	45–51
Clarified juice	Total flow	103·93	102·16	100
	Brix	13·24	14·22	13–17
	Purity	84·34	83·34	85
Filter cake	Total flow	4·19	4·17	2–5
	Pol	2·29	1·11	0·5–3
	Water	73·00	72·88	70–80
Syrup	Total flow	26·61	21·90	23
	Brix	61·61	66·69	60–70
	Purity	84·34	83·49	80–87
Final molasses	Total flow	3·59	3·68	2–5
	Pol	29·04	30·20	32–36
	Purity	33	33	28–36
Commercial sugar	Total flow	12·87	11·34	10–13
	Pol	97	97·54	97·5
	Insoluble	0·0	0·04	0·02–0·05

* All parameters of sugar cane fixed by user.
Imbibition fixed as 23% by weight of cane.

The SOA model was recently used for troubleshooting in a Cuban factory which was having difficulties with its energy balance. The simulation model proved to be a useful tool in identifying the sources of the problem[27].

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[24] *Chemical Engineering*, 29th April 1974.
[25] García & Clark: "The Raw Sugar Manufacturing Process in Vacuum Pans" (Instituto del Libro), 1969.
[26] Pérez de Alejo: Master's Thesis, Universidad de La Habana, 1976.
[27] Pérez de Alejo *et al.*: *Paper presented to the 1st Scientific Conf.*, Instituto Superior Politécnico José A. Echevarría, 26–29th December 1977.

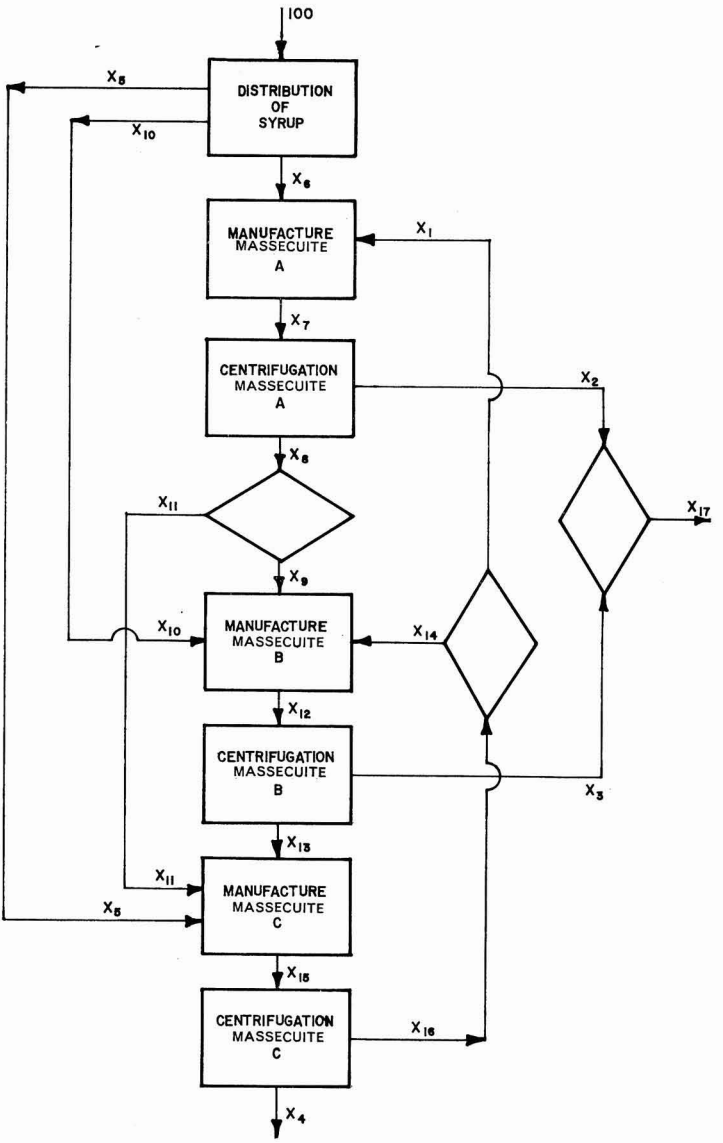

Fig. 2. Diagram of the linear programming model for the boiling house

The SOA model is also being used in preliminary design work for the construction of new sugar factories[28].

Conclusions

The most important conclusions derived from this study are:—

A state of the art simulation model has been developed of the raw sugar manufacturing process, integrating the available information in the literature on the different unit operations and subprocesses into a total sugar factory model.

The principal limitations of this model do not lie in the computer programmes or simulation language but rather in the lack of sufficient knowledge of the chem-

[28] Manchado *et al.*: "BALANCE Users Manual" (IPROYAZ, Ministerio del Azúcar, Havana), 1977.

ical and physical phenomena involved in many of the subprocesses for raw sugar manufacture.

The SOA simulation model can be used in its present form, with the aforementioned limitations, for trouble-shooting in sugar factories, preliminary design and analysis of new factories, and in the education of engineers and technologists for the sugar industry.

Table VI. Results of energy balance (weight % cane)

Saturated steam at 212°F consumed	*SOA Model results*	*Base case results*	*Range of typical values*
Heaters	13·16	2·23	*
Vapour cell	—	13·19	26–37
Quadruple-effect	21·1	19·56	
Vacuum pans	13·57	11·53	11–15
Miscellaneous	8·00	7·99	8–10
Sub-Total	55·84	54·53	54·7
†Theoretical BTU × 10^6 produced per lb dry bagasse	81·96	81·96	81·77–84·44
Boiler efficiency	0·55	0·55	0·49–0·67
BTU × 10^6 consumed per ton cane	1·05	1·22	0·84–1·35

* Values given for heater evaporator combination.
† Boiler efficiency not considered.

Table VII. Pol balance (weight % pol in cane)

	SOA Model results	*Base case results*
Final molasses	7·99	8·22
Cachaza	0·51	0·26
Undetermined loss	1·14	1·08
Bagasse	2·23	5·50
Total losses	11·87	15·06
Sugar recovery	88·13	84·94

Summary

A mathematical simulation model has been developed which provides a means for calculation of mass and energy balances for all the unit processes in the manufacture of raw sugar from cane. Limitations are imposed by lack of sufficient knowledge of the subprocesses involved but the model is suitable for solving of factory problems, design and analysis of new factories, and education of technologists. The model is illustrated by an information flow diagram, a diagram of the linear programming model for the boiler house and an account of the unit modules, and results of its use are tabulated.

La simulation d'une sucrerie

Un modèle de simulation mathématique a été établi, qui offre la possibilité de calculer les bilans de masse et d'énergie pour toutes les opérations unitaires en fabrication de sucre brut de canne. Certaines limitations sont imposées par l'absence de connaissance suffisante des sous-opérations inclues, mais le modèle est utilisable pour la résolution de problèmes d'usine, la conception et l'analyse de nouvelles usines et pour la formation de techniciens. Le modèle est illustré par un schéma de circulation d'information, un diagramme de modèle de programmatation linéaire pour la chaufferie, un relevé des modules unitaires et les résultats de son utilisation sont présentés sous forme de tableau.

Simulation einer Zuckerfabrik

Ein mathematisches Simulationsmodell ist entwickelt worden als Hilfsmittel für die Berechnung der Massen- und Energiebilanz für alle Einheitsverfahren bei der Herstellung von Rohzucker aus Rohr. Beschränkungen sind auferlegt durch Mangel an genügender Kenntnis von mit einbezogenen Sub-Verfahren, aber das Modell ist geeignet zur Lösung von Fabrikproblemen, für Entwürfe und Analysen neuer Fabriken und die Ausbildung von Technologen. Das Modell wird illustriert durch ein Informations-Fluss-Diagramm, ein Diagramm des linearen Programm-Modells für die Verdampfstation und eine Berechnung des Einheitsmodells; die Ergebnisse sind tabelliert.

La simulación de un ingenio azucarero

Se ha desarrollado un modelo para simulación matemática que provee un medio para calcular balance de masa y energía de todos los procesos unitarios en la fabricación de azúcar crudo de caña. Se imponen limitaciones por falta de conocimiento adecuado de los sub-procesos implicados, pero el modelo es conveniente para solucionar problemas de fabricación, diseño y análisis de nuevos ingenios, y la instrucción de tecnólogos. Se ilustra el modelo por un diagrama del flujo de información, un diagrama del modelo de programación lineal para la casa de calderas, un examen de los módulos unitarios, y resultados de su uso los que se presentan en forma tabular. □

Peru sugar industry difficulties[1].—Continuing low prices, inefficiencies in the industry and the unhealthy state of the Peruvian economy, capped off by a severe early-year drought in the major cane production areas, have seriously affected the sugar industry. Sugar output is beginning to drop, as production costs continue their upward spiral. Because of the drought, sugar production in calendar year 1978 is expected to have totalled only 850,000 tonnes, raw value, down from 930,000 tonnes in 1977. Another 50,000 tonnes drop is forecast by the USDA for calendar year 1979 as the effects of the drought continue. Despite the drop in production, Peru should be able to fulfil its export commitments under the International Sugar Agreement of 285,250 tonnes, raw value, in 1978, which compares with the 412,000 tonnes shipped in 1977. In 1979, however, it seems to be highly unlikely that the country could meet its export quota if production should actually fall to 800,000 tonnes, since, even with quotas at their lowest level, there would not be sufficient sugar available after meeting domestic demand. Because of rising sugar prices and declining purchasing power, estimated domestic consumption in 1978 was reduced to 550,000 tonnes, or 32·7 kg per caput, from 570,000 tonnes, or 34·8 kg per caput, in 1977. Consumption in 1979 is expected, at best, to hold steady. The stocks needed for domestic consumption and those obligatory under the ISA mean that it is likely that Peru will have to declare a quota shortfall if production is not greater than the forecast 800,000 tonnes.

Mauritius bagasse paper study[2].—The Belgian engineering company Sybetra and the Mauritian company Sigma have studied a project for a paper plant in Mauritius having a capacity of 120,000 tonnes of newsprint. The raw material would be bagasse. The required investment would be about 1100 million rupees ($178 million). The Indian Ocean market for newsprint would be about 700,000 tonnes.

St. Vincent sugar factory[3].—According to press reports, the Government of St. Vincent has announced that it is to award contracts for construction of a sugar factory; there are three elements: the dismantling, shipping and re-erection of a sugar factory from Trinidad, a similar contract from Barbados, and structural work for the entire factory at Mount Bentinck, St. Vincent.

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[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (34), 17.
[2] *Westway Newsletter*, 1978, (61), 10.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (36), 17.

Newark replacement and expansion project

By F. ROBSON and M. FLACK

Paper presented to the British Sugar Corporation Ltd. 24th Technical Conference, 1978

PART II

Vacuum pans

There are nine 60-tonne pans installed, four for white massecuite, two for raw, two for after-product and one pan for either raw or after product. The white pans have stirrers. All pans are boiled automatically, using microprocessors, and all controls have manual override. The A.P. pans are given a footing of magma made by mixing high green syrup and A.P. sugar.

A common vacuum system is used, air and non-condensable gases being extracted by a Waller-Nash dual compressor system. Hot and cold condensers are used; vapour from two white pans goes to one hot condenser (after 1st stage raw juice heating) and from the two hot units to a common cold condenser. Similarly, high raw and A.P. pans have a hot condenser to each pair of pans followed by a cold one for each duty. Cooled water is added to all condensers and collected along with condensed vapour in the seal tank. Seal tank water is circulated through an existing and one new induced-draught splashback twin-cell cooling tower. Both together handle 6000 gal.min^{-1} water in parallel. From the coolers water is pumped direct to pan condensers. There is no head tank. White pans use 2nd and 3rd vapour and all other 3rd vapour only, except during thick juice run when only 1st vapour is available.

Centrifugals

White massecuite is processed in seven Broadbent fully-automatic centrifugals with 48 in × 30 in baskets. A charge holds approximately 650 kg of massecuite and a machine can be charged twenty times an hour. The feed speed is variable at 170-230 r.p.m. and the machine spins at 1000 r.p.m. Plough speed is also variable at 40-70 r.p.m.

High raw and after-product massecuite are each purged in four 850-kg BMA continuous centrifugals. Both massecuites are pump fed using Mirrlees magma pumps. As stated earlier, raw sugar is remelted and A.P. sugar mingled with high green syrup, or dissolved and pumped with high green to the raw pans.

After-product massecuite curing

The A.P. pans drop massecuite into a crystallizer from which it is pumped to the first of four curing crystallizers each with a capacity of 110 tonnes. Massecuite overflows from one to the other, finally being pumped to the continuous centrifugals. Blanchard-type cooling elements are provided. The massecuite is reheated whilst entering the BMA 850S machines. Molasses not required for pulp addition is stored in a 19 m diameter yard tank.

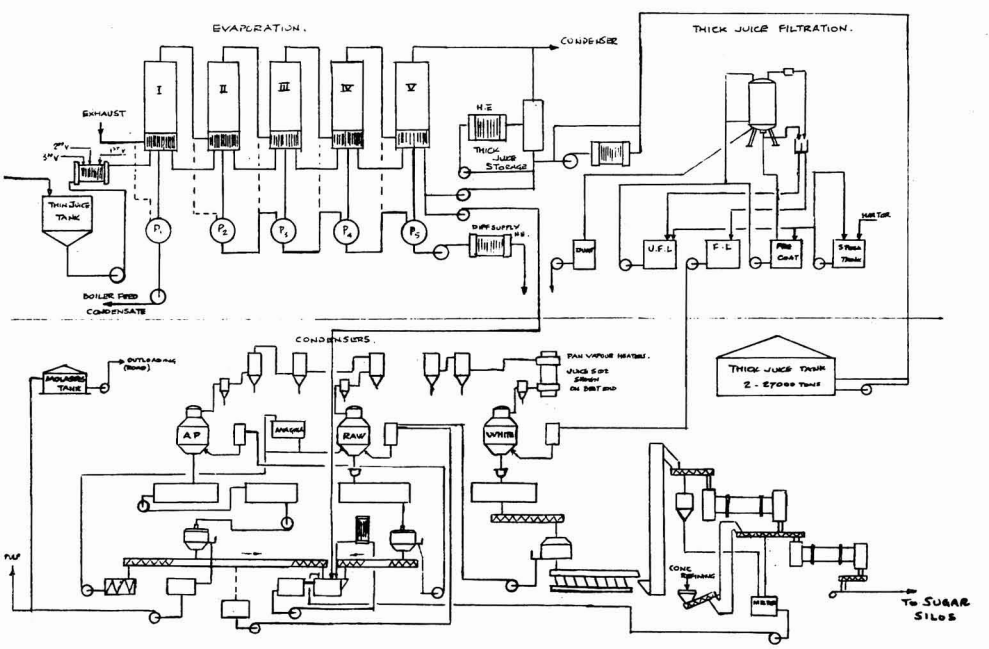
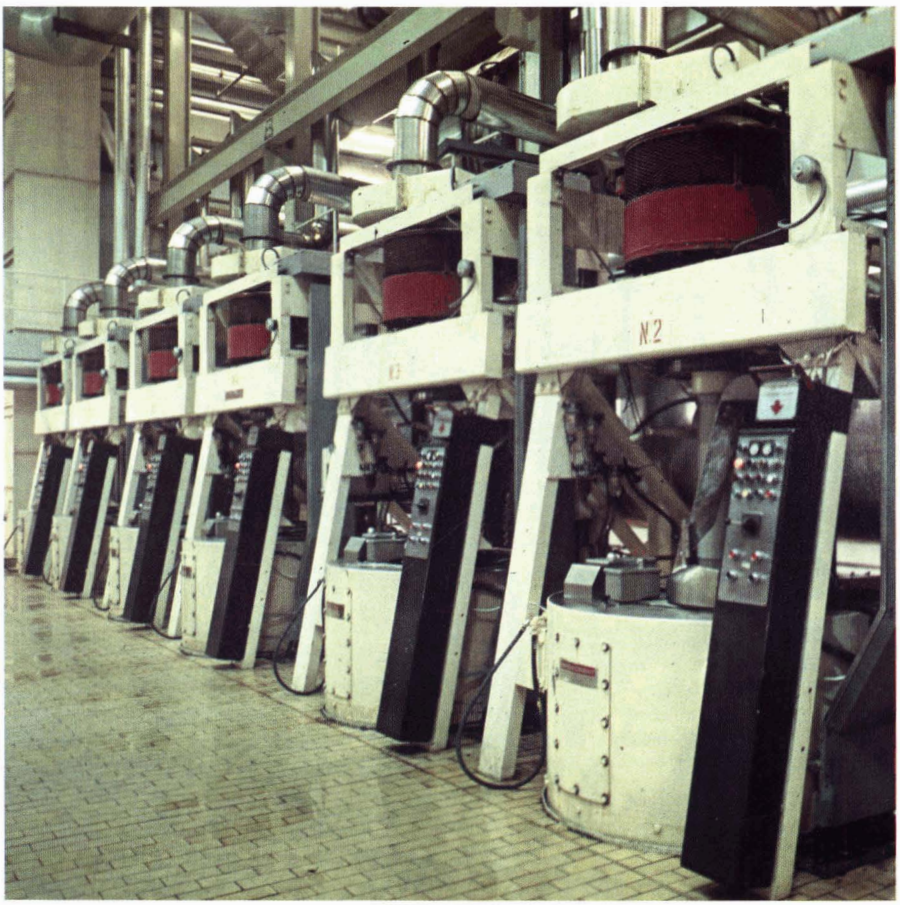


Fig. 6. Schematic flowsheet — Sugar end



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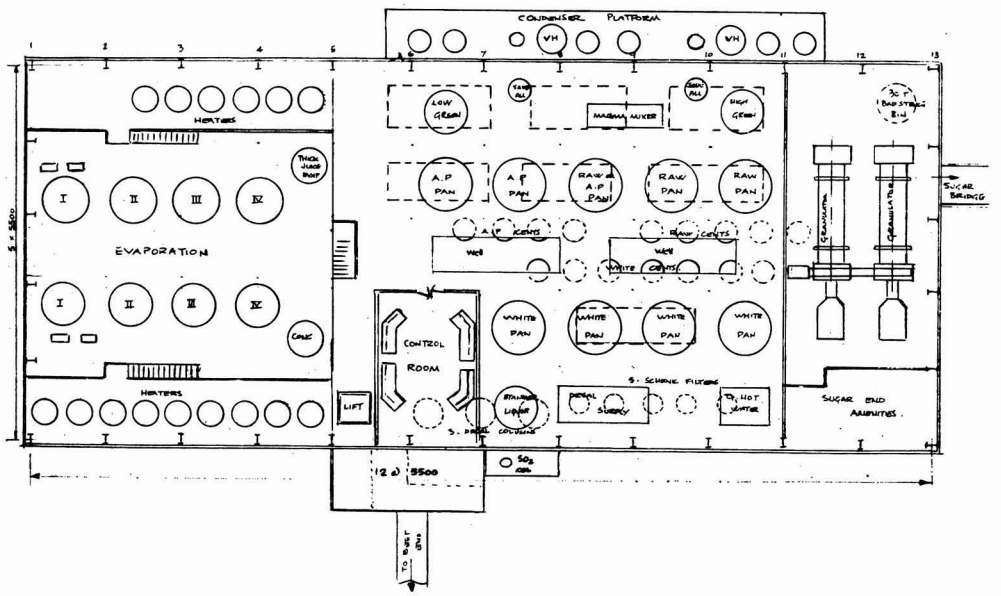

Fig. 7. Plan of sugar end

Sugar handling

Wet white sugar discharged from the centrifugals is conveyed via a grasshopper conveyor and bucket elevator to two 8-ft diameter granulators made at Corporation workshops, screened over three Locker "Rotex" screens using 10-mesh stainless steel wire screens. After screening, sugar is conveyed through an 8 ft diameter cooler to a pair of Avery type 4091 automatic weighers, capacity 250 kg per tip. Sugar is passed over two magnetic chutes before entering one of three concrete silos. These are of standard B.S.C. pattern, i.e. 66 ft diameter by 175 ft high, holding 12,000 tonnes each. Conditioned low humidity air is blown in at points in the silo floor.

An existing 200-tonne capacity bin has been retained together with its bagging-off facility, for emergency use in case of conveyor breakdown to the silos or, if the need arises, to segregate any sugar.

Sugar taken from the silos is weighed on another Avery weigher, screened to remove lumps and conditioned, if necessary, through an 8 ft diameter rotary conditioner. There follows a complex system for screening and conveying special sugars for packeting and/or bulk loading. A single bagging point is included at this stage.

Boiler house

In one building there has been housed three boilers, control room, turbo-alternator and electrical distribution boards. The two main boilers, built by Clarke Chapman in cooperation with Sulzers, were designed for an output each of 50 tonnes steam per hour at 650 psi (45 bar). These boilers drive the 10MW G.E.C. alternator through an Allen turbine. Extra make-up for process steam is provided by a "Maxecon" package boiler producing 30,000 lb steam per hour at 150 psi (10 bar). This boiler is also used for off-season heating.

Power generation and distribution

Power requirements are supplied by a single turbo-alternator capable of delivering a maximum of 12 MVA or 10 megawatts at a power factor of 0·8.

The generated A.C. voltage is a nominal 11,000 volts which feeds a high voltage distribution system comprising switches and transformers.

The 11 kV high-voltage distribution system has as its source a main switchboard in the boiler house, from which it supplies the whole factory either through radial feeders and transformers or from ring-main feeders and transformers. In either case the transformers and/or H.V. ring main units are sited throughout the factory and local to the areas that they serve.

A choice of two grid supplies are also available at the main boiler house board for off-season supplies and emergency supply in the event of an alternator trip. Together with the boiler house control panel the system provides for such facilities as parallel operation, power factor control and selective tripping, etc.

Apart from the transformers, no other electrical machines are supplied directly from the 11 kV system. The Corporation's policy is to supply all A.C. motors below 175 hp at 415 volts (or lower) and A.C. motors above this rating at 3300 volts. The aforementioned transformers are therefore used to provide power at these two voltage levels.

The 3·3 kV and 415 V distribution is arranged via multi-motor control panels sited in strategically placed MMC rooms. Depending on the factory area, it is possible to have separate 415 volt and 3·3 kV MMC rooms or a single

room containing both and incorporating a high voltage ring-main unit.

The 415 V MMC panels are a combination of motor starter cubicles, small power and lighting distribution switches, etc., whilst the 3·3 kV panels consist, in the main, of motor starter units.

In addition to the A.C. motor drives there are a number of D.C. motor drives on such applications as diffusion towers, slicers, presses, cossette pumps, etc. These drives are speed-controlled and, again, it is present Corporation policy to use direct current motor thyristor converter controls.

The boiler-house medium voltage (415 V) board has the facility of automatic changeover to the grid supply in the event of an alternator trip-out. All factory essential services are fed from this board; perhaps the most important of these are the boiler house compressors which will continue to run, in the event of an alternator trip, to maintain the operation of the boiler controls.

A degree of emergency lighting is provided throughout the factory, supplied from battery-fed invertors, situated under the boiler house control room.

Instrumentation and controls

Nearly all of the factory instrumentation and controls are arranged in groups and designated by the various factory process stations.

These instrumentation groups or control schemes are arranged to provide indications and controls for the various batch and continuous sections of the process from central points, and, as such, are displayed in control panels which are situated in the various control rooms.

A minimum amount of plant-manned manual back-up facilities are provided for the batch operation sections of plant, i.e. filters, decalcification, vacuum pans, etc., and consist, in the main, of switches and regulators (housed in lockable boxes) to permit manual operation of the plant.

The control rooms are themselves designated by the factory areas and provide for the following process stations:—

Beet end control room.—Rotary vacuum filters, G.P. filters, lime kiln repeat, beet end general, dry fluming, beet washers, pulp presses, diffusion, supervisory and carbonatation.

Lime kiln.—MMC room with weigher panel and controls.

Sugar end control room.—Vacuum pans (white, raw and AP), sugar end general, standard liquor filters, decalcification, sulphitation, dissolver, thick juice storage, slicer control panel and dryer controls.

In addition to the above there are various smaller control rooms containing panels with instrumentation and controls for other sections of the factory, viz. dry silo fluming, sugar silo air conditioning, sugar conveying and screening, etc.

The instrumentation used in Newark factory is essentially the electronic type and the majority of Fischer and Porter manufacture.

Where possible and practical, use is made of electronic transducers to provide the various plant primary measurements, i.e. tank levels, temperature, pressures, flows, density, pH, electrical current, electrical power, etc.

The transducer, mainly of the blind type, with no local display, converts the process parameter to an electronic signal, in our case 4-20 mA D.C., for either display or control purposes. Where pneumatic primary measurement transducers are used, then a further transducer converts the pneumatic signal to the above electronic signal.

The signals appear on the various panel instrumentation to provide information and to enable automatic control of the process. Various types of display instrumentation are used, e.g. strip indicators, deviation controllers, manual loading stations, etc.

Where the panel instrumentation is for continuous control purposes, then the controller provides a signal to enable modulation of the final control element. In the main this element is a control valve providing regulation of the process variable. However there are exceptions, viz. slicing machine drive motors and various other speed controlled electric motors.

The majority of control loops have pneumatically-operated final control elements. However, a number of the vacuum pan valves are the exception and take an electronic signal and pneumatic power; in either case the signal from the controller, converted to pneumatic either before or at the valve, provides for its regulation.

Associated with the intrumentation are various other indications, alarms and controls. These consist mainly of the illuminated push-button stations for electric motor operation and indication, push buttons and switches for the operation of the non-continuously controlled sections of process, alarm annunciation displays, etc.

Electrical power for the instrumentation and controls is derived from transformers and rectifier power packs contained in either equipment rooms adjacent to the control rooms or in the control panels themselves.

Pneumatic power is provided by electric motor-driven air compressors supplying a factory air distribution ring-main feeding various air distribution racks.

Two further aspects of the factory instrumentation and controls are the closed circuit TV system, which provide coverage of such areas as dryers, beet hopper, the dry silo, wet silo, and beet gate in the yard, and the mud thickener/tails plant with monitors mounted in the dryers control panel and beet end control room panels and the microprocessor control systems, used for the first time at Newark, for the automatic control of sugar boiling.

Five MPC80 microprocessor-based control systems were installed at Newark for the 1977/78 campaign. Each MPC80 is capable of multi-loop three-term control and sequencing. The main programmes for these systems are stored on UV erasable PROM devices. Each MPC80 was used successfully to control the boiling operations of two sugar pan sequences. The input, output and control facilities for each MPC80 are as follows: 16 analogue inputs, 12 analogue outputs, 32 digital inputs, 48 digital outputs, 8 single-term loops, 8 three-term loops, and 8 filter blocks.

Each MPC80 incorporates the facility for on-line editing, communication, with a teletype and reader/punch, and portable engineer's console.

GENERAL INFORMATION

Insulation

It was decided at the outset to use isocyanurate foam for insulation wherever possible. This material has a

high fire resistance and low smoke emission. It is resistant to most chemicals and will not absorb water. By comparison with mineral wool and glass fibre, it has a higher compressive strength and a lower "K" value. It can also be used up to temperatures of 150°C which makes it useful anywhere in the factory from turbine exhaust vapour lines onward.

All pipes and vessels were, therefore, insulated with this material, covered with 30-gauge polished aluminium sheet. On pipes, preformed or cut pipe, sections were used, depending on the supplier. Insulation thickness was as follows:—

1½ in–3 in bore pipe.....¾ in thick
4 in–8 in bore pipe ..... 1 in thick
9 in–12 in bore pipe .....1½ in thick
Over 12 in bore pipe .....2 in thick

For compound curves isocyanurate sheet can be specially cut. This is, however, very expensive and so, on vessels such as evaporators, the dished tops and bottoms were insulated with high density mineral wool held in position with wire netting before covering with the aluminium. In the latter instance, 3 in thick material was used. The overall result of the lagging is a clean clinical finish suitable for a food factory, together with heat insulation efficiency.

Safety

During the design stage a lot of thought and effort was put into making Newark as safe a work place as possible. To this end every aspect of access to plant and machinery, particularly for maintenance, was carefully considered. This caused quite a number of design problems. It was sometimes difficult to position a platform without obstructing something else. Nevertheless, every drive, unless at ground level, has a maintenance platform with proper access to it.

Lifting beams have been placed at strategic points above heavy gearboxes and motors, wherever practical. In some instances for example above the vacuum pans, electric hoists have been installed to allow safe, speedy maintenance. Overhead cranes are fitted above the turbine, all centrifugals and the pulp presses.

All bought-out machinery drawings were carefully vetted to ensure that all guards were to a high specification. Most of the design was before the Health and Safety at Work Act. However, our regard to safety has paid off in as much as our specification in nearly every case satisfied the Act.

All new roofs are metal clad and therefore are sufficiently strong to support personnel during maintenance and cleaning. However, people can fall from roofs and so it was decided to: (*a*) fit all flat roofs with handrails all round; (*b*) supply a running shackle fixed to a track running along the apex of all sloping roofs. Each roof has a proper access with a platform easily reached from within the building. From this it is very easy to "hook on" a safety harness to the running shackle. Personnel can traverse the roof of a building from end to end in complete safety.

It should be noted that all this absolutely necessary safety work added considerably to construction costs

Floor construction

The traditional method of using timber shuttering fixed between steel joints before concreting floors, takes a lot of expensive timber and is very labour intensive. It was decided, in conjunction with the civil contractor, to lay out a new method. This consisted of using a metal interlocking tray made by the British Steel Corporation. The tray is colour coated on the exposed side and gives a pleasing appearance from below when installed. It is fixed to the steel beams by "Hilti" rivets. This proved to be far quicker than the traditional method; there was no timber removal afterwards and the floors could be used much sooner as the tray supported the concrete even though not completely cured, the trays providing safe access even before concreting.

A further advantage is that underfloor painting is not necessary.

Operations

During the early part of the campaign, in addition to normal teething troubles, more serious problems developed.

Stone and weed catchers, particularly the former, proved to need considerable strengthening and modification. Owing to the entry of trash and stones into the slicers, cossette quality was inevitably poor with consequent detrimental effect on commissioning diffusion plant.

In addition to this, the characteristics of the original cossette pumps were unsatisfactory when the pumps were running slowly, causing mincing-up of cossettes.

The rotary charger for the lime kiln seized, causing problems with burnt lime and milk-of-lime quality.

The reinforced concrete block supporting the drive of the wet white sugar shaker under the Broadbent centrifugals pulled away from its foundations—a most unusual and unwelcome sight with the whole block vibrating in unison with the shaker. This shaker was appreciably larger than any previously installed and the live vibratory load presumably was in excess of that calculated.

Remedial work on the shaker involved casting a massive new concrete block around the original, the two being tied together by reinforcing steel.

This work took several days and necessitated a complete factory shut-down. The opportunity was taken to carry out remedial works on stone catchers, weed catchers and other areas where deficiencies had been noted and alterations needed. Assistance with these works was given by personnel from adjacent factories. Despite this, the stone catchers needed continual attention throughout the campaign.

New cossette pumps were flown in from BMA in Germany. Even this operation had its snags. Industrial action at various airports, combined with extra inspections and a reluctance to handle large packages because of terrorist activities affecting various airlines, led to several days' delay in delivery. During this period the original cossette pumps were used, a minimum low speed setting being allowed. This meant that more circulation juice than was necessary had to be used to keep the pumps fed.

A further consequence of all these happenings was that the tower diffusers had to be pumped out through the pulp presses, following rapid works with temporary piping and on the separator installed for this purpose but not completed prior to operations.

It proved impossible to free the lime kiln distributor, so that the bottom of the chute had to be cut out to allow a more central feed of coke and stone.

Throughout the campaign, however, the kiln burned erratically and it was necessary to import burnt lime to maintain throughput and quality.

Following these initial problems, slice was steadily built up and the more normal teething troubles sorted out. We were hindered by the occasional complete loss of power due to electrical and mechanical hitches on the turbo alternator and associated switchgear.

However, following the solution of these difficulties, throughput was reaching close to 5000 tonnes per day, thick juice storage plant was being commissioned, when unexpected limitations of the boiler plant precluded further slice increase owing to shortage of steam.

The other factor limiting further progress was the beet shaker/water separator conveyor between the beet washer and elevators. Unexpected limitations in the supplier's design and assembly meant that continual repairs were necessary to this item of plant to maintain throughput at all.

There were two other major problem areas. For reasons already mentioned initial testing of beet unloading plant was not possible. Only the jacknife tipping bays were available at campaign start and various teething problems on hydraulics caused traffic problems and delays to beet lorries.

The boom of one of the main beet conveying belts collapsed early in the campaign. Urgent repairs and strengthening were carried out, fortunately completely before the second belt suffered the same fate.

A reversible belt common to both main feed systems was a continual headache and was removed during the 1978 off-season, the problem being the difficulty in tracking it in both directions combined with build-up of mud and soil.

Following these repairs and the successful commissioning of the tipping platforms lorry turn-round was basically very satisfactory.

The pulp bagging and associated bag conveying plant had been extended not long before the campaign. Late completion of electrics and consequent lack of commissioning time meant difficult operation, remedial works during campaign and the need to dispose of quantities of unbagged dried pulp.

The plant in all other areas proved satisfactory and successful, once normal starting-up problems were overcome.

The complete fluming and transport of beet from the silos to the hopper above the slicers was carried out throughout the campaign from the main beet end control room. This is a new achievement for the Corporation and worked extremely well. Some modifications to gun positions and improvement to night viewing for television cameras should facilitate the better fluming of odd pockets of beet which built up in some flumes.

The diffusion system and its controls operated most efficiently in the latter half of the campaign, especially considering the somewhat indifferent cossette quality and the number of stops and starts of the plant with which the diffusers had to cope. Evaporators gave few problems once the beet end flows were steady. Vacuum pans were very satisfactory. The condenser, vacuum and cooling tower systems gave the necessary surplus of vacuum essential to the good control and operation of the pan station.

Raw pans and after-product pans were boiled automatically, both by graining and use of magma, with the aid of microprocessors virtually throughout the campaign. Following the commissioning of the white pan system a little later, these were similarly controlled for the rest of the campaign. Various modifications to programmes became necessary, based on operating experience. Consistency of product from all pans was achieved, with beneficial effects all round. It should be noted that during the steady running periods with reasonable throughput, E.E.C. Grade 1 sugar was regularly produced.

Centrifugals were most efficient and smooth running. Schenk standard liquor filters operated smoothly, apart from a phase when the feed pumps were partially blocked with extraneous material caused by a screen failure in the remelt dissolver. Electrical and control systems throughout the factory, on which so much depended, proved the value of adequate design and installation, based on the continuous development work carried out in this field by the Corporation. It is not yet correct to state that the factory can be completely operated from the control rooms. The present Newark factory has, however, gone some considerable way towards this.

CONCLUSIONS

The 1978 off-season has seen the completion of an ambitious project—the creation of a new factory. Remedial works to problem areas are being carried out, together with improvements and the final touches to plant and buildings not done in 1977. Whilst the results of last campaign did not reach all the desired targets, the good periods showed that the factory has the capability of producing the projected results.

Appreciations are expressed to all who participated in the planning and carrying out of the project and especially to all those at Newark whose major efforts through a long and arduous period are worthy of particular mention.

Summary

A detailed account is given of the reconstruction of the Newark beet sugar factory over a period of five years, with information on the equipment installed, problems overcome and operation of the plant.

Projet de déplacement et d'extension de Newark

On présente un rapport détaillé sur la reconstruction de la sucrerie de betteraves de Newark qui a duré cinq ans. On donne des informations concernant le matériel installé, les problèmes surmontés et la marche de l'usine.

Umbau und Ausbauprogramm von Newark

Über die Rekonstruktion der Rübenzuckerfabrik Newark während einer Periode von fünf Jahren wird ein detaillierter Bericht gegeben, mit Informationen über die installierten Anlagen, die gelösten Probleme und den Betrieb der Fabrik.

Projeto del reemplazo y expansión de Newark

Se presenta un examen detallado de la reconstrucción de la fábrica Newark de azúcar de remolacha, durante un periodo de cinco años, con información del equipo instalado, problemas superadas y del operación de la planta.

SUGAR CANE AGRONOMY

Cost reduction guidelines in sugar cane production. T. R. Escober and F. I. Ledesma. *Sugar News* (Philippines), 1977, **53**, 260-268, 296-297.—Advice on reducing cane growing costs without marked decrease in sugar production is given by two representatives of the Sugar Cane Research Division of the Victorias Milling Co. The recommendations cover: land preparation, planting (including suitability of setts and varieties), fertilization, drainage, weed control, harvesting, ratooning, intercropping and transportation (with measures listed for reducing fuel consumption).

Regulating sugar cane growth for increased yields and profits. Anon. *World Farming*, 1977, **19**, (12), 28-29, 32.—Advice is given on aerial application of "Polaris" cane ripener, covering nozzle position (as governed by the airflow characteristics which are specific to each type of aircraft), nozzle angle (dependent on direction and speed of travel, and affecting the droplet size) and calibration of the equipment while the aircraft is on the ground.

Cane agronomy and plant physiology in Mauritius. Anon. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1976, 27-37.—The sugar yields from cane to which varying quantities of potassium were applied are tabulated for 9 sites representing 7 different soil types. As in previous years, a positive response was obtained, the mean maximum yield being 9·67 tonnes.ha^{-1} compared with 8·06 tonnes.ha^{-1} in the control. However, differences occurred between the results at the different sites as regards peak values as a function of application rate, and even the mean rose to a peak of 9·41 tonnes of sugar per ha at 142 kg K_2O per ha, after which it fell to 9·31 tonnes.ha^{-1} at 213 kg.ha^{-1}, then rose to 9·67 tonnes.ha^{-1} at 284 kg.ha^{-1} K_2O. Six concrete lysimeters were put under construction for studies on the uptake of ammonium nitrogen and nitrate N by cane and the leaching of these ions in the soil (the International Atomic Energy Agency is to provide ^{15}N-labelled ammonium sulphate and potassium nitrate for the purpose). Trials were carried out at four locations in which specific varieties were treated with 7·1 and 14·2 tonnes.ha^{-1} of calcium silicate or 9·4 tonnes.ha^{-1} of coral sand in 1967, then replanted in 1973 without further treatment and finally harvested in 1976 as 3rd ratoons. At only one location did the residual effect of calcium silicate disappear, whereas a marked residual, positive effect was found in the other cases, the sugar yield increasing further with the double dosage rate. At only one site did coral sand have a slight positive effect on sugar yield by comparison with the control. In studies on the sulphur status and behaviour in Mauritian soils, the total S content ranged from 286 to 878 ppm and was significantly correlated with the organic matter content. Fractionation revealed that inorganic S (mainly in the form of sulphate) constituted only 3·29% of the total S, emphasizing the importance of the organic component of soils in relation to their S status. The absence of any relationship between total soil S and cane leaf S, or between organic S and leaf S, suggests that S available for cane growth depends on the complex microbial mineralization of the organic fraction. Trials planted to study the S status of cane grown with and without S application were considered necessary because of the low S content of locally-manufactured fertilizers and the increasing depletion of S in Mauritian soils. While it has been found in the literature that cane growth is not adversely affected by soil acidity unless the saturation of the soil exchange complex by calcium is below 60%, or if its saturation by exchangeable aluminium exceeds 60%, investigations showed that these conditions are only encountered in Mauritius when the soil pH falls below 5; at pH 5-5·5 it is uneconomical to apply lime, since this will not substantially improve the exchangeable Ca status. Of those examined, the Latosolic Brown Forest soil is the least responsive to liming, but 9·5 tonnes.ha^{-1} of calcium carbonate should be sufficient to raise the Ca saturation above 60% and correct any Al toxicity. Leaf analysis for N, P and K as a function of cane age in the range 3-7 months showed that, in small planters' cane, K levels varied in an irregular manner, while N and P levels fell from excess to optimum at 5 months and thereafter were on the low side, thus indicating the need for adjustment. However, it is pointed out that, since small planters usually apply fertilizers very late in the year, the intervals between fertilization and leaf sampling is rather short, so that there is need for care in interpreting the results. Results for estate and large planters' cane indicated a satisfactory P status, while extreme deficiencies of N and K were infrequent. Tests were carried out to establish whether different types of cane knives would be better than the conventional billhook type used in Mauritius. Results showed that a long-handled type very similar to that formerly used in Queensland gave the best performance, followed by a long-handled type previously used in Louisiana, after which came a short-handled South African knife and finally the Mauritian type. In drip irrigation trials, best results in terms of cane and sugar yield were given by a system where the drip-tube lines were laid along every cane row at an inter-row width of 1·62 m. Next best was a system in which the inter-row widths were alternately 0·97 and 2·26 m and the lines were laid between the cane rows where the wider inter-row spacing occurred. Laying the lines between the cane rows in alternate inter-rows of 1·62 m spacing gave the poorest results of the schemes investigated, although they were still better than those given by surface irrigation, while the latter improved markedly on the values for the unirrigated control. There was no interaction between variety and irrigation treatment. "Polaris" ripener sprayed from a helicopter at rates of 3, 4 and 5 kg.ha^{-1} increased cane pol and reduced fibre % dry matter, the maximum response in most trials occurring 6 weeks after application and continuing up to 9 weeks after spraying. The effects tended to increase with dosage rate, although at the highest rate yellowing and scorching of leaves took place and lateral bud development was inhibited. There were fewer water-shoots at harvest in treated plots, particularly as a result of the highest dosage rate. While good response to "Polaris" is obtainable even in high rainfall areas, the interval between application and subsequent rain was found to be a critical factor; since complete absorption of the

ripener may take at least 4 hours, any rain within that time will cause wastage of the chemical by washing it from the leaves and so reduce its effectiveness. The effect of spray volume at two concentrations was also studied,whereby cane response was inversely related to the application rate, indicating better absorption at higher concentrations, possibly because of run-off when high volumes were used. In an investigation of the relationship between cane flowering and yield of a 1st ratoon crop, pol in flowered cane was greater than in vegetative cane, both increasing with date of harvest, which also affected fresh weight and sugar yield. Environmental factors affected mainly pol, while age of crop was the least important of the three factors affecting cane performance. The effect of harvest date on the partitioning of dry matter in plant cane grown in four contrasting environments was investigated, whereby it was found that partitioning was influenced by harvest date and variety but not by environment; sucrose % fresh weight increased with later harvests as a result of increase in dry matter content, partitioning of dry matter in favour of sucrose, and conversion of reducing sugars to sucrose, but there was no evidence of desiccation. The varieties studied showed marked differences in ripening. In maturity trials, variations in fresh weight yield were due to variety, harvest time and environment, of which variety was the least important factor. The same three factors affected variations in sucrose content expressed on a fresh weight basis, harvest time having greatest influence, while variety was again the least important. On the other hand, variety was as important as environment when the sucrose content was expressed on a dry weight basis, indicating that environmental variations of sucrose expressed on a fresh weight basis partly result from differences in moisture content. Sugar yields were therefore influenced mostly by environment and harvest time, although the effect of variety was also highly significant.

Drainage and flood mitigation problems in the North Queensland sugar region. D. W. Beattie. *Producers' Rev.*, 1977, **67,** (12), 11-20.—Between 1955 and 1974 cane sugar production in northern Queensland rose by only 19·1% compared with an average of 39·6% for the entire state. The poor performance is attributed in part to inadequate drainage in an area notorious for its high annual rainfall and to flooding caused by heavy torrential rains. The effects of flooding on cane are described and reasons for the poor drainage examined. A general study of the problem was undertaken by the Irrigation and Water Supply Commission (which the author represents) with the aim of establishing a programme of further detailed investigations in each of the problem areas identified and of putting forward proposals for remedial work and calculating the costs involved. The results of the study are discussed, whereby it is concluded that flooding causes the loss of such a small proportion of the total cane harvested that remedial measures would be financially justifiable in only 8 of the 44 areas (totalling 42,860 ha) requiring improvements in drainage (although in another 18 areas flood mitigation would make the drainage measures more effective); improvements in drainage in the assigned areas would result in marked increases in sugar yield.

Land utilization in the Maryborough region (of Queensland). A. Hegarty. *Producers' Rev.*, 1977, **67,** (12), 28-31.—The agricultural uses of land in the region are discussed, with particular mention of cane growing (for which 41% of the crop area is utilized). The development of irrigation is described in connexion with cane and other crops, and the land use capabilities of a total area of 203,900 ha examined. In a particular study, 9423 ha out of a total of 19,100 ha was found to be suitable for cane growing under irrigation, whereas only about one-third of the area is in fact being used for cane.

Need for sulphur fertilization in sugar cane. B. S. Nadagoudar and G. V. Lokeshwarappa. *Indian Sugar,* 1977, **27,** 381-383, 386.—Reasons for S deficiencies in crops are examined and the function of S in plant growth and metabolism indicated. The S requirement of cane and effects of its deficiency are discussed, and factors affecting its oxidation in the soil are considered. Brief mention is made of S losses from soil by leaching and of cane response to S.

Construction aids for building efficient drains. A. I. Linedale. *Cane Growers' Quarterly Bull.*, 1978, **41,** 60-61. Various aids for construction of drainage systems having the right dimensions and gradients to give maximum efficiency are described.

Deciding between mixtures or straights. G. R. Cullen. *Cane Growers' Quarterly Bull.*, 1978, **41,** 67-68. The pros and cons of using straight fertilizers or mixtures are discussed. Mixtures have the advantage of convenience while straight fertilizers are less expensive, but it is pointed out that the cost advantage of the latter can be lost by greater transport and application expense, etc., so that all factors should be considered before a decision is made.

Abandoned cane a continuing threat to commercial crops. J. Wright. *Cane Growers' Quarterly Bull.*, 1978, **41,** 76-78.—The threat which abandoned cane poses to commercial cane is discussed. Major areas of abandoned cane in Queensland remain from previously assigned cane areas, while isolated cases involve cane which spilt during transportation or is growing on headlands, in drains or gullies. Among measures suggested for elimination of the cane are ploughing-out, intensive cattle grazing, hand digging with a mattock and spraying with "Glyphosate" (which at 5·4 kg.ha^{-1} killed 90% of the stools in a trial).

Strip trials help farm practice assessment. Anon. *Cane Growers' Quarterly Bull.*, 1978, **41,** 81-83.—The value of strip trials as an easy method of evaluating the effect of a specific treatment on cane yield is discussed, and application of calcium silicate (cement) used to demonstrate how to evaluate the results. The strips should extend the length of the cane block and a minimum of two treated strips separated by at least the number of rows used in each strip; an 8-row strip is preferable in most cases, the 4 centre rows being used for observation and yield calculation, while the 2 rows on each side of the centre rows act as guard rows to lessen the effect of one treatment on another. Comparisons should be made in one block in the same year, and the location of the trial strips should be indicated by permanent markers.

SUGAR CANE MECHANIZATION

Wheels collapse on new bin trailer. Anon. *Producers' Rev.*, 1977, 67, (10), 41.-Details are given of a bin trailer designed by a Mr. G. Hickling for use in wet weather but which, unlike many "home-made" wet weather systems, still carries the rail bin to the harvester for filling. An important feature is the arrangement whereby the back wheels collapse outwards to allow the bin to be winched on; the wheels are held in place by gravity under normal movement. At the rail siding, the wheels are held in two concreted holes, one on each side of the tramline, while the trailer is being reversed. Rollers on the back of the bin engage the tramline, and the wheels collapse under the effect of weight. The bin is then winched on between the spread wheels. The system allows full-sized tractor tyres to be used, and, since the bin comes to rest at a low slung level with its weight evenly spread between the rear axle and the tractor, the rear wheels exert less than 25% of the normal ground pressure. Another unusual feature of the system is a high-clearance, goose-neck hitch for maximum manoeuvrability, which permits the tractor to be turned through about 340°–a factor of some advantage in confined spaces.

Automatic planting. C. Morton. *Producers' Rev.*, 1977, 67, (11), 73-76.-The requirements of a suitable mechanical cane billet planting system are discussed, including the need to reduce damage to roots in harvesting of the seed cane and in transfer to the planter trailer (which should be direct from the harvester and not via a side-tipping transporter). Since the mass of material to be planted per cane is considerable and there is little room in the bottom of the drill to take it, there are occasions when one cane is planted on another; to avoid this, it is recommended that the drill be widened, which would also allow better soil coverage. The question of nutrition is briefly discussed, wherein it is suggested that occurrences of lack of phosphate may be a result of damage to cane and subsequent poor root development. Possible planter design features which would minimize cane damage are outlined.

Harvesting of sugar cane. E. Cerrizuela. *Serie Did. Fac. Agron. Zootecn. Univ. Nac. Tucuman*, 1977, (43), 34 pp. *(Spanish).*- *In* Tucuman only 15% of the cane is estate cane, the rest being supplied by 20,000 growers; organization of regular supplies is thus a complicated task. Most cane is harvested manually but semi-mechanized systems are being adopted by the larger growers. A history of mechanization is outlined, and a description is given of the main types of harvester. Types of loader are surveyed, as are the various transport systems and means of cane handling at the factory, cleaning of mechanically harvested cane, problems arising, losses, soil compaction, etc. A bibliography of 23 references is included.

Twin-bin cane hauler. Anon. *Australian Sugar J.*, 1977, 69, 401–403.—A cane hauler having a capacity of 9 tonnes of cane is provided with two bins, one of 5 tonnes capacity at the front and one of 4 tonnes capacity at the rear. Designed by Mr. B. Newton, the unit is attached to a tractor by means of a goose-neck hitch. At the transfer point, the front bin is hydraulically raised and the cane tipped onto a 1 m wide conveyor belt mounted before it; the cane is then fed by the conveyor into the factory bin. The hauler bin is then lowered, and cane tipped into it from the hydraulically raised rear bin, after which the cane is transferred to the conveyor belt as before. The complete operation is designed to take only $1\frac{1}{4}$ minutes. For operation under adverse field conditions, the hauler is fitted with large tyres which are filled with air instead of water to give a weight reduction.

Crichton over-row harvester. Anon. *Australian Sugar J.*, 1977, 69, 406-407.-Information is given on an over-row chopper harvester manufactured by Mr. G. Crichton. It is provided with a floating base cutter which is so fitted on a spring head that stones and other foreign bodies are swept aside to allow only the cane stalks to enter the knives after being lifted by the gathering tines. The base cutter merely slides over the top of embedded stones. The conical cover at the top of the cutter also prevents build-up of trash. The elimination of extraneous matter from the feed increases the life of the chopper blades, while the gathering chains, not running directly on the ground, will cut about 20,000 tonnes of cane before replacement, in contrast to about 2000 tonnes under good conditions with conventional harvesters. Maintenance costs of a Crichton harvester which has operated for two seasons, cutting more than 7000 tonnes of cane, were minimal. The cane loaded into bins was remarkably clean, despite the absence of extractor fans.

New Mackay cane haul-out hopper. Anon. *Australian Sugar J.*, 1977, 69, 418-419.-It is stated that the trend to larger factory cane bins is not without a problem, *viz.* that of loading them onto trailers, for which winching is becoming necessary. However, the "Elecane" haul-out cane hopper, which is briefly described, is designed to load rail trucks where they stand. The tailgate is moved forward by a special precision thread screw running the entire length of the 12-tonne capacity bin. As the tailgate moves, it pushes the cane forward towards a transverse conveyor in the floor of the hopper. The conveyor transfers the cane to an elevator at the side of the hopper which is adjustable at an angle so as to permit the cane to fall from the top into the rail truck with only negligible spillage. Structural strength is afforded by a beam which acts as a monorail to absorb the thrust of the moving tailgate as well as acting as a massive backbone. The hopper may be mounted on a haul-out trailer, truck-mounted, or in the form of a self-propelled tracked or articulated transporter. It has been patented by Mr. J. Seip, a former cane harvesting contractor.

Cane mechanization in Mauritius. Anon. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1976, 37-43.- Trials to determine the effects of harvesting and loading methods as well as cane burning on the amount of gross cane, total net cane and sugar sent to the factory

showed no significant differences in the values of the parameters or yield factors as a function of treatment, whereas differences in the amount of scrapped cane were significant. The quantity of extraneous matter was significantly greater when mechanical rather than manual loading was used. Use of a McConnel harvester gave a total sugar yield which was greater than with manual harvesting, and harvesting of green and burnt cane gave almost the same sugar yields. Results for 1st ratoon cane of M 356/53 variety showed significant differences in gross cane sent to the factory, total gross cane yield and extraneous matter % cane sent to the factory between (*i*) manual harvesting and loading of green cane, (*ii*) manual harvesting and loading of burnt cane, and (*iii*) mechanical harvesting and loading of burnt cane. A significant difference in the gross cane sucrose content was found between treatments, but not in the amount of sugar sent to the factory. A Japanese NB 8 hand-driven windrower harvester developed for small farmers in Okinawa cuts green or burnt cane at the base and windrows it without topping. In a small number of trials, it was found to give satisfactory cutting where the cane was relatively erect and not too heavy and where ground conditions were suitable. Trials are reported in which mechanical planting plus application of 533 kg.ha^{-1} triple superphosphate in the furrow was compared with manual planting plus the same quantity of superphosphate or plus 19 tonnes.ha^{-1} factory mud in the furrow. Sub-plot treatments involved use of a rotary hoe plus application of 23·7 tonnes.ha^{-1} mud or 533 kg.ha^{-1} triple superphosphate. Sugar content and yield were highest when manual planting plus superphosphate application was used without any sub-plot treatment. Rotary hoeing with superphosphate application gave the next best figures when coupled with manual planting, although even when used in conjunction with mechanical planting it still gave better results than the other treatments. While no significant differences in sugar yields between furrow, flat ground and ridge planting were found in trials at two sites, at another significantly greater yields were obtained with furrow and flat planting. In 3-year investigations of the effect of mechanical loading on ratoon growth, cane yields were greater with mechanical than with manual loading.

New developments in local cane harvesting equipment. Anon. *S. African Sugar J.*, 1977, **61**, 599.—Three new developments in cane harvesting are briefly described. In the interrupted windrow system, each bundle of cane in a windrow is picked up by the loader grab using a pincer-type action so that the cane is lifted as cleanly as possible from the ground; where a bundle does not constitute a full grab load, it is placed on top of the next bundle in the line and the two picked up together. While a certain amount of practice is needed on the part of the driver before he becomes sufficiently skilled, the system reduces extraneous matter by comparison with the push-piling type of action generally used by drivers. The second development is the addition of a high-lift attachment to a Bell loader which enables the grab to attain a height of more than 4 m. The third modification described is a rotary cane flinger attached to the guide arm of the harvesting attachment on a Bell machine; it moves the cut cane off the cutting blade as quickly as possible and lays it in a neat, continuous windrow, thus eliminating the need for the swinging motion of the machine. Moreover, the cut cane is left with its butt ends in a reasonably straight line, so that topping is made more effective and accurate.

Early warning system works. Anon. *Producers' Rev.*, 1977, **67**, (12), 50.—Information is given on a cane harvester provided with a set of shaft monitors connected to an alarm box in the cab and which give an early warning of a cane blockage and foreign material such as sticks and stones in the feed train *before* a major jam occurs. When the shaft speed changes, the monitor light in the cab goes out and an audible alarm sounds. Without the monitors, the throat of the harvester had to be full of cane before a blockage was noticed and considerable mutilation of the cane could occur. The monitors also provide early warnings of faults in the hydraulic system.

Cane haulage: developing new infield tipper units. R. B. Newton. *Producers' Rev.*, 1977, **67**, (12), 52–54. Problems encountered with infield cane transport in Queensland are discussed. While the small-diameter, relatively narrow wheels used on existing trailers cause soil compaction, so that it would appear logical to replace them with larger tyred wheels, such wheels would have to be placed at the side of the trailer, which would thus become too wide. The alternative solution of devising a long trailer and placing the bin in front of the trailer wheels presents a number of mechanical problems, however. Hence, the need is for a tipper unit having a self-unloading bin; a trailer designed and manufactured by the author's company is of this type and has a capacity of 4 tonnes of cane. Stability is good and soil compaction very much reduced; the latest design has a narrower bin to reduce spillage and drop the centre of gravity, while letting the wheels into the bin configuration keeps the bin nearer to the rear axle, promotes stability and allows removal of weights and water from the wheels of the towing tractor. The advantages of funnels mounted on the tipper units to prevent spillage are briefly mentioned.

Tests show billet planter sound but can be improved. C. M. McAleese. *Cane Growers' Quarterly Bull.*, 1978, **41**, 85–86.—Tests on an automatically fed cane billet planter are reported. Results showed that the planter (which requires only two operators) performed satisfactorily but that there is need for reduction of damage to the cane eyes by the harvesters supplying the cane, which would increase the germination percentages. Other minor problems are also mentioned.

Cane trailer modifications for muddy conditions. Anon. *Australian Sugar J.*, 1977, **69**, 449–451.—Illustrations are given of a cane trailer modified to combat the problem of soil compaction in muddy cane fields. The axle frame has been extended to give a more effective weight distribution of the trailer, while the cane bin rides between the wheels and not above them, as previously. In addition, the tyres used for the trailer are large low-pressure pneumatic ones as used on the rear of tractors and having a special tread designed for wet weather conditions. Although the wheel pits at the rail sidings have to be wider and deeper to cater for the modified trailers, the great width of which prevents their use on public roads, reduction in soil compaction has resulted, as is clearly shown by an illustration.

CANE PESTS AND DISEASES

Sugar cane diseases and the three-tier seed programme. K. Singh. *Sugar News* (India), 1977, **9,** (6/7), 81-89.—The situation in India as regards red rot, wilt, smut, mosaic, grassy shoot and ratoon stunting disease is reviewed. The author considers that chemical control is hampered by the protection provided by the cane rind to the pathogen once it is inside the cane and by the barrier created by the nodes, which prevent chemicals moving smoothly from one internode to another, so that diseases can spread from one place to another with seed cane. Hence, it is felt that heat therapy offers the only hope of combating disease. The three-tier system of seed cane production includes foundation seed, which is raised from heat-treated material; the crop raised from this cane is taken as certified seed to first multiplication plots which in turn provide, in the third year, planting material for the second multiplication plots where commercial seed cane is produced. A planting technique has been developed for boosting the tillering capacity of the cane bud and thus substantially raising the stalk output per bud. Known as "spaced transplanting", it involves vertical planting of single-bud setts in a 20 m^2 nursery plot one month before normal planting. The sprouted setts are then vertically transplanted in the field, 1 ha of land requiring only 12,500 setts or about 1·2 tonnes of cane in contrast to 6-7 tonnes per ha with conventional planting. Brief mention is made of the need to maintain the moisture content of the setts to create a good, healthy stand; steeping the setts in fungicide solution is recommended, while treatment with "Malathion" by soaking or (preferably) swabbing before planting is also advocated as a measure against mealy bugs and scale insects.

Seed piece transmissible sugar cane diseases and their control measures. V. P. Agnihotri and K. Singh. *Sugar News* (India), 1977, **9,** (6/7), 90-95.—Symptoms and methods of control are given for red rot, smut, wilt, grassy shoot, ratoon stunting and mosaic.

Influence of cultural/agronomic practices and varietal characters on the control of pests and diseases. K. C. Alexander and H. C. David. *Sugar News* (India), 1977, **9,** (6/7), 103-108.—The control of pests and diseases by agronomic practices is discussed, each practice being described individually, and the positive role played by varietal selection examined.

The I.I.S.R. moist hot air treatment plant for seed cane. N. S. L. Srivastava, K. Singh and M. P. Sharma. *Sugar News* (India), 1977, **9,** (6/7), 96-102.—A description is given of a unit developed at the Indian Institute of Sugarcane Research for treatment of 2-m lengths of cane with steam-saturated air at 54°C for 4 hours for control of grassy shoot, ratoon stunting and red rot. Treatment has no adverse effect on germination. The economics are compared with those of hot air and hot water treatment.

Cane diseases and pests in Mauritius. Anon. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1976, 43-50. Mention is made of the general disease situation in Mauritius and of trials to determine the resistance of new cane varieties to specific diseases. A method for detecting latent leaf scald infection was tested on 30 stalks showing severe, mild or no symptoms taken from 10 diseased stools; the leaf and stem tissues from each stalk were macerated in sterile water for 2 hours, after which the suspensions were centrifuged and the resultant sediments used for inoculation of three young shoots of a potted susceptible variety. The inoculations gave positive results for the 20 stalks showing disease symptoms and for 8 of the 10 stalks not exhibiting symptoms. For serological detection of the disease, an anti-serum against an isolate of the leaf scald pathogen, *Xanthomonas albilineans,* was prepared by intravenous injection of a rabbit with the bacterial serum. Good serological reactions were obtained with the bacterial antigen by agar gel diffusion, tube precipitin and micro-agglutination tests. No reaction was obtained with other bacterial pathogens, *viz. Xanthomonas vasculorum* (gumming disease), *Pseudomonas rubrisubalbicans* (mottled stripe) and *P. solanacearum.* The serological detection of the disease in cane tissue is under investigation. As a preliminary to studies on the causal agent of chlorotic streak, some success was achieved in growing excised roots from diseased and healthy plants in aseptic liquid culture. Despite the curative effect of hot water treatment for 20 minutes at 52°C, however, diseased cuttings after treatment did not show such vigorous growth as healthy cuttings. Heat treatment to control gumming disease was also investigated. Treatment of 3-bud setts at 52°C or 54°C for 20 minutes on one day increased tolerance to longer treatment the next day (52°C for 2 hours or 54°C for 1 hour) as indicated by % germination. However, since the pathogen has been found to resist a treatment of 58°C for 1 hour and increase in the 2nd day treatment beyond 54°C proved lethal to the setts, the treatment does not appear to be a suitable method of control. The bacterium associated with ratoon stunting disease was detected by phase contrast microscopy in three varieties showing nodal symptoms of the disease, and its presence was confirmed by electron microscopy at Rothamsted Experiment Station in the UK. Inoculation of juice from diseased plants into 20 uprights of *Pennisetum purpureum* (elephant grass), using a method devised in Brazil, did not reproduce symptoms of the disease, as was also the case when heat-treated cuttings of a susceptible cane variety were used as uprights. Moreover, the associated bacterium could not be found by microscopy. Two strains of Bana grass, a *P. purpureum* × *P. typhoides* hybrid, which have given excellent results in South Africa with the inoculation technique, have been introduced. Trials on pineapple disease control with fungicides showed that "Bayleton" was as good as the standard fungicides, "Aretan" and "Benlate", in terms of % germination at any of the three concentrations used, while results with "Topsin M" were comparable to those with the standards at 0·1% and "Tillex" at 0·25 and

0·5% concentration. None of the chemicals adversely affected growth at the concentrations used. The effectiveness of sett treatment with three dosages of "Aretan" and "Benlate" in two mechanical planters was tested; with the "Don" planter the setts were dipped, while with the "Waletz" they were sprayed. Complete immersion of the cuttings with the "Don" planter gave satisfactory results, whereas the sideways spraying used with the other planter was ineffective and gave very low germination (only 4%) of the cuttings when planted in beds inoculated with the pineapple disease organism. At the Plant Pathology Dept. of Rothamsted Experiment Station, C. Ricaud managed to isolate the characteristic duplex particles of the streak virus from cane leaves by differential centrifuging, but the yield was too low and further purification could not be attempted. Serological tests by agar gel diffusion to compare the local strain of the virus with that from Kenya showed that the former strain did not react with the cane streak antiserum when either crude sap or partially purified extract was used; slight reaction was obtained with diluted maize streak antiserum, particularly when purified extracts were used, but the results were erratic and the reaction less positive than for the Kenya cane strain antigen. In a long-term experiment to determine if cane is adversely affected by heavy spraying of potatoes with "Dithane M-45" fungicide in cane inter-rows, there was no effect on cane yield up to the 1st ratoon crop; microbiological examination of the soil did not reveal any difference between treated and untreated plots. About 450,000 of the parasite *Aphytis mytilaspidis* of the armoured scale insect *Aulacaspis tegalensis* were released in 1975-76 in various localities where the pest is troublesome. The parasite was later recovered in the field on several occasions, indicating that it was becoming established, but definite evidence that it has adapted itself to local conditions is awaited. In work on the sex pheromones of the stem borer *Chilo sacchariphagus* it was found that the attraction of males to females is governed by two components of the female pheromone, and the attractiveness in the field of vials containing different ratios and total loadings of synthetic material of the components was tested. After levels of both factors had been found which were highly attractive to males, an experiment was begun to monitor population changes during crop growth using water traps containing pheromone-loaded vials as attractants. An important cane pest which has reappeared in Mauritius cane fields is the soft scale insect *Pulvinaria iceryi,* which infests the leaf blades, although is sometimes found on the leaf sheaths, and causes chlorosis and premature death of the leaves; only a few insects are needed to induce the leaf symptoms. The abnormal colour of the affected leaves differs with cane variety, but often there is a distinctive ochraceous hue with or without purple suffusions. Moderate-to-severe infestation stops growth and kills the shoots; younger shoots, whether of virgin or ratoon cane, succumb most readily. Affected plants do not seem capable of recovery, even if the insects disappear, and the surviving shoots remain stunted. The outright death of plants is a frequent result of infestation. Many natural enemies of the pest have been found, including a fungal disease, hymenopterous parasites, predators and a Cecidomyid fly whose larvae develop entirely within the egg sac of the scale insect. The incidences of these enemies varied from place to place, while hyper-parasites were frequently found attacking the hymenopterous parasites. Many common grass weeds proved to be alternative hosts of the pest. Infestations have also occurred in Réunion, but the outbreak in Mauritius is considered only a temporary phenomenon, probably linked with weather, and natural mortality is expected to cause a recession, although in 1976 the attacks were increasing and appreciable losses in the 1977 crop were expected.

Leaf scald in 40 per cent of Burdekin farms. I. T. Freshwater. *Cane Growers' Quarterly Bull.,* 1978, **41,** 65-66.—While most of the leaf scald outbreaks reported on 300 farms in the Burdekin area of Queensland were of minor importance, several blocks were found in which the disease caused a monetary loss, and basic control measures initiated by the Bureau of Sugar Experiment Stations in 1977 need to be maintained for some time. The major step discussed is the replacement of Q 63 variety with Q 96.

Two surveys in the Fiji disease area. P. A. Jones. *Cane Growers' Quarterly Bull.,* 1978, **41,** 83-84.—Information is given on two surveys being conducted in the Bundaberg area of Queensland to establish actual losses resulting from the Fiji disease outbreak. One is aimed at determining the effects of the disease on the cropping ability of particular blocks of N:Co 310 cane (which constituted 96% of the cane grown locally in 1976 but which is also highly susceptible to the disease and so is gradually being replaced), while the other is to establish the different plough-out strategies adopted by farmers for diseased cane.

Blady grass a source of leaf scald infection? Anon. *Cane Growers' Quarterly Bull.,* 1977, **41,** 87-88.—There is evidence that *Xanthomonas albilineans* (leaf scald) can survive for some time in *Imperata cylindrica* var. *major* (blady grass). In a specific case in 1975, the diseased grass had been growing next to infected cane which had been removed some years before, and there were no leaf scald-susceptible varieties growing on the farm when the diseased grass was found. More recently, specimens of the grass showing typical leaf scald symptoms were collected from a farm and revealed the presence of the pathogen, whereas records showed that leaf scald had been last found in cane on the same farm in the 1960's.

Leaf scald trials. Anon. *Cane Growers' Quarterly Bull.,* 1977, **41,** 88.—Five leaf scald trials involving 542 cane varieties have been planted at the Pathology Farm of the Bureau of Sugar Experiment Stations. In an attempt to develop leaf scald symptoms under controlled conditions, infected canes suffering from moisture stress were exposed to a night temperature of 5°C and normal day temperatures for one week. Although a distinct band of cold chlorosis was induced in the treated canes, they failed to develop leaf scald symptoms in the leaves during or after treatment, although previous experiments had revealed the development of strong internal stem symptoms of the disease as a result of the same treatment.

CANE BREEDING AND VARIETIES

Viability of buds of sugar cane cuttings. D. A. C. Frazão, J. D. Costa and O. P. Godoy. *Brasil Açuc.*, 1977, **90,** 317-325 (*Portuguese*).—Cane of variety CB 41-76 was harvested and cut into one, two and three-budded setts which were planted the same day and after 7 and 14 days, to find the effect of delay on germination and speed of emergence. The trials included cane planted in January/March for harvest at 18 months and cane planted in September/October for harvest at 12 months. The results showed that the germination of setts planted in January/March was not affected by a delay of up to 7 days, while young buds permitted better storage than old buds (from lower parts of the stalk), giving higher speeds of emergence when planted at both periods. When planted the same day, the position of the buds on the stalk did not influence germination percentage. Except for the youngest buds, germination was markedly reduced by a delay of 14 days before planting.

A search for essentials in breeding and evaluating sugar cane varieties. G. Arceneaux. *Sugar J.*, 1977, **40,** (5), 16-21.—A survey is presented of cane breeding, starting from the work carried out in Java which culminated in the breeding of POJ 2878. It is stated that results of studies on ancestral derivation have shown that the parental background of present commercial varieties represents only a small fraction of all possible sources and that a number of breeders are of the opinion that little further can be expected from conventional breeding methods; one possibility is the widening of the genetic base by crossing *S. officinarum* with *S. spontaneum* germplasm. The possibility of increasing cane productivity by means of conventional breeding methods is examined, and the importance of breeding for disease control discussed. Flowering induction is briefly considered, and problems in estimation of sugar yield in varietal trials (particularly using the VCF system[1]) explained. References are made to the achievements in cane breeding in a number of countries, and to the contributions made by certain breeders to plant improvement. The opportunities and risks in varietal selection are discussed.

Status of the Philippine sugar cane germplasm collection. A. T. Barredo and T. R. Escober. *Sugar News* (Philippines), 1977, **53,** 241-254, 297.—Despite the fact that over 62% of the total sugar cane area in the Philippines is planted with high-yielding varieties, since 1956 there has been a steady decrease in the cane and sugar yields per ha. It is considered necessary to increase the cane breeding programme, for which there is need to increase the present germplasm collection in the Philippines (567 accessions compared with 2156 in the world collection at Canal Point, Florida, and Beltsville, Maryland). An expedition to collect wild clones was made in the Philippines; of 302 clones, 16 were *Saccharum officinarum*, 1 *S. robustum*, 274 *S. spontaneum*, 1 *Erianthus arundinaceus* and 10 *Miscanthus* spp. Further means of expanding the germplasm collection are discussed, as well as the question of disease prevention.

CoC 671—an improved sugar cane variety suitable for early crushing in Tamil Nadu. A. K. Kadirvel and G. Devaraj. *Indian Sugar Crops J.*, 1977, **4,** 38-39.—In plant and ratoon crops, CoC 671 proved better than the standard high-yielding, high-sugar variety, Co 658, as is shown by a table of results for the years 1972-75. The new variety, which is an early-season one, is briefly described.

Stability and adaptability analysis of sugar cane genotypes. I. Interactions within an experimental site. J. A. Mariotti, E. S. Oyarzabal, J. M. Osa, A. N. R. Bulacio and G. H. Almada. *Rev. Agron. Noroeste Argentino,* 1976, **13,** (1-4), 105-127 (*Spanish*).—Regression analysis was carried out on yields obtained with 28 varieties grown over five crops (plant and four ratoons), each with a minimum of three replicates, in order to determine "stability", defined as capacity to show a highly predictable response to the environment. This response varies markedly with genotype but tends to be linear, even with low regression coefficients, while increasing age of the plant cane gives decreasing stability with respect to both cane and sugar yield per ha and sugar % cane. These two factors are both highly repeatable traits between crops within an experiment; stability is moderately highly repeatable, while regression shows a near null repeatability. The apparent positive association between yield and stability is very favourable as regards varietal selection.

CoA 7701—a suitable substitute for Co 997. K. K. P. Rao, B. Gopalam, J. P. Rao, B. J. Rao, K. L. Rao and G. V. S. Rao. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 1-Ag. 10.—CoA 7701, produced by crossing Co 419 with Co 62174, was compared with the standard early-maturing variety Co 997 (grown on nearly 34% of the cane area in Andhra Pradesh) and with Co 419, a local standard variety, over a 3-year period. Tabulated results show that at 10 months, CoA 7701 outyielded Co 997 in both cane and sugar, while it was less susceptible to smut and red rot than were both of the standard varieties. Under natural conditions it was also found to be free from rust. Like Co 997 it was drought-resistant and non-flowering. It is therefore recommended as a replacement for Co 997, especially in areas where red rot is endemic.

CoA 7602—a new promising red rot-resistant variety. K. K. P. Rao, B. Gopalam, J. P. Rao, Y. Satyanarayana, B. J. Rao, J. S. N. Raju and K. L. Rao. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 111-Ag.118. Varietal trials are reported in which CoA 7602 gave a higher sugar yield than did Co 975, a commercial variety also resistant to red rot. However, since Co 975 tolerates waterlogged conditions, it should continue to be grown where appropriate, while CoA 7602 should be grown where its drought-resistant property is of value.

[1] Arceneaux: *I.S.J.*, 1976, **78,** 86.

SUGAR BEET AGRONOMY

A comprehensive study of the problem faced while introducing commercial cultivation and processing of sugar beet in Sri Ganganagar, Rajasthan and remedies suggested thereon. N. Mukerji. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 39-Ag. 45.—Beet was first processed commercially at the Sri Ganganagar factory in 1972/73, but in that campaign yields were about half of the estimated, while in the subsequent campaign they were only about one-quarter of the theoretical. The author examines various facets of beet agronomy as practised in Rajasthan, starting with beet seed quality, and drilling and ending with harvesting, in order to establish causes of the poor performances and suggest remedies where appropriate.

Interpretation and practical field utilization of the relationship between brei nitrate and sugar content of sugar beets. D. G. Westfall, M. G. Barnes and N. E. Pence. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19,** 307-315. See Westfall & Barnes: *I.S.J.*, 1976, **78,** 19.

Effect of plant spacing on performance of six sugar beet hybrids. A. Suzuki, A. W. Erichsen and R. K. Oldemeyer. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19,** 324-330.—The effect of plant spacing was studied at target values of 6, 12 and 18 inches, the inter-row spacing being constant at 22 inches. The varieties were selected for differences in yield and sugar content and their performances evaluated on the basis of these two parameters as well as number of roots per plot and thin juice purity. While significant differences were found between varieties for all parameters, no significant interaction was found between variety and spacing. Juice purity was significantly higher at the smallest spacing and the root yield significantly lower, partly because of loss of small beets during harvesting and laboratory handling, although the possibility that such a small spacing could adversely affect yield under the test conditions is suggested.

Effect of soil injected ethylene on sugar beet (*Beta vulgaris* L.) yield parameters. L. J. Francl, R. E. Dennis, D. K. Parsons and A. H. Freytag. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19,** 331-336.—Ethylene was injected 20 cm below the soil surface in furrows at the rate of 6·2 kg.ha^{-1} and its effect on beet and sugar yield and sugar content determined in rows adjacent to the furrows and at intervals of 5, 10 or 50 rows from the injected furrows. After results had indicated a 16·5% greater sugar yield in the row nearest the injected furrow than in the 50th row, with beet yield falling gradually with distance from the treated furrow, further investigations were conducted in the following year. However, no significant differences were found in the yield parameters, and the results were highly variable and hence inconclusive. It is suggested that further research should be directed towards finding the optimum dosage rate and date of application of ethylene and optimum soil and environmental conditions.

Weed control in sugar beets. Efficiency of carbanilate herbicides and their mixtures, 1968-72. E. F. Sullivan and L. K. Fagala. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19,** 337-344.—Trials are reported with "Phenmedipham" (methyl *m*-hydroxy carbanilate *m*-methylcarbanilate) as a post-emergence herbicide on its own or with other herbicides, including "Desmedipham" ("Betanex") (ethyl *m*-hydroxy-carbanilate carbanilate), which was also tested as a mixture with "Pyrazon" [5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone]. The carbanilate herbicides and mixtures were found to be selectively effective against a number of weeds, and used as a 1·4 (or 1·5) + 1·4 kg.ha^{-1} mixture had a broad spectrum of activity without damage to the beet crop. "Pyrazon" or "Ethofumesate" (2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranol methane sulphonate) enhanced the effect of "Phenmedipham" and gave better results than 'Pyrazon"+"Dalapon" (2,2-dichloropropionic acid).

Factors affecting quality in sugar beet. P. S. Bhatnagar and B. Raj. *Indian Sugar,* 1977, **27,** 337-339.—Climatic factors and cultural practices which affect beet quality are discussed.

How can the production of quality beet be furthered? C. Winner. *Zuckerind.*, 1978, **103,** 119-128 (*German*).—With basic changes in beet agriculture that have been brought about in recent years, there has been a marked fall in beet quality, against which countermeasures in the sugar factories have proved of limited effect. The agronomic factors affecting beet quality and how it can be improved are examined. The part that individual factories can play in analysing the problems confronting farmers in their own areas and in advising growers is discussed. While empirical and statistical means can be used by factories in collaboration with farmers to establish causes and effects, it is admitted that a major difficulty lies in the almost complete absence of strict linearity in relationships, so that statistical evaluation of test results has often led to erroneous conclusions. The limitations on causal analysis by extrapolation are indicated. The importance of varietal selection is discussed, and three specific areas in which factories can help are described: soil analysis (i) for nutrient content, (ii) for nitrogen and (iii) for nematodes.

Preliminary studies regarding economics of sugar beet production at Sriganganagar (Rajasthan). S. K. Tewari and P. S. Bhatnagar. *Indian Sugar,* 1977, **27,** 393-395.—The economics of beet cultivation were compared with those of other crops. While beet was less profitable than kharif (tropical-season) crops, cane and cotton, it was more profitable than two other rabi (temperate-season) crops, mustard and wheat, and its inclusion in a crop rotation is recommended. The most profitable of 14-month rotation crops was cotton+beet.

Economics of sugar beet production at Sriganganagar (Rajasthan). S. K. Tewari and P. S. Bhatnagar, *Indian Sugar,* 1977, **27,** 455-457.—See preceding abstract.


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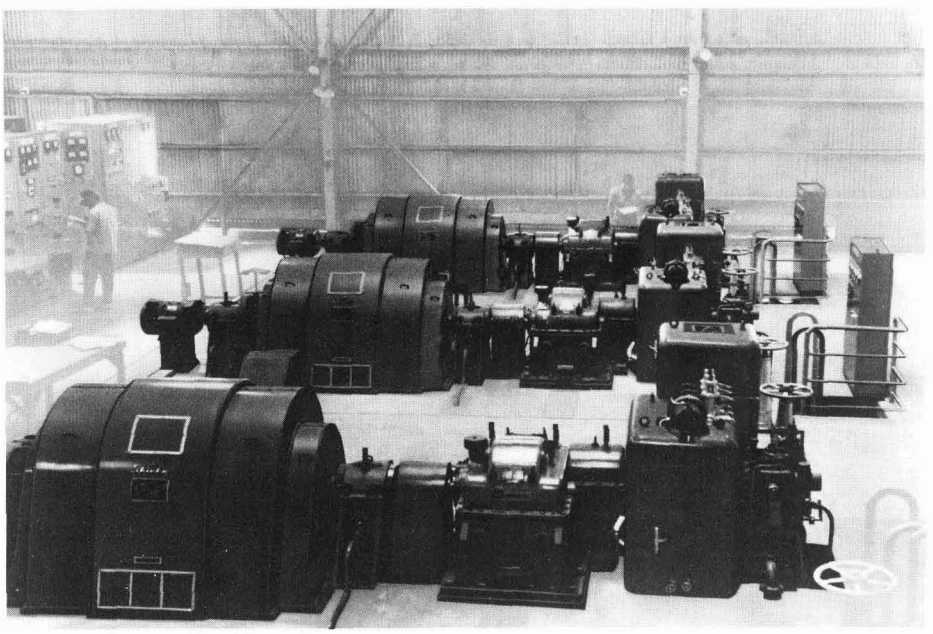

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CANE SUGAR MANUFACTURE

Phosphatation of unfiltered second carbonatation cane juice—development of a new system of cane juice clarification for manufacture of superior quality sugar at reduced manufacturing costs. I. Laboratory and pilot plant studies. S. P. Mishra. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.5-M.32.—Details are given of a system in which 2nd carbonatation juice is treated with phosphoric acid to adjust the pH to about 7·2 at 70°C (instead of being filtered) and subsequently settled in a continuous subsider of low retention time. Laboratory investigations at three factories in 1975/76 and 1976/77 showed that neutralization of the 2nd carbonatation juice with 10% phosphoric acid at 0·4% on juice volume improved juice physicochemical properties by comparison with conventional carbonatation and contributed to rapid settling, increased purity and lower juice CaO, ash and colour content. Pilot plant studies confirmed the laboratory results. A diagram illustrates the salient features of the clarifier designed for the system.

An economical layout for vapour bleeding and steam connexions at the juice heater station in a cane sugar factory. J. T. Jadhav. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.85-M.88.—An arrangement is briefly described in which raw juice is heated in two stages—to 55-58°C with 3rd effect vapour and to 65-70°C with 2nd effect vapour. Sulphitation juice is first heated to 95°C with 1st effect vapour and then to 100°C with exhaust steam. The sequence in which the heaters are used in a 4-day cycle and the layout of piping and valves for vapour supply to the heaters are indicated.

An alternative possibility for the design of a continuous pan for sugar factories. C. J. Abraham. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.89-M.94.—The author suggests use of a modified ammonium sulphate crystallizer as a continuous vacuum pan. Main features of the system are an external calandria through which the massecuite flows from the classifier and back into the upper vaporizer, the classifier of approximate parabolic shape which extends below the vaporizer and into which a specially profiled downtake extends, and a spherical crystal catcher in which the larger crystals settle, while the smaller ones remain in suspension in the classifier. Syrup is fed into the classifier. Advantages claimed for the system are listed.

A study on production of bold grains in a sulphitation sugar factory. S. Srinivasan and K. N. Pandey. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.95-M.102.—Details are given of the practices adopted at the authors' sugar factory to produce large-grained sugar. The system included double sulphitation and a 3-massecuite boiling scheme. Data are tabulated.

Continuous centrifugals for low-grade massecuite techniques adopted to get low-purity final molasses. A. P. Chinnaswamy, A. Anthoniswamy, P. Marimuthu and R. Lokan. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.103-M.113.—Information is given on the sugar house scheme used at the authors' factory when a battery of 12 Buckau-Wolf horizontal continuous centrifugals was installed for use as foreworkers on low-grade massecuite. Results are compared with those of previous seasons when batch machines were used, and show that, contrary to general belief in Indian sugar factories, the continuous machines gave lower molasses yield and purity.

Observations on the working of a Buckau-Wolf vertical continuous centrifugal type SC-1100T. B. B. Pawar, S. N. Patil and R. C. Karve. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.115-M.119.—Trials with the title centrifugal used as foreworker on low-grade massecuite are reported. Results indicated a satisfactory performance, with uniform quality of product, and a screen condition which suggested a longer life by comparison with screens in other machines. The greater simplicity of design considerably reduces maintenance costs.

Performance of first installed "Unigrator" in Pakistan at Fecto Sugar Mills Limited, Darya Khan, Mianwali. S. M. Alam. *Proc. 14th Conv. Pakistan Soc. Sugar Tech.*, 1977, 209-222.—Installation of a "Unigrator" in place of a heavy-duty cane knife set brought about initial improvements in cane preparation and mill extraction (which had been low at 92-94·5%). However, problems associated with the "Unigrator" and with necessary modifications to the cane feeding system caused the performance to fall as the first season of operation progressed. Modifications were to be carried out for the next season and were expected to result in a considerable improvement in efficiency. Details are given of the teething troubles and of the modifications envisaged.

Mill setting and experiments in improving the operational efficiency of the mills. J. S. Huja. *Maharashtra Sugar*, 1977, **3**, (2), 9-20.—The objectives of mill roller and trash plate setting are explained and calculation of both demonstrated. Means of raising mill efficiency are described, including improvements in cane preparation and the use of heavy-duty pressure feeders, Messchaert grooving, imbibition (up to a maximum of 30% on cane) and hydraulic pressure application to the top roller; the importance of mill sanitation and of Brix curves as a guide to mill performance are also noted.

Reclamation of mill turbine rotor shrouding and blades. P. B. Bargaje. *Maharashtra Sugar*, 1977, **3**, (2), 21-24.—See *I.S.J.*, 1979, **81**, 53.

Formula for added water % cane. S. Nath and S. N. Tripathi. *Sharkara*, 1975, **14**, (1), 13-16.—While an automatic weigher having an integrating counter will give a reading for imbibition water % cane which is near to the true figure provided frequent calibration is carried out,

it does not take account of the quantity of bearing cooling water which leaks into the mixed juice. A formula has therefore been developed for calculation of added water % cane (Z) which takes the following form: $Z = B + \frac{100\ (KC-AB)}{100\ H + GC} - 100$, where A = Brix % mixed juice, B = mixed juice % cane, C = Brix % primary juice, G = fibre % bagasse, W = Brix % bagasse and K = 100 — Brix free cane water % cane. The formula has been applied to actual data from a number of Indian factories and the calculated values compared with those given in the factory reports, showing differences ranging from 0·14% to 1·96% absolute. Prerequisites for accurate use of the formula are listed.

Sugar factory technology in Mauritius. Anon. *Ann. Rpt Mauritius Sugar Ind. Research Inst.*, 1976, 56-61.—In tests to determine the rate of deterioration of chopper-harvested cane and hence the maximum acceptable delay between harvest and crushing, chopped cane consignments were stored for periods of 42-55 hours, samples being taken every 6 hours for juice analysis. Whole cane samples were used as controls. Atmospheric temperature, relative humidity and rainfall were recorded at frequent intervals. Values of gravity purity, reducing sugars:sucrose and dextran content were highly variable, particularly the dextran level, which was found to reach 5000 ppm on Brix (at which processing difficulties in the boiling house could be expected) 18 hours after harvest. However, sucrose losses over the same period were not considered likely to be significant. Investigations on the amount of suspended matter in mixed juice and its effect on the precision of refractometric Brix measurements, carried out with the help of sugar factory chemists, showed that the average industrial level was 0·55% and that the Brix value dropped by 0·13 units on average after filtration through Whatman No. 91 filter paper. Trials at seven factories to assess the effect of harvesting practices on the amount of suspended solids in mixed juice showed that manual cutting and loading gave an average of 0·51%, while manual harvesting and mechanical loading gave 0·98% suspended solids. In both cases, the observed refractometric Brix of the mixed juice dropped by 0·16 units following filtration. In view of the adverse effect of suspended solids on chemical control precision it is recommended to determine the solids and filter the juices before Brix measurement. In experiments to assess the possible advantage of using a preparation of a heat-stable bacterial amylase ("Termamyl") for starch hydrolysis in evaporation syrup, the traditional process, based on action of the naturally occurring enzymes in the juice during retention at 72°C for 10 minutes, gave a reduction in starch content which was about the same as that given by adding 1·5 g.tonne^{-1} of "Termamyl" in the 2nd evaporator effect, where the temperature is about 95°C. There is therefore no justification for use of "Termamyl", particularly since the traditional process does not entail loss of sucrose. On the other hand, were starch to become a major problem in the future, the bacterial enzyme might be useful. The heat transfer coefficient of a semi-Kestner vessel having 5·5 m tubes and a total heating surface of 1158 m^2, which was installed as the 1st effect in a quintuple-effect evaporator at Mon Loisir factory, was found to be 2860 and 2739 kW.m^{-2}.°K^{-1} on the 1st and 5th days of a week, respectively, values which compare favourably with those quoted by Allan[1] for South African installations. Loss determination on the basis of the sucrose:chloride ratio before and after evaporation was tested on weekly bulked samples taken throughout the season at three factories. Statistical analysis of the results showed a significant difference between sucrose before and after evaporation at only one factory. It is suggested that the difficulty of adequate sampling under industrial conditions may have had an adverse effect on the results. Studies on massecuite boiling are reported in which the crystallization velocity varied with mother liquor purity, as is clearly shown by a graph representing boiling at two factories. At another two factories, the crystallization velocities were lower and there was no apparent relationship with purity, probably because of irregular availability of heating steam (since at one of the two factories crystallization velocities comparable to those at the other two were obtained during that part of the process when heating steam availability was not a limiting factor). Extending the holding period of low-grade massecuites in crystallizers from 28 to 36 hours increased purity fall by 0·5 units, which could give an extra 60 tonnes of bagged sugar over an average season at the factory where the tests were conducted. The temperature of the massecuite dropped 1-2°C lower than usual, and lubrication water was added to the massecuites whenever necessary to prevent overloading of the drives. Cooling water was also passed through the elements throughout crystallization. A technique was developed for determination of raw sugar crystal size distribution by dry sieving. The sugar sample is washed successively with methanol and sugar-saturated *iso*-propanol to remove the molasses film and then dried by evaporating off the *iso*-propanol under vacuum in a rotary film evaporator in which the movement of the sugar crystals prevents caking; the free-flowing sugar is then passed over a rotary test sieve shaker. The technique does not alter the crystal size distribution of the original sugar and is apparently much simpler than wet sieving. In a study of the relationship between the moisture:non-sucrose ratio and equilibrium relative humidity, equipment developed for bringing sugar samples to equilibrium with air of known R.H. was found to operate satisfactorily. However, results for impure sugar samples, prepared by coating analytical-grade sucrose crystals with cane molasses of varying composition, were highly variable, so that the relationship could not be suitably expressed by an equation. After a pilot subsider for separating suspended solids from mixtures of wet scrubber water and filter cloth wash water had given encouraging results at two factories, a larger model capable of handling 25% of the relevant effluents at one of the factories was constructed and tested. Results indicated that a subsider designed on a basis of 1 m^2 settling area per 9 m^3 of effluent per hour would produce an overflow of sufficiently low suspended solids content (0·4 g.litre^{-1}) to permit discharge into natural water courses. A pre-coated DSM screen proved suitable for dewatering of the subsider underflow; the pre-coat was the particulate fraction obtained from untreated effluent mixture which passed over the screen on its way to the subsider. The material retained by the screen after underflow treatment contained about 82% moisture and was disposed of by spreading over waste land.

[1] *I.S.J.*, 1978, **80**, 21.

BEET SUGAR MANUFACTURE

Metallo-polymer surface coatings for diffusers. N. P. Romenskii. *Sakhar. Prom.*, 1978, (2), 15-19 (*Russian*). For prevention of diffuser corrosion and erosion, a surface coating made up of aluminium (sprayed onto the basic metal), to which is then applied an epoxy resin and finally a layer of fluoropolymer, has proved successful in tests at various sugar factories. Information is given on the techniques and methods used to apply the coating.

Raw juice purification with mud separation before liming. A. F. Yakimov. *Sakhar. Prom.*, 1978, (2), 19-23 (*Russian*).—A juice purification scheme is described in which a fifth of the 1st carbonatation mud and all of the 2nd carbonatation mud (practically pure $CaCO_3$) are added to the raw juice to give a pH of 7·8-8·2. After heating to 80-86°C, the juice is transferred to a preliming vessel in which unfiltered over-saturated defeco-saturation juice is added at 150-200% on raw juice to raise the pH to 9·0-9·5. The pH is further raised to 11 by addition of milk-of-lime equivalent to 2·25-2·75% CaO on weight of beet. After 4-7 minutes' preliming, the juice is transferred to a defeco-saturation vessel and its pH adjusted to pH 9-10 with milk-of-lime and CO_2. At this stage, the juice settling and filtration properties increase, but so do its colour and lime salts content. The juice is split into two parts on discharge from the vessel: one (150-200% on raw juice volume) is transferred to preliming, while the remainder passes to a second preliming vessel where it is treated for 2-2½ minutes with a small quantity of milk-of-lime to give an alkalinity of 0·20-0·25% CaO. The juice then flows to a second defeco-saturation vessel where its pH is brought to 10·8-11·2. After clarification or filtration, the juice is treated with 40-45% milk-of-lime and heated to 90°C; it is then fed into a liming tank for 10-15 minutes (to decompose the invert sugar and amides), after which it is heated to 100°C and subjected to 2nd carbonatation. By comparison with conventional juice purification, the new scheme gives a 0·5-1·2 units higher 2nd carbonatation juice purity, while thick juice purity is 0·7-1·3 units higher. The lime salts content is reduced by 25-28%, while thick juice colour rise with prolonged heating is 15-18% less than normally and sugar yield and quality are enhanced. Variants for handling juice from poor-quality beets are briefly described.

Optimization of the raw juice purification scheme for factories of Northern Caucasia. V. A. Kolesnikov, D. M. Leibovich, B. F. Kolesnikov and V. A. Maksyutov. *Sakhar. Prom.*, 1978, (2), 23-27 (*Russian*).—Problems with juice purification, leading to inadequate thermal stability, a marked fall in syrup and run-off pH and increase in reducing matter and sugar losses, are examined. Adoption of progressive preliming and fractional cold and hot main liming in 1976/77 improved the situation, as shown by tabulated data.

Experience in operation of the DDS massecuite boiling control system. B. A. Eremenko, A. F. Kravchuk and V. A. Karpenko. *Sakhar. Prom.*, 1978, (2), 41-45 (*Russian*).—The principle on which the DDS system operates is explained and the key components and sequence of operation described. Tests on 1st massecuite boiling demonstrated advantages of the system over manual control, but showed that, in terms of increase in pan throughput and in massecuite crystal content and reduction in massecuite and sugar colour as well as in centrifugal curing time and heating steam consumption (as a result of reduction in water drinks % massecuite weight), the system was not as good as the Soviet computerized "Kristall-1KM" system. Use of the DDS system since 1974 has also shown that it is not applicable in the case of raw sugar refining, since the conductivity of the massecuite (of purity higher than 94) is below 2 mS while the sensitivity of the measuring element is almost zero. The low conductivity was also responsible for its failure to operate satisfactorily on massecuite prepared from 2nd and 3rd remelt sugar. Where syrup purity is low (85-88) there is need for constant correction of the programmed conductivity (as determined from massecuite samples) because of electrode scaling. It is suggested that provision of remote control means would improve pan boiling at one factory where the DDS system is installed.

Float-type Brix regulator for sugar syrups. N. F. Bondarenko and M. A. Marushchenko. *Sakhar. Prom.*, 1978, (2), 45-48 (*Russian*).—A Brix regulator for evaporator thick juice is described. It is basically a float chamber receiving juice from a header tank which in turn is fed from the concentrator of an evaporator. The juice overflows from the top of the float chamber into a pipe section which leads back to the concentrator. Movement of the float actuates a regulator; if the Brix is too low, the flow of heating steam into the concentrator is increased and hence the amount of water evaporated rises, but if the Brix is too high, the juice is diluted with juice from the sulphitation tank. Tests have shown that the system is accurate to within ± 1°Bx and has permitted maintenance of a constant Brix within the range 64-65°, thus contributing to a drop in fuel consumption by 0·15-0·20% on weight of beet.

Why sugar beet failed in Maharashtra. A. D. Karve. *Maharashtra Sugar*, 1978, **3**, (3), 39-41.—The author blames the management of two sugar factories for their apathetic approach to beet processing. Phaltan Sugar Works Ltd. offered growers the same price for beet as for cane, despite a 40-50% higher sugar content in the beet, the reason being given that the factory was unable to extract all the beet sugar (probably because the diffuser used was not designed to handle beet). Walchandnagar Industries Ltd. planned to use a separate small diffuser for beet, but failed to build one. Another problem is the need to use carbonatation for beet juice processing, while all cane sugar factories in Maharashtra use sulphitation which is unsuitable for beet juice. However, investigations at the National Sugar Institute have shown that sulphitation is successful with a 1:9 mixture of beet and cane juices. It is stressed that beet must be regarded as a supplement to cane in Maharashtra and that, because of the shortness of the beet campaign, a factory processing only beet would not be

practical. However, with a constantly falling supply of cane and plans for the construction of another 20 factories in the state, the need for an alternative to cane will be great, so that development of a mixed beet and cane juice technology will be necessary.

Conditioning powdered sugar. D. Nahler. *Sugar J.*, 1977, **40,** (7), 19-22.—See *I.S.J.*, 1977, **79,** 231.

Remarks on the article by T. Baloh: Calculation of the air flow for forced ventilation of beet piles. S. Vajna. *Zuckerind.*, 1978, **103,** 136 (*German*).—The author analyses certain points raised by Baloh[1] by referring to his own book on the subject[2].

Sucrose losses during extraction caused by micro-organisms. M. Milic. *Proc. 1st Congr. on Food Production in Yugoslavia*; *Sugar Beet and Sugar Manufacture*, 1975, 126-129; through *S.I.A.*, 1978, **40,** Abs. 78-192.—At two factories, these losses were 0·06-0·20% on beet.

Level control of coupled evaporator vessels: a multivariable design study. D. H. Mee. *IFAC Symposium on Multivariable Technological Systems*, 1974, Paper F11, 14 pp; through *S.I.A.*, 1978, **40,** Abs. 78-206. Control of the levels in the bodies of a multiple-effect evaporator presents an example of a multivariable industrial system where interactions between controls cause instability. In a computer control scheme initially proposed for an evaporator station, levels were controlled by manual presetting of the juice feed valves and automatic regulation of the steam valves according to the difference between the set point and the actual value of the level in each body. In practice it was found that if more than one feed valve was open, the system was unstable, owing mainly to pressure differences between the vessels. A mathematical model of the system is derived, from which an improved design of control scheme is suggested; this scheme gave excellent stability. Some currently available mathematical techniques for designing control schemes are discussed.

Gas recycling in carbonatation. N. Marignetti and G. Mantovani. *Sucr. Belge*, 1978, **97,** 47-52 (*French*).—While the quality of lime produced in kilns fired by gaseous or liquid fuels is higher than in coke-fired kilns, the CO_2 content in the gas is lower, so that there is need for greater CO_2 utilization efficiency in carbonatation. Unless this is achieved, there will be a quantity of CaO left unsaturated, as is shown for all fuels (except coke) where the degree of utilization is 59% (cited as typical by various authors). The increase required to avoid this ranges from 7% absolute for heavy oil to 12% absolute for natural gas. The chief factors affecting CO_2 utilization are discussed, *viz.* gas distribution, the surface of contact between the gas bubbles and the juice, and the length of travel covered by the bubbles. The problem can be overcome by installing a second carbonatation vessel to which is fed the vapour-gas mixture from the first vessel. The mixture can be recirculated by a liquid-ring compressor, a liquid ejector or a steam ejector. The compressor system is discarded because of high costs, while there are certain disadvantages in use of a liquid ejector, although a scheme based on it is illustrated. A scheme is also described for a steam ejector, which is the cheapest of the three recirculation systems to install.

Experience with Westfalia separators for thick juice and remelt. W. K. Nielsen. *Sucr. Belge*, 1978, **97,** 53-62.—See *I.S.J.*, 1978, **80,** 120.

Reply to the comments of Dr. S. Vajna on the article "Calculation of the air flow for forced ventilation of beet piles". T. Baloh. *Zuckerind.*, 1978, **103,** 205-206 (*German*).—The author answers the criticism[3] of his method of calculating the air flow in artificially ventilated beet piles, and concludes by pointing out that in the forthcoming campaign there would be ample opportunity to test his theory.

A new filtration method for thick juice. The counter-current thin-film filter. H. Nowatzyk. *Zuckerind.*, 1978, **103,** 206-207 (*German*).—A new filter is described which is similar to a candle filter but operates on the basis of a thin-film system without applied pressure. The juice is fed from below into the filter element and is brought to the cloth by means of a splitter section and vortex spiral. It passes through the cloth as a thin film, the cake formed by the impurity particles in the juice acting as an aid until it collapses. In contrast to other systems, the cake does not form simultaneously over the entire element but does so gradually as the juice passes at constant velocity up the element. Filtrate falls under gravity to the bottom of the casing and is discharged, the first filtrate emanating from the bottom section of the element and so on up the element. Operation of the filter ceases when the cake reaches the top of the spiral; washing involves feeding condensate under pressure to a halfway point up the column and then blowing compressed air up through the condensate, followed by a very short rinsing period. A filtration surface of 0·75 m^2 can handle 1000 litres.hr^{-1} of 62°Bx thick juice at 84°C. Experimental models of the filter have been tested at two West German factories.

The SKD-6 beet washer. R. P. Polishchuk and V. I. Kotlyarov. *Sakhar. Prom.*, 1978, (3), 16-18 (*Russian*). Details are given of the Soviet SKD-6 twin-trough beet washer in which the beets pass from a trough having a low water level to a high-level trough, each trough being provided with two parallel paddle shafts. Average retention is about 5½ minutes, and total rated daily throughput is 6600 tonnes of beet. Power input is rated at 45 kW.

Means of reducing the sugar content in molasses. M. I. Daishev and T. P. Trifonova. *Sakhar. Prom.*, 1978, (3), 19-21 (*Russian*).—Treatment of *A* green syrup of 60°Bx with a strongly acid cation exchange resin in Ca^{++} form at a 3:1 v/v syrup:resin ratio followed by simultaneous liming and gassing with CO_2 reduced the sugar loss in standard molasses by 54·2% compared with 26·9% using only defeco-saturation. The partial re-

[1] *I.S.J.*, 1979, **81,** 23.
[2] "Zuckerrüben-Lagerung" (Verlag Dr. Albert Bartens, Berlin), 1962.
[3] *I.S.J.*, 1979, **81,** 88.

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placement of the K and Na ions by Ca ions in the ion exchange stage brought a drop in the melassigenic coefficient from 1·551 to 1·105.

Device for purifying yellow sugar in centrifugals. A. P. Kozyavkin, N. I. Odorod'ko, L. S. Taranenko and A. G. Shingur. *Sakhar. Prom.*, 1978, (3), 31–32 (*Russian*). Mention is made of tests to determine the optimum location of a nozzle for green syrup used to wash low-grade sugar in a centrifugal[1]. The flow rate and optimum angle of flow from the nozzle were also established, and a description is given of an electrically operated diaphragm valve used to regulate flow of the syrup to the nozzle.

Determination of pulp press water quantity. V. N. Bazlov. *Sakhar. Prom.*, 1978, (3), 40–44 (*Russian*).—Official methods used in the USSR to determine the quantity of fresh and of pressed pulp are discussed and factors affecting pulp yield examined. Investigations have shown that, while the solids content of pulp is largely governed by the quality of beet, the moisture content is dependent on the design of the diffuser, particularly the cossette discharge system, as well as on the cossette length and temperature of the exhausted cossettes on discharge. Values of the pulp factors mentioned have been calculated by the two main official methods and are tabulated. Calculated values of press water quantities and pulp water contents at dry solids contents in the range 15–20% with and without press water recycling to diffusion show that the norms set for pulp yield are incorrectly based. The method used for the calculations is therefore recommended in place of the previous methods.

Tests on a direct-flow/film condenser at Peregonovka sugar factory. V. I. Dovgopol, S. V. Markitan, I. B. Charnyakhovskii and B. N. Moskalev. *Sakhar. Prom.*, 1978, (3), 45–50 (*Russian*).—The condenser in question is divided into two sections connected by a vapour line; the upper section is designed for condensation of only 10–20% of the vapour by the thin-film method and heating of fresh process water, while the lower direct-flow section condenses the remainder of the vapour from the evaporator and pan stations. Full details are given of tests in which the condenser had considerably less hydraulic resistance than a counter-current tray type.

Preservation of sugar beet with natural cold and its processing during the 1976/77 campaign. M. Z. Khelemskii *et al. Sakhar. Prom.*, 1978, (3), 51–56 (*Russian*). Results are reported of storage of beet deliberately frozen with forced cold air for processing in sugar factories of the Bashkir ASSR (an autonomous republic, to the north of Kazakhstan, where typical ambient temperatures in December-February range from —15°C to —25°C). The benefits derived from the treatment are discussed; they included a daily sugar loss of 0·005% on weight of beet, compared with a norm of 0·012%, and good processing quality.

Sucrose degradation during low-grade massecuite recrystallization by fluctuating means. L. I. Trebin, I. G. Bazhal, V. O. Shtangeev and I. S. Gulyi. *Izv. Vuzov, Pishch. Tekh.*, 1977, (6), 78–81 (*Russian*).—The boiling system, in which fluctuations are brought about in temperature so as to cause forced recrystallization[2], was applied to low-grade massecuite. At a temperature amplitude of ±20°C and a fluctuation frequency of 1–3 per hr, the sugar loss was slightly lower than in conventional boiling. Very slightly less sugar was lost in crystallization by varying the temperature of the water in the cooling elements at regular intervals.

Effect of fluctuations in scroll speed on sugar losses in pulp. Yu. P. Dobrobaba. *Izv. Vuzov, Pishch. Tekh.*, 1977, (6), 159–160 (*Russian*).—The speeds of twin scrolls in a sloping-trough diffuser were deliberately varied so as to impart pulsations in diffusion. From 7 days with and 7 days without speed fluctuations it was established that the pulp sugar loss was reduced by 31% as a result of the technique.

Recent experiments to determine sugar beet losses in loading-unloading. P. Soós and A. Lengyel. *Cukoripar*, 1977, **30,** 210–214 (*Hungarian*).—Since there is little knowledge in Hungary on the losses caused by bruising of beets during loading and unloading, investigations were carried out with various types of equipment, particularly the cleaner/loader system of the Herriau "Super" harvester. For assessment of the effect of height of drop, further tests were conducted in which beets were dropped through various heights onto concrete or iron surfaces, as well as a bed of beet, and the weight losses determined. Results are given in graph and table form.

Sugar factory experience with the heat pump. A. Fényes. *Cukoripar*, 1977, **30,** 214–220 (*Hungarian*).—The heat distribution and efficiency are demonstrated by means of a Sankey diagram for a factory provided with the conventional arrangement of quadruple-effect evaporator fed with steam from a turbine. By means of a mathematical examination of steam utilization, the author shows how use of a heat pump with a thermocompressor as a complement to the steam turbine in a factory of 3000 tonnes/day beet slice can raise efficiency and give substantial monetary savings in power and maintenance. In the scheme suggested, the turbine delivers steam direct to the 1b effect, to which the thermocompressor also supplies steam as well as feeding the heat pump, which transfer steam to the 1a effect; some of the vapour from the 1a effect is recycled to the heat pump, while the rest is fed direct to the 2nd effect.

New electric massecuite reheater. J. C. Giorgi and B. Richard. *Sucr. Franç.*, 1978, **119,** 129–131 (*French*).—A massecuite reheater (as yet untested) is described in which the massecuite passes vertically between four electrodes each of which takes the form of a grille in which the bars are plates 2 cm thick and 3 cm apart; the mean distance between the bottom of one grille and the top of the one below it is variable and of the order of 2 cm. The space is regulated by fixing the grilles to interconnected inclined plates and allowing one of them to pivot about one of the grilles which is stationary. The space is altered when changes occur in the massecuite temperature after heating—it is widened if the temperature rises and *vice versa*. The reheater is rated at 50 kW.

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[1] Kozyavkin *et al.*: *I.S.J.*, 1978, **80,** 280.
[2] Bazhal *et al.*: *ibid.*, 1977, **79,** 203.

NEW BOOKS

The Gilmore Louisiana-Florida-Texas-Hawaii sugar manual 1978. Ed. C. M. McKay. 169 pp; 22×28 cm. (Sugar Publications, Gilmore Sugar Manual Division, 503 Broadway, Fargo, ND 58102, USA.) 1978. Price: $32.50.

The latest Gilmore sugar manual opens with a concise Buyers' Guide, followed by detailed information on the factories in each of the four states of the title, an alphabetical list of these factories (with telephone and ZIP Code numbers) being provided as an introduction. In each case, details are given of processes and equipment (in some instances information is also provided on agricultural equipment and practices), senior staff and results obtained in 1976 and 1977. The book is undoubtedly the best available source of detailed information on the sugar industries of the four states.

A herbicide guide for cane growers. (South African Sugar Association Experiment Station, Mount Edgecombe, Natal, South Africa.) 1978.

The SASA has prepared a guide to help cane farmers in their selection of herbicides, a choice which is made particularly complicated by the increase in the number of products available. The products are classified under "true" pre-emergence herbicides of short-term (4-5 weeks) and long-term (6-12 weeks) activity, late pre-emergence herbicides of 6-12 weeks' activity, and short- and long-term post-emergence herbicides. In each case, recommended rates per ha, approximate costs, weeds controlled and special comments are given. Also included are brief notes on problem weeds, the value of trash and tops, the pros and cons of short- *vs.* long-term herbicides in plant as opposed to ratoon crops, mixing of herbicides, optimum spraying conditions, jets for use with herbicides and phytotoxicity problems, and finally a list is given of herbicides registered in South Africa for use in cane. The guide is given in the form of a visible index record, with section titles immediately visible in stepped order.

Annual report 1976-77. 65 pp; 20×27 cm. (Taiwan Sugar Research Institute, Tainan, Taiwan.) 1978.

The report is on research conducted by the various departments of the TSRI in 1976-77, covering cane breeding, cultivation, weed control, water, plant physiology, soil and plant nutrition, groundwater resources, plant pathology, entomology, sugar technology and by-product utilization. Numerous tables, graphs and colour photographs accompany the text. Details are also given of research work currently being undertaken, and mention is made of a project on evaluation of the economics of mechanical harvesting in Taiwan. Extension and Training Centre programmes have been used to train cane farmers and Taiwan Sugar Corporation technicians, and the Instrument Service Centre has been involved in development of automatic control systems, particularly using a micro-computer. The report throws light on the very useful and important work being conducted at the Institute.

Hawaiian sugar manual 1978. 47 pp; 15×23 cm. (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, HI 96701, USA.) 1978.

Sub-titled "A handbook of statistical information", this booklet contains textual and tabular material on the Hawaiian sugar industry and its history, the US sugar industry (including corn sweetener manufacture), US sugar legislation and world sugar, including the International Sugar Agreement and its price stabilization mechanism. A brief glossary of terms used in the sugar industry is appended.

Centre d'Essai de Recherche de Formation: Rapport 1977. 138 pp; 21×30 cm. (Centre d'Essai de Recherche et de Formation, La Bretagne, 17490 Ste.-Clotilde, Réunion.) 1978.

While some material in the latest report from La Bretagne concerns cane diseases, chemical weed control and ripener tests, the bulk of the report is devoted to breeding work and varietal trials, details of which are given in the form of tables and notes. Particularly interesting are colour photographs of three new varieties, R 568, R 569 and R 570, the merits of which are described. A table is presented of Réunion varieties tested by CSR Ltd. at Roseville in Australia for resistance to Fiji disease. Of the 15 varieties, 2 were found to be highly resistant, 6 were resistant, 4 were highly susceptible and 3 were intermediate in their reaction.

Ispansko-russkii slovar' po sakharnoi promyshlennosti (Spanish-Russian dictionary of the sugar industry). Ed. J. Moreno Pallí and J. Lodos. 144 pp; 11×17 cm. (Izd. "Russkii yazyk", Pushkinskaya ul. 23, Moscow K-9, USSR 103009.) 1976.

Although there will be few of our readers for whom a Spanish-Russian dictionary of sugar terms will be of interest, the compilers are to be congratulated on their contribution to the communications exercise, bearing in mind the number of articles in Spanish (admittedly, most of them emanating from Cuba) which Soviet technologists would have difficulty in reading without the help of such a dictionary. What is particularly interesting is the fact that, although the work is intended to help in the collaboration between Cuban and Soviet technologists, the work is not restricted to the cane sugar industry, many of the 6000 terms referring to beet processing. There are some agricultural terms, but not many, and obviously the compilers have decided to avoid the subject of agronomy—anomalies do creep in, e.g. the term for cane mosaic disease is given but not for any other serious cane disorders, while beet diseases are not mentioned. A short list of abbreviations is given, including the two well-known machinery manufacturers BMA and DDS. Although in the preface the possibility of errors and inaccuracies is accepted and corrections invited for use in a revised edition, the reviewer could find no obvious flaws and certainly no typographical errors in the Spanish or Russian.

LABORATORY STUDIES

American Crystal new research centre. Anon. *Sugar J.*, 1977, **40,** (7), 15-16.—Information is given on the American Crystal Sugar Co. beet research centre (costing more than $8 million) which was opened at Moorhead, Minnesota, in September 1977. There are four areas devoted, respectively, to process research, chemical research and administration, agricultural research and seed handling. The process research area includes a pilot plant for testing (on a scale below factory scale but greater than laboratory scale) processes and equipment designed by the company's own research staff as well as normal commercial equipment.

High-pressure liquid chromatographic method for determination of betaine in sugar factory products. G. Steinle and E. Fischer. *Zuckerind.*, 1978, **103,** 129-131 (*German*).—High-pressure liquid chromatography was used to determine betaine in various sugar products. The minimum weight of sample differed according to the nature of the product; in the case of beet, juices, molasses and pulp (pelleted or mixed with molasses) it was based on 12·5% betaine on soluble non-sugars. Molasses and juices were made up to 100 cm^3 with distilled water; beet and pulp were made up with 90 cm^3 distilled water, heated for 30 min at 75-80° on a water bath, cooled to 20°C, made up to 100 cm^3 with water and filtered, the filtrate then being used for the HPLC. In the case of white sugar, 100 g was dissolved in 1 litre water, passed through a column of 50 cm^3 highly acid cation exchange resin in H^+ form; after removal of the sugar by washing with distilled water, elution was carried out with 200 cm^3 5% ammonia, the eluate concentrated by evaporation and the solid residue dissolved in 2·5 cm^3 water. A Siemens 50 cm, 3 mm i.d. S 100 column was packed with 10 μm "Nucleosil"-NH_2 and 83:17 acetonitrile:water, adjusted to pH 5·5 with 5N acetic acid, used as solvent at a flow rate of 1·5 $cm^3.min^{-1}$ at 35°C. The sample injection volume was 20 μlitre. A Perkin-Elmer LC 55 spectrophotometer used as detector was about four times more sensitive than a Siemens SR 210 refractometer and detected a number of substances (probably beet constituents) which were present in such small quantities that the refractive index was unaffected. Linearity was established between the quantity of betaine (added to molasses solution in known quantities) detected by both instruments and peak height. Ranges of betaine contents found in the various named factory products in 1975/76 and 1976/77 are tabulated.

Knowledge on beet pectin. H. Andres, F. Kornfeil and V. Prey. *Zuckerind.*, 1978, **103,** 132-136 (*German*). Gravimetric, volumetric, colorimetric and enzymatic methods of pectin determination are reviewed and tests reported on quantitative determination using pure pectin preparations. Photometric determination using ruthenium red proved unsuccessful since no or only very slight precipitation took place at higher concentrations, so that no quantitative relationship could be established between extinction and concentration. A method based on precipitation of the pectin with cadmium gave values which were lower than given by a method involving addition of NaOH to liberate the pectic acid by splitting off the ester methoxyl groups in the pectin, after which acetic acid followed by calcium chloride were added and the pectin determined as calcium pectate after the chloride had been driven off; the pectate recovery was at least 98%. Precipitation with methanol was also tested and found to give at least 91·3% recovery. Details are given of a gas-liquid chromatographic method for determination of the methanol content, i.e. the degree of pectin esterification, by distillation after saponification with NaOH. Details are also given of a gel chromatographic method for determination of the pectin molecular weight.

The determination of the water content in white sugar and other sugar factory products by the Karl Fischer method using a recording potentiometer (the KFS method). H. Schiweck, T. Cronewitz and G. Müller. *Zuckerind.*, 1978, **103,** 185-190 (*German*). Details are given of an adaptation of the dead-stop Karl Fischer titration method, using a recording potentiometer, for determination of the moisture content in molasses, syrups and white sugar. Formamide is used as solvent for sugar, 10-15 minutes being required for dissolution of a test sample depending on crystal size (the amount of sample corresponding to a water content of 8-12 mg). In the case of syrup and molasses, 10 g samples have proved best, and methanol and formamide are suitable as solvents. Since consumption of the Karl Fischer solution has been found to depend on time, attaining a maximum in the first hour and falling thereafter, the titre must be established before each series of analyses. The method was used to determine the total moisture content in sugar stored in paper or polyethylene packets, as well as the surface and internal moisture. As expected, the moisture content fell more rapidly in paper packets, but the final values were practically identical regardless of material. The total and internal water contents rose with increase in crystal size, while the surface moisture content was little affected.

Determination of organochlorine insecticide residues in dry sugar beet pulp and molasses. P. B. Koster. *Zuckerind.*, 1978, **103,** 200-203 (*German*).—A gas-liquid chromatographic method is described which has been developed for determination of chlorinated hydrocarbon residues in beet pulp and molasses. Detection was possible down to 0·002 ppm and 0·0001 ppm in pulp and molasses, respectively. Values are tabulated for samples from Dutch sugar factories in recent campaigns, showing that the levels of all the pesticides determined were below the acceptable national level for animal fodder. Moreover, all chlorinated hydrocarbons have been banned from use with the exception of "Lindane" which is being increasingly replaced by "Aldicarb".

L-glutamine decomposition in main liming and evaporation. J. Nedelkovits and K. Fábián. *Cukoripar*, 1977, **30,** 227-231 (*Hungarian*).—The fates of L-glutamine, L-glutamic acid, amino-N and L-pyrrolidone carboxylic

acid (PCA) during juice purification and evaporation were investigated by means of laboratory studies and with reference to results from Petoháza factory. The contents of all four components in beet, juices (raw, thin and thick) and molasses were determined. Adsorption by $CaCO_3$ during purification, and saponification during evaporation (under the effects of temperature and pH) reduced the glutamine content considerably to a minimum which remained practically constant until molasses at below 5 ppm N on beet and was almost the same as the glutamic acid content (which remained practically constant from beet to molasses). The amino-N and PCA contents were also practically identical at the end of evaporation, remaining at this level in molasses (approx. 20 ppm N on beet), but the former had fallen from its original content in beet, while the PCA content had risen.

Determination of the bichromate oxidizability of sugar factory waste waters. A. P. Parkhomets, A. I. Sorokin and E. V. Ivashchenko. *Sakhar. Prom.*, 1978, (3), 22-25 (*Russian*).—After differences in the COD of different categories of sugar factory effluent had been found between the standard bichromate method, involving 2 hours' boiling of the sample, and an accelerated method in which only 5 minutes' boiling was used, tests were carried out to find causes of the discrepancies. Results showed that the COD values were governed by both the nature of the effluent and the period of boiling in the presence of potassium bichromate. For routine daily analyses, a variant of the rapid method has been devised in which 0·5-5 cm^3 of the sample is poured into a 100-cm^3 flat-bottomed round flask into which is then added 100 mg of mercuric sulphate followed by 20 cm^3 0·4N solution made up by dissolving 20 g finely crushed potassium bichromate in 500 cm^3 distilled water to which is then added 500 cm^3 conc. sulphuric acid. The contents of the sealed flask are boiled for 5 min, cooled, diluted with water, transferred to a conical flask, made up to 100 cm^3, and 2 cm^3 85% phosphoric acid followed by 3-5 drops of an indicator [diphenylamine, ferroin (based on phenanthroline and ferrous sulphate) or N-phenyl anthranilic acid] added. Titration is carried out with Mohr's salt. The difference between the quantity of Mohr's salt used to titrate a distilled water sample *a* treated as above and the effluent sample *b* is used to calculate the COD, which is given by $\frac{8000\,(a - b)\,NK}{V}$ where N is the normality of Mohr's salt, V is the volume of effluent (cm^3) and K is a correction factor having a specific value for each category of effluent.

Effect of potassium lactate on sucrose degradation in sulphitation juice. Z. A. Mil'kova, S. Z. Ivanov, V. V. Navolokin and B. I. Belolipetskii. *Sakhar. Prom.*, 1978, (3), 25-26 (*Russian*).—Investigations showed that addition of 0·025 and 0·1 mole.litre^{-1} of potassium lactate to sulphitation juice samples increased the sucrose degradation rate, reduced the juice thermal stability and caused a sharp fall in pH, the effects increasing with increase in the amount of lactate.

Semi-automatic line for determination of beet sugar content. A. Ya. Zagorul'ko *et al. Sakhar. Prom.*, 1978, (3), 32-36 (*Russian*).—Details are given of the LVV-40-1 semi-automatic tarehouse line which occupies only 9 m^2 of floor space and can handle 50 samples per hour.

Determination of the optimum juice alkalinity in preliming. L. P. Reva and G. A. Simakhina. *Sakhar. Prom.*, 1978, (3), 36-40 (*Russian*).—The optimum preliming alkalinity, at which albumin removal is maximum, is determined by adding (at the temperature at which the process is usually carried out in the factory in question) increasing quantities of milk-of-lime to 5-6 samples of juice, each of 50 cm^3, giving pH values in the range 10-12. After 10 or 20 minutes, depending on whether hot or warm preliming is used, the precipitate which has formed is removed under vacuum and the residual albumins in the filtrate determined by adding biuret and measuring the colour photocolorimetrically at 660 nm. Results have shown that the pH corresponding to optimum alkalinity is 11·4-11·5. The method is applicable both with and without recycling of carbonatation mud and takes only 50-60 minutes.

Technological characteristics of beet crowns and their effect on root quality as raw material for factory production of sucrose. R. Miletic. *Proc. 1st Congr. on Food Production in Yugoslavia; Sugar Beet and Sugar Manufacture*, 1975, 93-100; through *S.I.A.*, 1978, **40**, Abs. 78-146.—Compositions of crowns and roots of three beet varieties are tabulated, and the effects of the non-sugars are discussed.

Density measurement of sweetener solids. G. P. Heffelfinger. *Food Prod. Develop.*, 1977, **11**, (5), 28-29; through *S.I.A.*, 1978, **40**, Abs. 78-210.—At the Central Laboratory of the Syrup Plant Quality Control Department of Coca-Cola USA, the density, and hence the concentration, of flavoured syrups is measured by a Mettler/Paar precision density meter. This instrument is based on a quartz crystal timer, a U-shaped glass tube and a device to produce oscillations of constant amplitude in the tube; the time for a given number of oscillations is a function of the mass of the tube plus its contents. For 55°Bx syrups, sensitivity ranges from 0·02 to 0·0002°Bx, depending on the frequency of the oscillations. The precision is higher than that obtained with pycnometers or hydrometers (standard deviation $\pm$0·002°Bx). The accuracy is good for concentrations below 20°Bx, but above this it decreases with increasing concentration, and the meter must be calibrated against sugar solutions of concentrations similar to that of the sample, e.g. 50° and 60°Bx.

Measurement of the sizes of colloidal particles in coloured media. S. T. Krylov, E. B. D'yakova and V. V. Navolokin. *Fiz.-khim. Osnovy Pishchev. Tekh.*, 1974, **2**, 102-106; through *S.I.A.*, 1978, **40**, Abs. 78-213.—A method is given for converting light scattering data into mean particle size r via the dissymmetry A at infinite dilution and the parameter Z ($= 8\pi r/\lambda$); the formula derived for A allows for attenuation by the liquid phase. Values of A_∞, Z and r are tabulated for juices, syrups and molasses sampled at a beet sugar factory on four dates in November-December 1970; the persistence of smaller particles throughout purification and crystallization is noted. It is concluded that diffusion should be directed towards maximum coagulation, and that polishing filtration (of juice?) and syrup sulphitation are advisable.

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BY-PRODUCTS

Mechanical considerations on depithing equipment. J. Lois C. *Revista Icidca,* 1976, **10,** (3), 3-30 (*Spanish*).—A survey is presented of the various depithing machines currently in operation or under development, with an account of their mechanical design, maintenance and technical characteristics (capacity, power requirements, etc.). A comparison is made of the units described.

Mathematical simulation of black liquor recovery systems. M. Castellanos C., P. López G. and M. García P. *Revista Icidca,* 1976, **10,** (3), 45-54 (*Spanish*).—The simulation has been developed, based on materials and energy balance equations, in order to study different systems for recovery of black liquor from bagasse sulphate pulp production.

Simulation of the production of bagasse sulphate pulp. R. Suárez R. and L. González P. *Revista Icidca,* 1976, **10,** (3), 55-64 (*Spanish*).—Development of a mathematical model of the steady-state bagasse pulping process is described.

A scheme for the disposal of distillery spent wash. R. S. Dubey, N. C. Varma, M. K. Patil and S. N. G. Rao, *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977. G.1-G.6.—A scheme is proposed for distillery waste treatment, in which the spent wash is neutralized with lime, evaporated to 70-80°Bx in a sextuple-effect evaporator and then mixed with sufficient dried filter cake or bagacillo to make it suitable for handling, storage and transport. The mixture can then be sold as fertilizer. Details are given of the machinery requirements and of the economics of the scheme.

A positive step towards conversion of Indian sugar cane crude wax to an industrial or a hard wax. S. C. Ray and P. F. Jain. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, G.7-G.16.—Crude wax hydrogenation experiments with addition of lime (for saponification) and of phthalic anhydride (for polyesterification) are reported, and the resultant hard wax compared with crude wax and Carnauba wax.

Kojic acid synthesis by re-suspended mycelia of *Aspergillus flavus.* P. Bajpai, P. K. Agrawal and L. Viswanathan. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, G.17-G.23.—*A. flavus* mycelia grown on a sucrose-yeast extract medium for 4 days were washed with sterile, distilled water and suspended in 0·2M sodium phosphate buffer of pH 6·5 containing 20% sucrose or dextrose. About 1·75 g of mycelia in 50 cm^3 buffer solution yielded 100 mg kojic acid after 20 hours and 2·15 g after 7 days. No kojic acid was formed by intact mycelia in the presence of phosphate alone or when homogenized mycelia were incubated with the buffer plus sucrose on a shaker, but intact mycelia pre-incubated during 4 days in the phosphate solution in the absence of the sugar could still form kojic acid if re-suspended in the buffer in the presence of sucrose.

Effect of clarification of molasses on kojic acid fermentation. P. Bajpai, P. K. Agrawal and L. Viswanathan. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, G.25-G.37.—Clarification of 10°Bx molasses with various agents increased kojic acid yield in only two cases (with egg albumin and ammonium sulphate) by comparison with results for unclarified molasses, while yield fell in all other cases; even ion exchange treatment failed to increase yield significantly. Addition of 1% yeast extract increased yield considerably in all cases except where ammonium sulphate was used as clarifying agent (when the yeast caused a 50% reduction in yield), but values for clarified solutions were still below those for unclarified molasses. The yields from unclarified molasses of 10, 20 and 30°Bx were considerably enhanced by the yeast (by 274% in the case of the 30°Bx solution to give a maximum yield of 53·3%, or 80 $mg.cm^{-3}$).

Experimental contributions to the study of the problems of pollution by distillery waste. C. A. Accorsi and F. Zama. *Ind. Sacc. Ital.,* 1977, **70,** 150-151 (*Italian*).—Treatment of vinasse by evaporation is complicated by the high content of inorganic salts (mainly calcium) which cause incrustation, while its use as animal fodder and as substrate for yeast production is also hindered. Experiments were conducted on pretreatment of vinasse to precipitate the inorganic salts by adding ammonia, heating to 75-80°C and then bubbling in CO_2 gas. The quantities of ammonia and CO_2 depended on the pH before and after ammonia treatment and the final pH required. At a pH of 10 before and 7·02 after CO_2 treatment, Ca^{++} ion elimination reached 90%. Analysis of the precipitate showed 55% $CaCO_3$ and 1·1% K + Na + total N. The question of time of reaction between the ammonia and vinasse before CO_2 introduction is discussed.

The sugar industry in Maharashtra: a perspective. P. N. Soman. *Maharashtra Sugar,* 1977, **3,** (2), 29-42. A survey is presented of agricultural and factory practices in Maharashtra, and some recommendations are given, including the erection of a distillery at every sugar factory, the cessation of khandsari sugar and gur manufacture, the use of molasses and bagasse as animal fodder and the possibility of adding CO_2 (emanating from distilleries) to irrigation water with the possible aim of raising cane yield. Other possible uses of CO_2 are also mentioned.

Commercial manufacture of citric acid by fermentation. I. A review. P. K. Agrawal and L. Viswanathan. *Sharkara,* 1975, **14,** (1), 17-44.—A survey is presented of the literature (142 references) on citric acid fermentation, factors affecting it, by-products from it and its economics. A flow diagram is given of both surface and submerged fermentation.

By-products research in Mauritius. Anon. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.,* 1976, 62.—Investigations on loss of dry matter and other changes in fresh muds during storage in sealed polyethylene bags

showed that sugar constituted the bulk of the dry matter lost (which was up to 20% of the original content). The amount of crude fibre also fell appreciably. The decrease in sugars and the increase in the amount of crude protein suggested synthesis of microbial protein. The 20·5% of crude protein in the material after 8 weeks' storage was therefore apparently due to both a loss of non-protein material and an absolute increase in crude protein. The effects of various additives on the quality of silage made from fresh cane tops was studied, and the best results obtained by incorporating 0·25% N as ammonia and 5% molasses. In goat feeding trials, there was no difference in the digestibility of fresh cane tops and of silage made from them. The production of volatile fatty acids (VFA) and lactic acid in the rumen were measured. A Perkin Elmer F17 gas chromatograph with a 1 m × 4·6 mm i.d. coiled stainless steel column packed with 15% "Tween 80" and used in conjunction with a flame ionization detector proved suitable for determination of the VFA of greatest interest, *viz.* acetic, propionic and *n*-butyric acids, in cane top silage and rumen liquor; the analytical method used was accurate to within ±5%, which is considered acceptable with biological materials. Preliminary laboratory experiments on synthesis of microbial protein from various cane by-products using an inoculum obtained from France did not give encouraging results, mainly because of the difficulty of simultaneously controlling humidity and temperature.

Commercial manufacture of citric acid by fermentation. II. Isolation of a culture giving high yields of citric acid. P. K. Agrawal, C. S. Bhatt and L. Viswanathan. *Sharkara,* 1975, **14,** (2), 9-15.—A number of fungal cultures from various sources were used in tests to produce citric acid on a medium containing 14% sucrose, 0·223% NH_4NO_3, 0·1% K_2HPO_4 and 0·023% $MgSO_4$ after adjustment to pH 2·2 with 1N HCl. A maximum of 35·2 mg anhydrous citric acid per cm^3 of medium was obtained with a culture identified as *Aspergillus niger.* Citric acid accounted for 73·4% of the total acids produced, and represented 25% of the sugar added to the medium.

Brazil's national plan for power alcohol from sugar cane. A. P. Saranin. *Producers' Rev.,* 1977, **67,** (12), 23-26.—The suthor outlines the National Alcohol Plan formulated by Brazil for alcohol production from sugar cane by the Melle-Boinot method using *Saccharomyces cerevisiae.* The fermentation and distillation processes are briefly described with the aid of a flow diagram, and the author's own views on the national scheme are listed.

Method for rapid determination of the optimal dose of potassium ferrocyanide in the preparation of molasses substrates for citric acid fermentation. W. Leśniak. *Przemysl Ferment. i Rolny,* 1976, **20,** (6), 22-25; through *S.I.A.,* 1978, **40,** Abs. 78-170.—The method involves determination of the free ferrocyanide concentration in solution after dosing with potassium ferrocyanide; for all the molasses investigated this concentration was 100-150 mg.litre^{-1} when the optimum dose had been added, i.e. that which gave maximum citric acid production.

Dissolved oxygen as a parameter of automatic control of the nutrient medium inflow in the yeast cultivation process. II. Choice of technological conditions for baker's yeast culture. T. Miśkiewicz and W. Leśniak. *Przemysl Ferment. i Rolny,* 1976, **20,** (7), 4-7; through *S.I.A.,* 1978, **40,** Abs. 78-166.—The increase in biomass was not affected by the amount of seed yeast used nor by the molasses concentration in the medium. Productivity was greatest when the dissolved oxygen concentration was 3-4% of the saturation value.

Dissolved oxygen as a parameter of automatic control of the nutrient medium inflow in the yeast cultivation process. III. Factory-scale investigations. T. Miśkiewicz, W. Leśniak, J. Pietkiewicz *et al. Przemysl Ferment. i Rolny,* 1976, **20,** (11), 5-7; through *S.I.A.,* 1978, **40,** Abs. 78-167.—Yeast was cultured in vessels of capacity 116 m^3. With throughputs greater than 70 kg molasses (containing 50% dry solids) per m^3 per hr, production of 1 kg yeast containing 27% dry solids required the consumption of about 1·05 kg molasses and 4 m^3 air; the residual solution contained more than 10% molasses. The properties of the product met the requirements for baker's yeast.

Inhibitory effects of molasses for citric acid production by *Aspergillus niger.* D. V. Vadehra, V. Gogia, M. Raj and J. K. Gupta. *Indian J. Experimental Biology,* 1977, **15,** (4), 335-336; through *S.I.A.,* 1978, **40,** Abs. 78-169.—Addition of cane molasses, either initially or after 2-3 days' fermentation, to a synthetic medium used for the culture of *A. niger,* decreased the yield of citric acid. Addition of dried molasses had a similar but greater effect; addition of molasses ash or of the non-dialysable fraction of molasses had a smaller effect, while addition of the dialysable fraction had about the same effect as whole molasses, suggesting that the inhibitory substances were low-molecular weight compounds which were partly destroyed by ashing.

Possible utilization of sugar cane bagasse. G. D. Agrawal. *Indian J. Environmental Health,* 1974, **16,** (2), 159-167; through *S.I.A.,* 1978, **40,** Abs. 78-180.—Processes for the production of furfural and of single cell protein from bagasse are outlined, and the feasibility of applying them in India is briefly discussed. It is considered that bagasse could be subjected to these two processes in turn, and afterwards used as fuel or as raw material for paper pulp.

Hemicelluloses as additive in papermaking. III. Effect of hemicelluloses isolated from plant raw materials compared with the effect of those isolated from pulps on paper properties. A. E. el-Ashmawy, F. Mobarak and S. el-Kaliobi. *Cellulose Chem. Tech.,* 1976, **10,** (5), 637-640; through *S.I.A.,* 1978, **40,** Abs. 78-182.—Hemicelluloses isolated from bagasse, bagasse pulp and rice straw were compared with that from rice straw pulp as additives in papermaking. The fibrous furnish used was a commercial bleached softwood pulp. After addition of 5, 10 or 15 g hemicelloluse/100 g pulp, the % retentions of hemicelluloses from bagasse and from bagasse pulp were, respectively, inferior to and equal to the % retention of that from rice straw pulp. In its effect on paper properties, bagasse hemicellulose was better than bagasse pulp hemicellulose but inferior to that from rice straw pulp.

BREVITIES

Kenya sugar production[1].—The Chairman of Mumias Sugar Company announced recently that Kenya would be self-sufficient in sugar and even have a surplus of mill white sugar available for sale outside the country after 1980. Production in 1978 was 230,000 long tons while local demand was estimated at between 250,000 and 400,000 tons. The industry's major problem is the excess of cane production over the milling capacity of the established factories, while the situation is being aggravated by non-contract growers who add to the supply of cane.

Ecuador sugar situation[2].—A critical stage was reached in the sugar situation in Ecuador during 1977/78, when 14,326 tonnes of sugar had to be imported in order to meet a shortage prior to the start of the next campaign. Previously, Ecuador had always been a net exporter without having to import a single tonne of sugar. The supply and distribution figures for the current and previous two years are tabulated below:

	1976/77	1977/78	1978/79
	tonnes, raw value		
Initial stock	7,711	33,102	33,915
Production	301,158	294,869	360,000
Imports	—	14,326	—
	308,869	342,297	393,915
Consumption	253,527	280,000	295,000
Exports	22,240	28,382	60,000
Final stock	33,102	33,915	38,915

The need to import arose from the fact that, towards the end of the 1977/78 crop year and immediately before the 1978/79 campaign, there was a shortage of sugar. Such a situation would not be anticipated from the above table; some hoarding of sugar must have taken place and such hidden stocks would tend to inflate the stock figures unless shown under consumption.

Guinea-Bissau sugar project[3].—According to press reports, the projected Guinea-Bissau sugar industry is to be considerably less ambitious than originally proposed[4]. Instead of an outturn of 60,000 tonnes of refined sugar per year, 80% for export, it is now planned to limit capacity to 10,000 tonnes, sufficient to cover local requirements. Up to 2000 hectares of cane would be planted and the factory, to be built in 1980/81, would process up to 650 t.c.d. The total investment required is thus reduced to $30–40 million, against the $185–200 million of the original proposals.

Pakistan sugar production[5].—The 1977/78 season produced an all-time sugar production record of over 856,000 long tons.

Brazilian milling tandem for Costa Rica.—Zanini S.A. Equipamentos Pesados has received an order worth about $1,400,000 for the supply of a tandem of four 37×72 inch mills t o Ingenio Taboga. The mills will be complete with their individual steam turbine drives and reduction gearing, and will replace an old tandem, allowing an expansion of capacity as well as improved extraction.

US smut emergency regulations[6].—After thoroughly surveying cane-growing areas of Florida, Louisiana and Texas, the US Department of Agriculture has established emergency regulations to stop the artificial spread of cane smut from infected areas of Florida to other states. Under the new Federal regulations, cane plants, parts of plants, and seed, and used cane processing and harvesting equipment may not be moved from the infected counties in Florida unless treated and certified free of smut spores.

C.I.T.S.

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Polish sugar industry decline[7].—The sugar industry has been going through a period of decline, judging by production in recent years. After a peak production of 1,950,000 tonnes, white value, in 1967/68, output declined to 1,620,000 tonnes in 1974/75 and had recovered to 1,670,000 tonnes by 1977/78. Prospects for 1978/79 are not encouraging; excessive rainfall after a very dry spring reduced the planted area from a planned 580,000 ha to only about the same as in 1977, *viz.* 532,000 ha. The official goal is to increase the beet area to 580,000 ha. At harvest time the fields were muddy because of almost continuous rain during the summer, and the harvesting was slowed, the delay causing further delay when farmers gave preference to lifting of frost-susceptible crops such as potatoes. Beet yield is expected to be low as is sugar content, and production is estimated at 1,610,000 tonnes. Weather conditions are obviously beyond the control of the authorities, but other factors which contributed to the decline in sugar production were a shortage of fertilizers, weed infestation, disease and the variety of beet grown.

West Indies Sugar Technologists 1979 meeting.—It has been decided to hold the next meeting of the West Indies Sugar Technologists in Guyana in September 1979, probably in the week commencing September 23. Representatives of firms and associations associated with sugar technology will be welcome and submission of papers to be discussed at the meeting are invited, the names of delegates and titles of papers to be notified to the Secretary, W.I.S.T., c/o Sugar Association of the Caribbean Inc., P.O. Box 230, 80 Abercromby St., Port-of-Spain, Trinidad, not later than the end of March 1979.

Cuban sugar factory plant replacement[8].—As part of the modernization programme of the Cuban sugar industry during 1976/80, 170 of the 913 mills installed have been replaced, and the further 100 are to be replaced in the subsequent five-year plan. In 1971 it was considered that some 80% of sugar machinery and equipment was obsolete, but by the end of 1978 over 70% of mill gearing was to have been replaced, and 98 turbines and 50 large steam engines installed. Of the industry's 1054 steam boilers, it is planned that 204 will be replaced by the end of 1980 and a further 133 in the following five-year programme. Of the 3500 centrifugals installed, 77% were considered out of date in 1971 and, by 1980, 1061 new machines will have been installed.

Somalia sugar expansion plans[9].—Currently Somaiia produces about 30,000 tonnes of sugar, sufficient to meet 50% of its requirements. Plans call for an increase in the crushing capacity of the mill at Jowhar and the building of a new one at Jilib (Lower Jobe). The latter project is planned to cover an area of 8500 ha, cost 1 million Somali shillings and have a production capacity of 32,000 tonnes. The new factory is expected to enter into service in June 1980 and to double its production after the second phase is completed.

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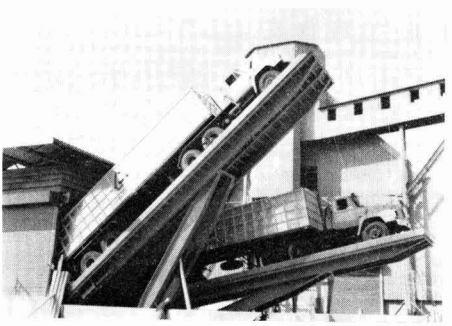
[1] *Standard Chartered Review*, 1978, (Dec.), 6.
[2] *World Sugar J.*, 1978, **1**, (6), 17.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (36). 18.
[4] *I.S.J.*, 1978, **80**, 322.
[5] *Standard Chartered Review*, 1978, (Dec.), 18.
[6] *US Dept. Agric. News*, November 24, 1978.
[7] *World Sugar J.*, 1978, **1**, (6), 18.
[8] *Cuba Economic News*, 1978, **14**, (88), 13.
[9] *World Sugar J.*, 1979, **1**, (7), 25.

BREVITIES

Brazilian sugar factories for Morocco.—Acting through a specially formed consortium, Zanini S.A. Equipamentos Pesados is to provide sugar factory machinery and Santal Equipamentos S.A. the cane loading and transporting equipment for eight turn-key sugar factories of 5000 t.c.d. average capacity in Morocco, to be constructed during the next ten years.

Raw sugar bulk handling in Thailand.—The illustration shows two of a fleet of 42 all-aluminium tractor-trailer units belonging to United Sugar Co. of Thailand to deliver and offload raw sugar directly into a new purpose-built storage terminal. The units are operated on a 24-hour basis, transporting raw sugar from mills to the terminal, where the whole tractor unit plus semi-trailer is tipped on the ramp, its sugar load being discharged onto conveyors leading to the main storage shed.



PROTECH.—This new company, otherwise known as Tate & Lyle Process Technology Ltd., has been formed in order to take over and expand the TALO range of products and processes, effluent engineering and fermentation processing—all previously handled separately by three Tate & Lyle Divisions. The TALO sugar syrups clarification processes, equipment and controls are already well-known and new techniques are now being introduced for sugar juice clarification/filtration, clarifier mud filtration and "transformed" sugar manufacture. As far as traditional effluent engineering is concerned, PROTECH is already well established in the UK and is looking to export markets for its major expansion. PROTECH's third area of expertise is fermentation processes and the company will be putting a great deal of effort into developing the rapidly expanding power and industrial alcohol sectors by introducing in the future new techniques such as continuous fermentation and immobilized enzymes for the conversion of starches. PROTECH can design and build complete distilleries, including by-product recovery plant, to meet individual requirements. The new company is based at Cosmos House, 1 Bromley Common, Bromley, Kent, England.

Switzerland sugar production, 1978/79[1].—The two sugar factories of Switzerland at Aarberg and Frauenfeld sliced a total of 633,653 tonnes of beet in the last campaign to produce 98,582 tonnes of white sugar and 22,125 tonnes of molasses.

Afghanistan sugar factory[2].—A sugar factory costing $53 million is to be built by Fives-Cail Babcock in the Kunduz area of north Afghanistan. It will produce 37,000 tonnes per year of refined sugar and is essential to make the country self-sufficient in sugar.

Brazilian bulk sugar terminal.—An illustrated booklet has been published by the Instituto do Açúcar e do Alcool to describe the modern bulk sugar terminal constructed at the port of Maceió. There are two raw sugar warehouses of hyperbolic section, each with a capacity of 100,000 tonnes. Sugar arrives in rail cars or trucks and is dumped into underground bins where it is weighed and transported to either the warehouses, a bagging station, or direct to the waiting ship. Sugar from the warehouse may be reclaimed, continuously weighed and sent direct to a ship or to the bagging station. A high level of automation is employed with centralized control of operations, and the various operations (reception, storage, reclamation, bagging, and loading in bulk and in bags) can be performed simultaneously. The final estimated cost of the construction and installation of the terminal is 450 million cruzeiros ($22,500,000). Reception capacity is 1000 tonnes.hr^{-1}—half by road and half by rail—while sugar in bulk can be loaded at 1000 tonnes.hr^{-1} and bagged sugar at 4000 bags per hour.

Colombia sugar project[3].—Colombia and Venezuela have approved the establishment of a $100 million equivalent agro-industrial complex in Zulia, to be financed by both governments and the Corporación Andino de Fomento. A mixed-capital company will plant cane over 10,000 hectares, build a factory to process 4000 tonnes of cane a day and construct an alcohol distillery with a daily capacity of 150 hl.

Greece sugar production, 1978/79[4].—Hellenic Sugar Industry A/S have announced that, despite adverse weather during the harvesting season, the 1978/79 campaign results were satisfactory. Sugar production was some 324,943 tonnes, white value, against 270,278 tonnes in the preceding campaign, and Greece is self-sufficient in sugar for the fourth consecutive year. As domestic sugar consumption is estimated at 285,000 tonnes, white value, the country has some sugar available for export. The area devoted to sugar beet in 1979 is expected to reach 46,000 ha, slightly in excess of the 1978 area.

Sudan sugar scheme difficulties[5].—Sudan is faced with serious difficulties in meeting payments due to Western export credit organizations and the government has so far been unsuccessful in its efforts to arrange to reschedule its debts on a bilateral basis. The creditors are interested in a multilateral arrangement after they have been fully informed about all Sudan's debts. The situation puts sugar projects in serious jeopardy; the Melut project, calling for 12,000 ha of cane and 100,000 tonnes of refined sugar production per year, was scheduled for completion in September 1979 but only 10% of the scheme had been carried out by December 1978.

Yugoslavia sugar exports possibility[6].—According to press reports, Yugoslavia will have a sugar surplus of 200,000 tonnes in 1979 and will offer 70,000 tonnes on the world market. It was added that in two or three years the export surplus could be of the order of 300–400,000 tonnes.

PERSONAL NOTES

Sir George Bishop, who was 65 in October, is retiring as chairman of Booker McConnell after the annual general meeting in May 1979. The board intends to elect Mr. **M. H. Caine,** at present vice-chairman and chief executive, to succeed him Mr. Caine will then combine the office of chairman with that of chief executive. Sir George has agreed to remain on the board after his retirement as chairman in a part-time andn on-executive capacity for the next two or three years.

Mr. **C. J. Laan** joined Humphreys & Glasgow Ltd. on November 1, 1978 and will assume responsibility for the establishment and management of their Singapore office. Until recently Mr Laan was sales director of Fletcher and Stewart Ltd., Derby. During his term of office with them, he travelled extensively throughout the world and negotiated contracts for several major sugar factory projects. He started his career in the sugar industry in Java in 1948, joined Booker McConnell in 1953 and worked with them in Guyana and Jamaica before returning to the UK in 1966. In Java and the West Indies, he was responsible for the management of sugar estates.

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[1] *Zuckerind.*, 1979, **104,** 82.
[2] *World Sugar J.*, 1979, **1,** (7), 28.
[3] *Bank of London & S. America Review,* 1978, **12,** 705.
[4] F. O. Licht, *International Sugar Rpt.,* 1979, **11,** (2), 29.
[5] *World Sugar J.*, 1979, **1,** (7), 27.
[6] F. O. Licht, *International Sugar Rpt.,* 1979, **111,** (2), 29.

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