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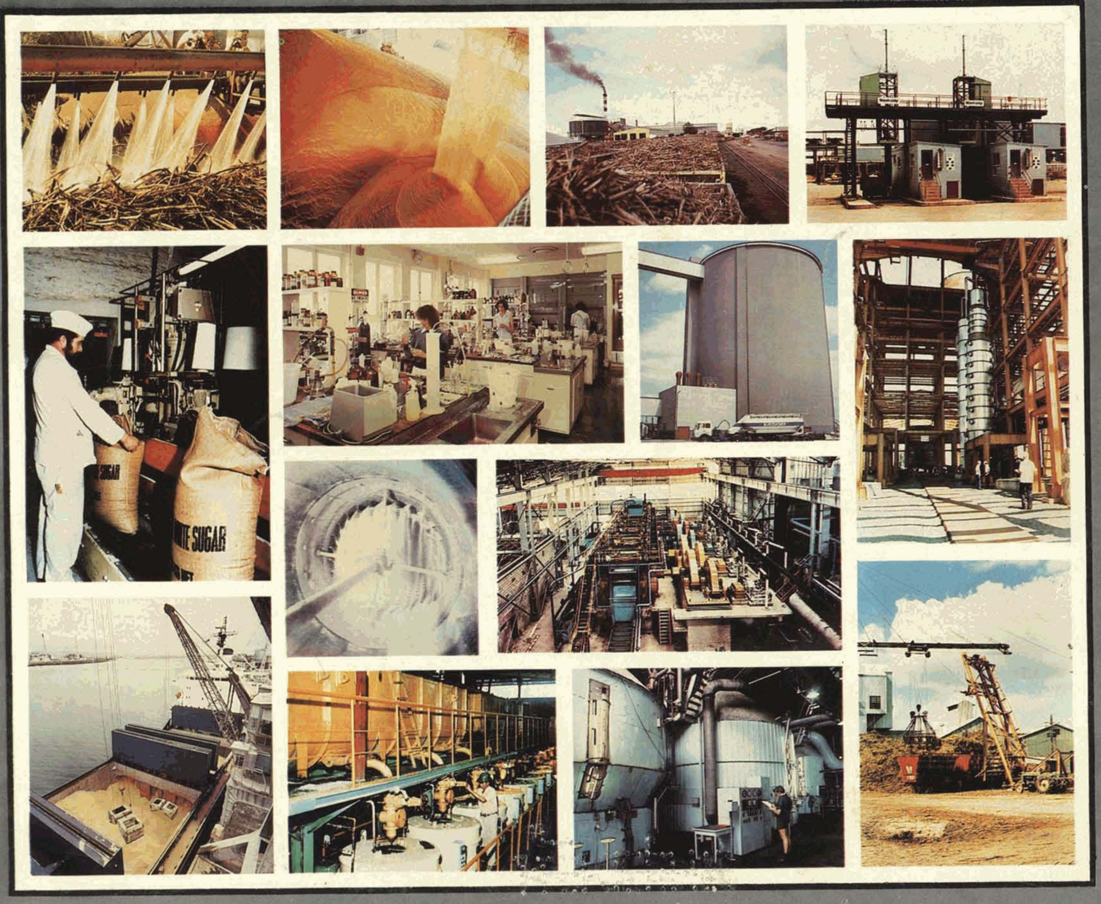

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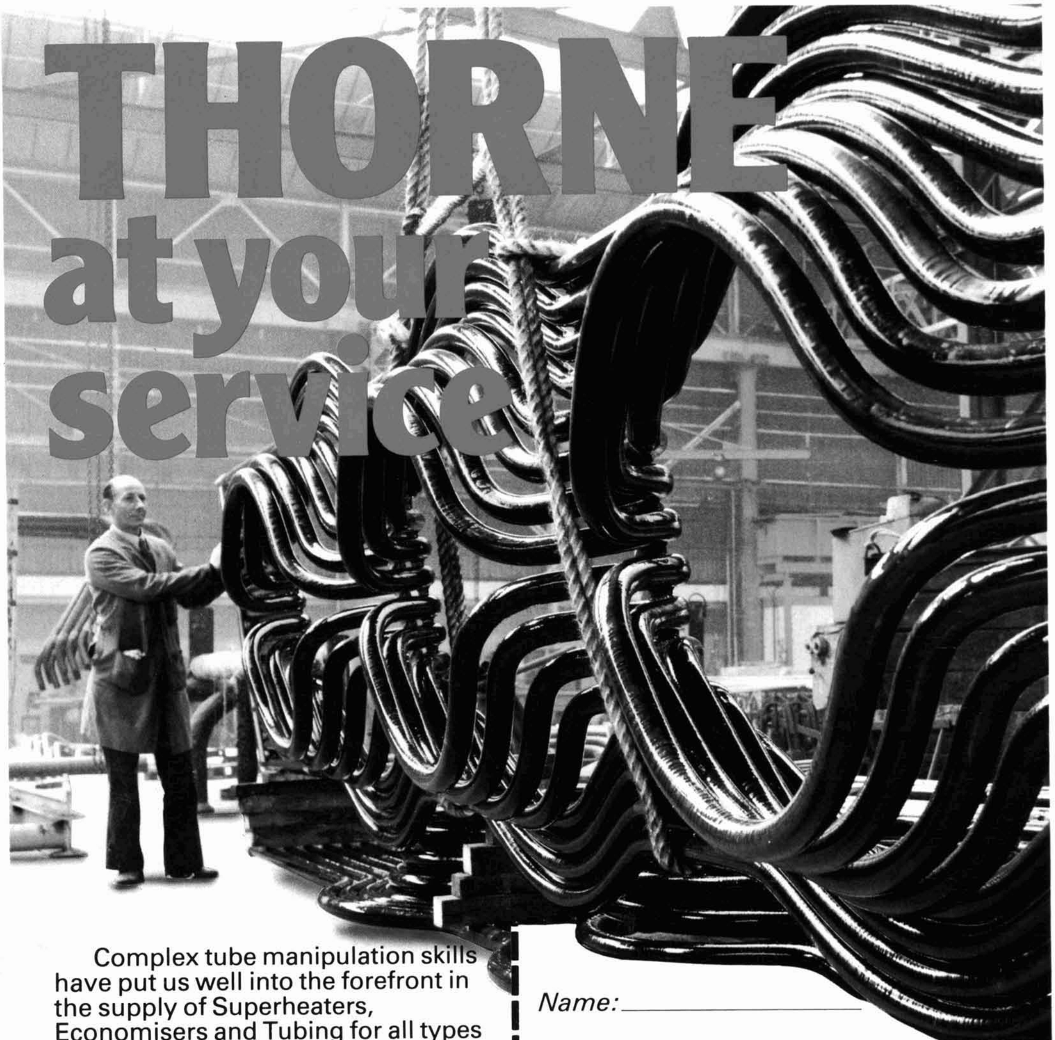
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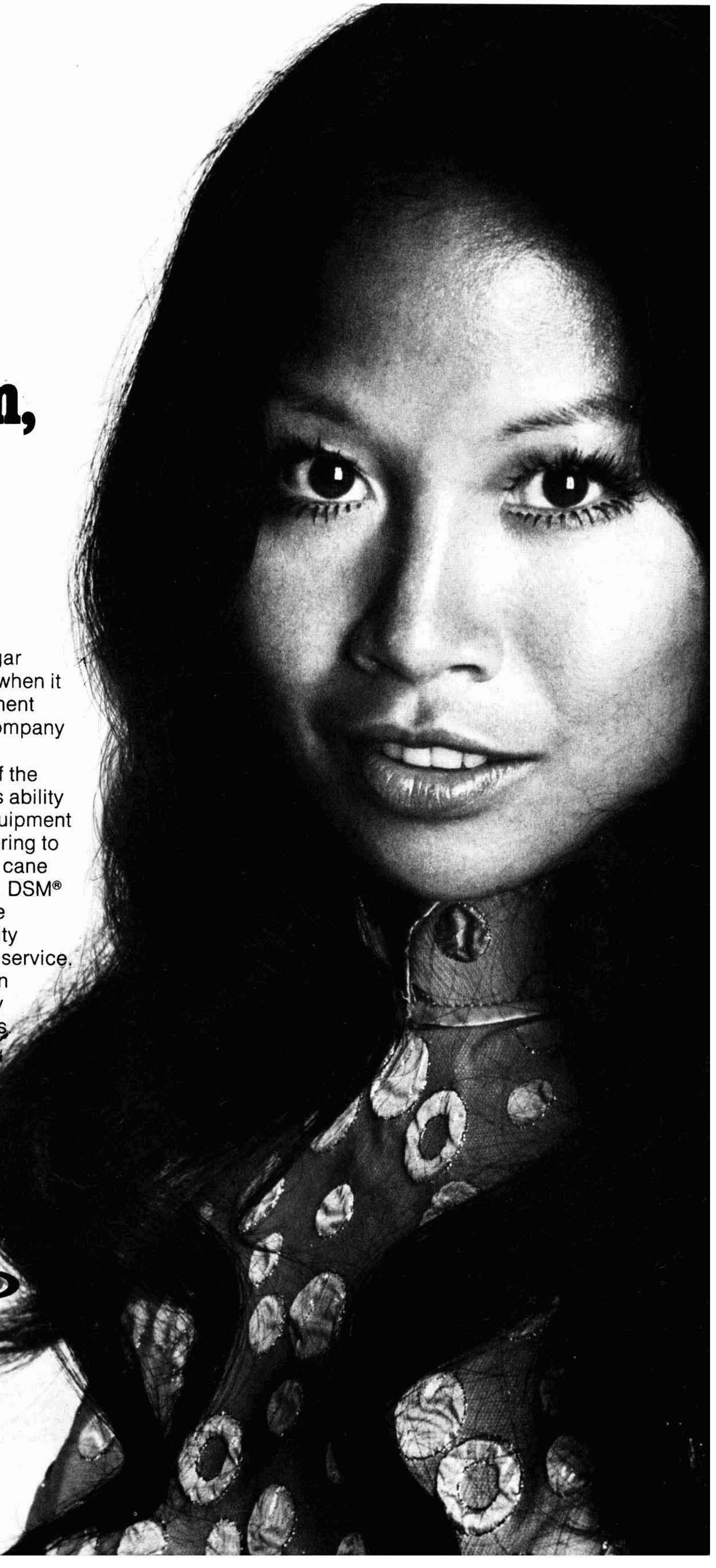

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NOTES AND COMMENTS

European sugar beet area

F. O. Licht GmbH recently issued their third and revised estimate[1] of sugar beet areas in Europe for the 1983 crop, based on conditions to the end of May. As a consequence of the very wet weather and consequent delays in getting into the fields, the crop areas have been reduced from the previous estimate in most countries of Western Europe, although Finland and Spain are seen as having sown slightly more area than the estimate of April 1983. The major reductions are indicated for the crops in Belgium, France, Turkey and Yugoslavia, with minor adjustments to the figures of some other countries.

Most of the eastern European area estimates are unchanged from April, but that for Poland is reduced by 9000 ha and that for the USSR by 25,000 ha. The net effect is of a reduction of 100,000 ha in Europe as a whole, compared with the second estimate and somewhat more than 200,000 ha reduction from 1982. The figures appear below.

	1983	1982	Decrease/increase 1983 vs. 1982	
	hectares			%
Belgium	107,000	130,000	– 23,000	– 17.7
Denmark	75,000	76,000	– 1,000	– 1.3
France	472,000	543,000	– 71,000	– 13.1
Germany, West	404,000	429,000	– 25,000	– 5.8
Greece	40,000	42,000	– 2,000	– 4.8
Holland	125,000	134,000	– 9,000	– 6.7
Ireland	36,000	34,000	+ 2,000	+ 5.9
Italy	225,000	255,000	– 30,000	– 11.8
UK	200,000	201,000	– 1,000	– 0.5
Total EEC	*1,684,000*	*1,844,000*	*– 160,000*	*– 8.7*
Austria	42,000	58,000	– 16,000	– 27.6
Finland	33,000	32,000	+ 1,000	+ 3.1
Spain	260,000	260,000	0	0.0
Sweden	53,000	54,000	– 1,000	– 1.9
Switzerland	15,000	15,000	0	0.0
Turkey	358,000	372,000	– 14,000	– 3.8
Yugoslavia	148,000	139,000	+ 9,000	+ 6.5
Total Western Europe	*2,593,000*	*2,774,000*	*– 181,000*	*– 6.5*
Albania	11,000	10,000	+ 1,000	+ 10.0
Bulgaria	54,000	53,000	+ 1,000	+ 1.9
Czechoslovakia	216,000	214,000	+ 2,000	+ 0.9
Germany, East	250,000	261,000	– 11,000	– 4.2
Hungary	109,000	126,000	– 17,000	– 13.5
Poland	481,000	493,000	– 12,000	– 2.4
Rumania	265,000	269,000	– 4,000	– 1.5
USSR	3,525,000	3,526,000	– 1,000	– 0.0
Total Eastern Europe	*4,911,000*	*4,952,000*	*– 41,000*	*– 0.8*
Total Europe	7,504,000	7,726,000	– 222,000	– 2.9

Licht have calculated the sugar production figures for each country's new area, based on the highest, lowest and average yields and these potential production figures calculated as shown below. The average yield total is a marked reduction from the actual figure for 1982/83, so far as the EEC is concerned, and Licht recognize that, not only has the area for many individual countries been reduced, but the lateness of the sowings and the cold, wet weather have delayed germination and growth, so that yields could well be lower than average. On the other hand, the USSR crop was sown earlier than usual and on only a slightly reduced area; it has subsequently been affected by dry conditions and so the beet crop is not likely to reach the planned 96.1 million tonnes but might well be greater than the disastrous crop last year.

A low crop for the EEC was expected at the beginning of June by the French Sugar Market Intervention Board (FIRS), who suggested tht it could fall to 10.3 million tonnes, white value (11.2 million tonnes, raw value)[2]. However, the weather improved considerably in the

	High	Average	Low	1982/83
	tonnes, raw value			
Belgium	888,000	830,000	737,000	1,200,000
Denmark	515,000	465,000	376,000	584,000
France	4,267,000	3,649,000	2,440,000	4,822,000
Germany, West	3,208,000	2,897,000	2,440,000	3,586,000
Greece	334,000	300,000	270,000	322,000
Holland	1,066,000	933,000	850,000	1,229,000
Ireland	204,000	192,000	176,000	242,000
Italy	1,579,000	1,415,000	1,271,000	1,283,000
UK	1,178,000	1,052,000	744,000	1,544,000
Total EEC	*13,239,000*	*11,733,000*	*9,304,000*	*14,812,000*
Austria	383,000	355,000	312,000	612,000
Finland	131,000	101,000	77,000	116,000
Spain	1,373,000	1,277,000	1,118,000	1,206,000
Sweden	381,000	342,000	296,000	388,000
Switzerland	145,000	123,000	106,000	120,000
Turkey	1,854,000	1,500,000	1,257,000	1,848,000
Yugoslavia	961,000	918,000	876,000	712,000
Total Western Europe	*18,467,000*	*16,349,000*	*13,346,000*	*19,814,000*
Albania	36,000	32,000	18,000	35,000
Bulgaria	199,000	167,000	147,000	180,000
Czechoslovakia	939,000	807,000	626,000	885,000
Germany, East	720,000	627,000	517,000	810,000
Hungary	537,000	474,000	341,000	587,000
Poland	1,914,000	1,621,000	1,284,000	2,012,000
Rumania	806,000	686,000	583,000	652,000
USSR	8,425,000	7,297,000	6,028,000	6,800,000
Total Eastern Europe	*13,576,000*	*11,711,000*	*9,544,000*	*11,961,000*
Total Europe	32,043,000	28,060,000	22,890,000	31,775,000

second half of June and reminded everyone that, with good growing conditions from now on, the prospects for sugar production could be changed considerably by harvest time.

ISA quotas in effect

Notification of quota shortfalls by exporting members of the ISA have to be made by May 15 and by September 30 each year, and a group of nine countries made declarations totalling 743,627 tonnes, raw value, for the first. Further shortfalls are likely to be declared in September, and Cuba, Ecuador and Mozambique have notified the Council that they will not be able to fulfil their quotas, but are not yet able to quantify their shortfalls.

Shortfalls are not to be redistributed until the price reaches 14.0 cents/lb so that the quotas in effect of the other exporting members are unchanged and the total of quotas in effect is 16,219,183 tonnes. As the current estimate of global requirements is only 12,992,000 tonnes, the reduction of the quotas of the nine exporting members has no practical significance.

The shortfalls declared were: Bolivia 17,470 tonnes, Guyana 8023 tonnes, Jamaica 83,773 tonnes, Mexico 70,000 tonnes, Peru 200,600 tonnes, Philippines 110,014 tonnes, El Salvador 39,233 tonnes, South Africa 144,514 tonnes and Trinidad 70,000 tonnes.

World sugar prices

Sugar prices on the world market fluctuated wildly during the first half of June, the LDP falling within five markets days from £188.50 per tonnes on June 1 to £157 on June 7, largely owing to evaporation of confidence on the part of speculators. The underlying improvement reasserted itself, however, and the raw sugar price rose again to £179 by June 10 and ended the month at £178, with a number of dips during the intervening period but of less severity. Bull factors included reports of new and continuing difficult weather conditions in both beet and cane sugar countries, indications of increased Soviet requirements, a report of white sugar imports by South Africa and Fiji, and the outbreak of cane smut in Barbados. Later in the month, improvement of weather in Europe and the news of better than expected crops in India, Indonesia and Mexico all had a bearish influence on the market.

White sugar prices ran almost parallel to those for raw sugar. After rising from £22.50 on June 1 to £28 on June 2 the differential between the LDP (W) and LDP remained at about £30 for the rest of the month. The LDP(W) started the month at £211 but, after falling to below £190 on occasion, ended the month at £206 per tonne.

1 *International Sugar Rpt.*, 1983, **115**, 309-313.
2 *Public Ledger's Commodity Week*, June 4, 1983.

World sugar production estimates

F. O. Licht GmbH recently published[1] their third estimate of world sugar production for the crops beginning in the twelve months from May 1982, which include the latest beet sugar campaign in Europe, for instance. In many cases the figures included are official final production data and these result in a total beet sugar output of 36,930,000 tonnes, raw value, against the second estimate of 36,706,000 tonnes and the corrected 1981/82 figure of 36,949,000 tonnes.

World cane sugar production for 1982/83 is set at 62,331,000 tonnes against the earlier estimate of 62,160,000 tonnes and the 1981/82 figure of 63,158,000 tonnes.

US sugar legislation[2]

At the end of June two measures were formally approved which had been held up for some time. The re-export program, which caters for the import of world market raws free of quota restrictions provided it is for refining and re-export within three months[3], has been implemented. There have been some minor changes; for example, the amount authorized under a single licence has been increased from 25,000 to 28,000 short tons.

Arrangements have also been completed which impose a ban on the import of blends to sugar and syrups, with effect from June 29. The International Trade Commission is to conduct an investigation to determine whether the import of these banned categories[4] has interfered with the operation of the price support program. The ban is in effect a zero-rated quota and will continue until the investigation is completed but if the ITC finds that harm has been done the ban will be extended.

US beet sugar supply contracts[5]

Long drawn-out and difficult negotiations on beet purchase contracts in the Rocky Mountain area of the US have apparently now come to an end. Both Great Western Sugar Co. and Holly Sugar Corporation undertook last autumn to negotiate contract changes that would reduce the cost of beets to both companies. In Great Western's case, the company said from the beginning that, without substantial beet cost reductions, their sugar factories would be closed. To those with knowledge of sugar production costs in large and small factories it seemed likely that this was no empty threat, the average GW factory slice being near the smallest in the US. After rejection of Great Western contracts by grower associations in Montana, Wyoming, Colorado and Kansas, acceptance was secured for a 3-year contract from Nebraska growers, sweetened by the offer to re-open the Bayard factory in the state. The Montana association then reversed its decision and the others allowed members to contract individually with the company. Great Western subsequently announced that it will operate all its eleven factories in the area, although it is speculated that they have not contracted as much acreage as they would have liked. The company has secured major benefits by gearing the price for beet to the average daily price for the No. 12 raw sugar contract on the New York market instead of using actual net sales proceeds, and this is expected to reduce the cost of beets by some $5.50 per short ton.

Holly reached an agreement with the associations of growers supplying its Sidney and Worland factories in late April, but not those supplying its Torrington factory. It hopes to reach agreement with individual growers but only a partial crop can be expected as a consequence of the lateness.

Aid sought for the Italian sugar industry[6]

Italian local government officials from the northern sugar-producing regions of Emilia-Romagna and Veneto have requested 200,000 million lire ($137 million) in funds from the government for a national sugar industry investment plan. The proposed closure of five factories belonging to Eridania, the financial problems of the Montesi and Maraldi firms and an estimated decrease of 40,000 hectares in sugar beet plantings this year (to 210,000 hectares) may add 500,000 million lire ($342 million) to the 1983 national deficit in food trade, according to the local authorities.

They said in representations to the Italian Parliament that 200,000 million lire ($137 million) in federal funds are needed to aid sugar producers. The national consortium of sugar beet growers said the decrease in sugar beet sowings this year resulted mainly from the failure of sugar producers to pay for beets from previous seasons. The companies owe farmers about 100,000 million lire ($68 million) for beets, according to the consortium.

Increase in HFCS usage[7]

Consumption of high fructose corn syrup in the US, Canada and Japan, the main user countries, is steadily increasing at the expense of sugar. In the US, sugar deliveries will decline from 9.3 million short tons in 1982 to 9.0 million tons this year, according to the US Dept. of Agriculture, mainly owing to the decisions by Cocal Cola and Pepsi-Cola to increase the use of HFCS in their soft drinks. US HFCS consumption could rise to 3.6 million tons in 1982, 16% more than last year.

However, its price advantage over sugar is expected to decrease; rising demand, coupled with higher corn prices should see HFCS rising to above 20 cents/lb in the coming months from 15-17 cents for the 55% fructose product in February. Sugar prices have risen recently to 23 cents/lb but should start to ease. Over the longer term, HFCS prices could receive a stronger undertone because the corn wet milling industry should approach full capacity in the next two years or so. Further in the background is the possibility of increased demand for alcohol which can be produced from corn syrups. This would most likely put some strain on HFCS capacity and give an additional boost to prices.

Canadian HFCS consumption is set to take off this year with an estimated 71% increase in usage from 156,705 tonnes to 267,000 tonnes or 22.4% of the total sweetener market, against 14% in 1982. HFCS's competitive edge will be cut as a result of lower refined sugar prices.

Unusually warm weather has increased Japanese soft drink demand and given a boost to the manufacture and sale of HFCS. Production climbed nearly 10% in the year to March 1983 at 873,023 tonnes against 797,773 tonnes. Prices for both sugar and alternative sweeteners have declined in response to cut-throat competition in the sugar refining industry and higher domestic beet sugar output.

1 *International Sugar Rpt.*, 1983, **115**, 233-241.
2 C. Czarnikow Ltd., *Sugar Review*, 1983, (1655), 118.
3 *I.S.J.*, 1983, **85**, 33, 193-194.
4 *ibid.*, 223.
5 *ManExec Inc. Memorandum*, May 18, 1983.
6 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 248.
7 *Public Ledger's Commodity Week*, June 18, 1983.

A flexible computer program for four-component material balances in sugar industry boiling houses

By R. G. HOEKSTRA
(Hulett Sugar Limited, Mount Edgecombe, South Africa)

PART I

Introduction

Manual calculation of boiling house mass balances has always been a tedious and time-consuming task and, because of this, the balances have usually been limited to only two components, namely sucrose and total solids. It was decided to design a computer program to take the drudgery out of this task as well as provide additional information to the user.

Requirements of the program

(a) The four components to be considered should be total solids, total sucrose, water and, where applicable, crystal sucrose. Total mass, non-sucrose and dissolved sucrose can all be expressed in terms of these four components. Suspended (insoluble) solids are to be ignored; all non-sucrose is assumed to be in solution.

(b) It should be possible for the user to choose which process variables are the given input values and which the unknowns to be determined. For example, in one run the massecuite exhaustion might be given and the molasses purity the unknown, whereas for another run the user might desire the converse.

(c) The program must be flexible, i.e. it should be possible to apply the program to any boiling scheme or configuration of boiling house equipment.

(d) The program should still run if excessive (redundant) information is provided, in which case it should use all the given information in such a way as to minimize the overall error. Such over-specification could be accidental, because it is not easy to determine the minimum number of relationships in a complicated system, or it could be deliberate, in that one might want to obtain the best possible "fit" to various data taken from plant operations.

(e) Although many of the boiling house operations are of a batch nature this program must assume steady-state, continuous operation, such as would be established over a fairly long period of time. There was no intention of introducing a discrete-unit time-based simulation such as that of Stephenson *et al.*[1].

(f) At this stage there is no intention of performing any optimizations in conjunction with process constraints, whether by linear programming, such as used by Pérez de Alejo & Friedman[2] or de Armas[3], or by Powell's penalty function method, as used by Kubasiewicz *et al.*[4]. When there is a capacity constraint, the maximum amount which that bottle-neck process unit can take should be specified as its given throughput rate in the input data.

R. G. Hoekstra

Choice of calculation methods

The alternative methods to consider were the following:

(i) *Let the computer simulate the hand calculation procedure*
The computer is programmed to calculate in exactly the same manner and sequence as would have been done by hand, except that it will of course execute faster and be error-free. This method is flexible only in so far as one could use different values for the same set of input variables. For other combinations of unknown process variables or a different configuration of vessels, the program would have to be re-written because a different calculation procedure is required.

(ii) *Iterative simulation of successive units*
Here the process units are calculated in the sequence of the actual process flow. The given or estimated inputs to the first unit are used to calculate its outputs, which are in turn the inputs to the next, and so on, up to the last unit. This method is used by Guthrie[5].

Where it is a simple process, with no re-cycle or branching, and the unknowns apply to processing units or streams towards the end of the process, the problem is quite straightforward. Only one pass of calculations through the system is required to provide the correct answer. If, however, there are one or more re-cycle streams, an estimate has to be made of the quantities or composition of the re-cycle stream before making the first pass through the process. After each pass, the data on the re-cycle stream are updated, until the answer has converged sufficiently.

This method has appeal because of its logical similarity to the actual factory: The process starts with the first unit, goes on to the next, forms a re-cycle stream at some stage, which in turn affects what happens in the units earlier on, until steady-state operation is achieved after a period of time.

The method does however suffer from the following disadvantages:—

(a) If the given input information specifies overall process characteristics, e.g. overall recovery, or specifies properties of units or process streams

1 *Proc. Summer Computer Simulation Conf.* (Newport Beach, CA, USA), 1978, 307-311.
2 *I.S.J.*, 1979, **81**, 67-71.
3 *Symposium on Computers in the Design and Erection of Chemical Plants* (Karlovy Vary, Czechoslavakia), 1975, 609-614.
4 *ibid.*, 599-607.
5 *Proc. S. African Sugar Tech. Assoc.*, 1972, **46**, 110-115.

towards the end of the process, with the unknowns being mainly at the beginning or middle of the process, programming becomes considerably more complicated, particularly with the updating after each pass.

(b) Complications arise when there are several re-cycle streams, or the process stream splits into proportions which are not directly specified.

(iii) *Solution of simultaneous equations*

With this method, the program sets up algebraic equations expressing the stream properties, processing unit properties and processing unit interconnexions in terms of the process variables, and solves them.

There exist well-known methods of solving systems of linear equations by computer, which can also be applied, with some modification, to non-linear relationships.

The advantages of this method are:

(a) Re-cycling and branching pose no complication at all

(b) It does not matter which variables are the unknowns, provided, of course, that one does not specify so many unknowns as to under-define the system

(c) Over-specification can be dealt with in a methodical manner, with minimum overall error.

A disadvantage is that a large matrix of equations is generated, requiring considerable storage space in the computer. This problem may be solved by using storage on disc.

In the light of the above arguments, it was decided to base the Boiling-house Operations Overall Balance program (acronym BOOB) on the method of solution of simultaneous linear equations.

Application to different boiling-house configurations

This program was not written for the sake of only one installation, but for application to a variety of boiling-house configurations. There were the following alternative approaches:

(i) *Write a separate program for each installation.* In this case each installation would have its own complete program, with associated set of input data on processs variables [See Fig. 1(a)]. This obviously would be a laborious and expensive method, as well as wasteful, because many of the calculation procedures are basically the same for all installations, and differ only in the context in which they are used.

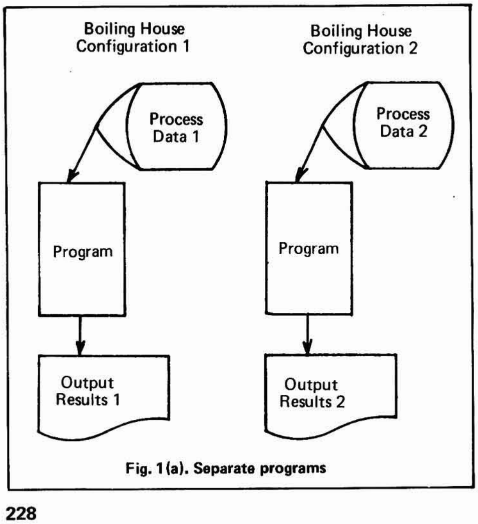


Fig. 1(a). Separate programs

(ii) *One complete program for all installations.* The other extreme is to have one program to cater for all installations. The data to it would consist of 2 sets: the usual data such as purities of process streams and performance characteristics of processing units, and additional data instructing the program by which streams the different processing units are to be linked up. See Fig. 1(b).

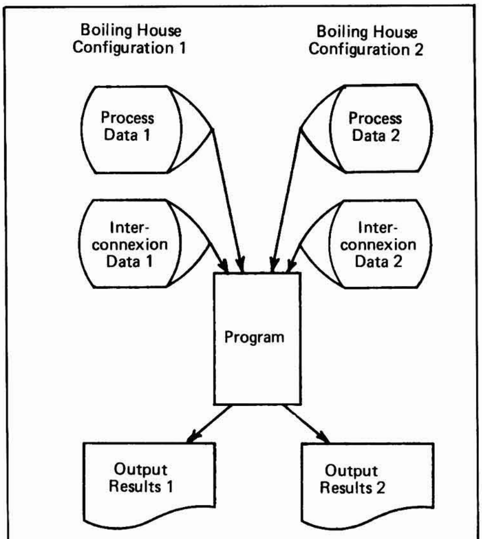


Fig. 1(b). Common program

This method has the advantage that the program can be applied to other installations without the need for the user to be familiar with a computer language.

The disadvantages are:

(a) The user instructions for defining the configuration in terms of the input data will be complicated and prone to misunderstanding

(b) The program for interpreting and executing such input data will be complicated

(c) The program will be large, as it will have to be "all things to all men"

(d) It is impossible to anticipate all the possible future variations in processing units and their configurations, and whenever something unusual is encountered, a programmer will have to change the program, making it bigger each time.

(iii) *Write a separate master segment for each installation.* This falls between the previously mentioned two extremes, in that the calculation sub-routines are common to all configurations, but the master segment of the program is individually written for each configuration, and calls the applicable sub-routines in the correct context and with the correct arguments. See Fig. 1(c).

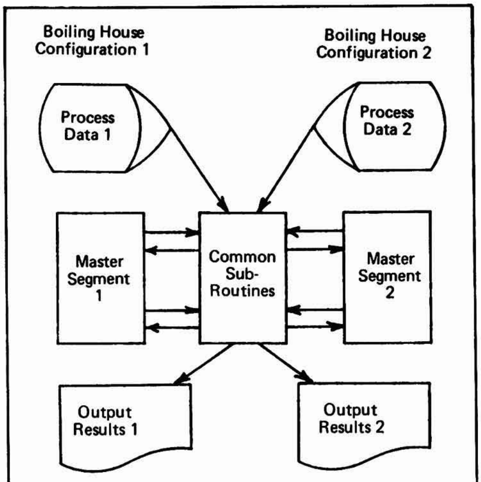


Fig. 1 (c). Separate master segments, common sub-routines

The master segment is straight-forward, requires little time and effort to program, and is hardly longer than what the additional configuration data for alternative (ii) would be. If the particular configuration has any special features, these can be incorporated in the master segment program, thus obviating the need to tamper with the sub-routines.

It was decided to base BOOB on the principle of individual master segments and common sub-routines, which is the same approach as the author[6] took in designing a program for multiple-effect evaporators.

The variables

The variables for algebraic solution were chosen to be the respective masses of the components in each stream, rather than derived properties such as purity or solids % total mass, because it is easier to write the equations in terms of tonnages, and they are more likely to be linear, thus lending themselves better to the method of solution.

Each process stream consists of the following components, called the *main stream variables.* Their symbolic representations are shown in capital letters:

SOLIDS	Total solids
SUC	Sucrose, which is part of the above SOLIDS
XTAL	Sucrose crystal, where applicable, which is part of the above SUC
WATER	Water.

Figure 2 illustrates the composition of a main process stream. The program can be made to apply to Brix and pol masses instead of total solids and sucrose, provided the user is aware that these alternative terms do not have exactly the same meaning.

There are also the following *additional variables* associated with some of the processing units:

WASH	Added water, such as movement water for pans, wash water for centrifugals or dilution water for minglers
VAPOUR	Vapour, such as vapour from pans to the condenser or wash vapour for centrifugals.

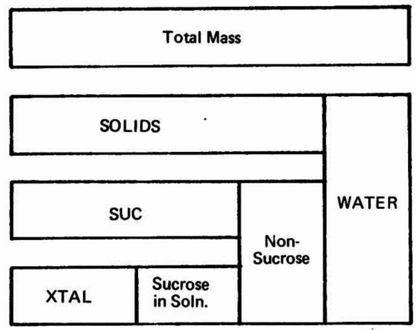


Fig. 2. Representation of composition of a main process stream: The main stream variables, which are used in the material balance equations, appear in CAPITALS

In performing a material balance over a processing unit, any WASH or VAPOUR must of course form part of the balance of the WATER component over the unit.

The program can take up to 30 variables for each of the components SOLIDS, SUC, and WATER in the main streams, i.e. each can be indexed up to 30. There can be 15 variables for XTAL, 5 for VAPOUR and 10 for WASH. It can cater for up to 30 processing units.

Fig. 3 shows the diagram for a partial remelt 3-boiling system, which is a typical application of BOOB.

Process stream properties

For purposes of identification by the user and manipulation in the program, the main process streams are numbered or indexed from 1 upwards, without gaps in the sequence, but not necessarily in the sequence of process flow (see Fig. 3).

Quantities: At least one of the main stream process variables must be expressed in terms of a tonnage, e.g. SOLIDS in syrup feed to A-pan = 100 tonnes.

Properties: Where applicable, the properties of the process streams may be expressed in terms of the ratios of their components, e.g.

$$\text{Purity} = \frac{\text{SUC}}{\text{SOLIDS}} \cdot 100$$

$$\text{Nutsch Purity} = \frac{\text{SUC} - \text{XTAL}}{\text{SOLIDS} - \text{XTAL}} \cdot 100$$

$$\text{Solids \% Total Mass} = \frac{\text{SOLIDS}}{\text{SOLIDS} + \text{WATER}} \cdot 100$$

$$\text{Crystal \% Solids} = \frac{\text{XTAL}}{\text{SOLIDS}} \cdot 100$$

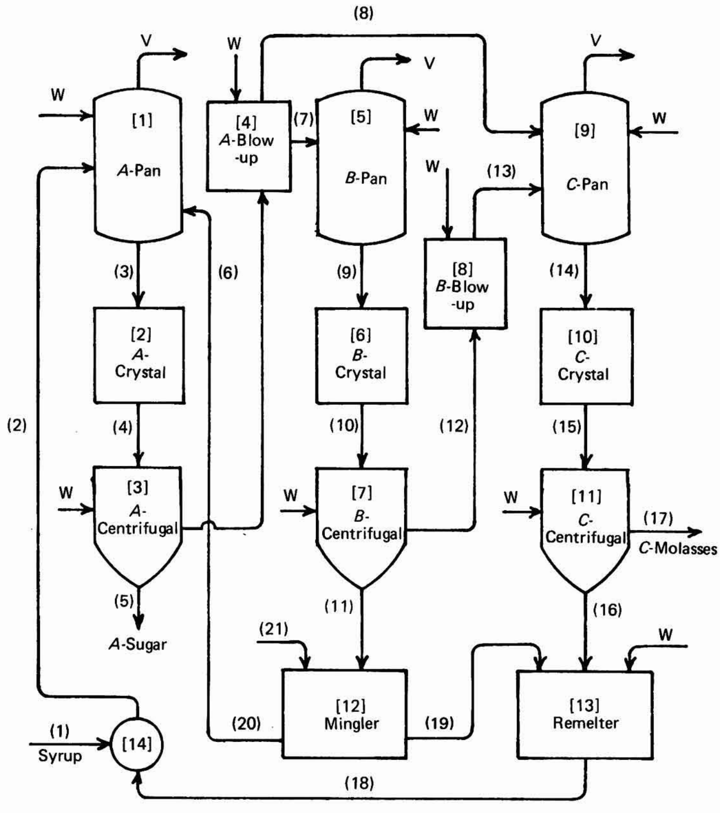
$$\text{Non-sucrose/Water ratio} = \frac{\text{SOLIDS} - \text{SUC}}{\text{WATER}}$$

Processing unit properties

Processing units are also numerically identified, starting from 1 upwards, and their associated properties correspondingly indexed.

Where applicable, each processing unit has some of the following properties:

[6] Hoekstra: *ibid.*, 1981, **55**, 43-50.



Unit [15] = Overall System
( ) = Main Process Stream References
[ ] = Processing Unit References
W = Water addition, (WASH)
V = Vapour, (VAPOUR)

Fig. 3. Application of BOOB to a partial remelt system

$$\text{Sucrose recovery} = \frac{\text{SUC out}}{\text{SUC in}}$$

$$\text{Massecuite exhaustion} = \left(\frac{10{,}000}{\text{Purity of M/cuite}}\right) \text{X}$$

$$\left(\frac{\text{Purity of M/cuite in} - \text{Purity of Mol. out}}{100 - \text{Purity of Molasses out}}\right)$$

$$\text{Purity rise}^{*} = \text{Purity out} - \text{Purity in}$$

$$\text{Crystal Growth factor} = \frac{\text{XTAL out}}{\text{XTAL in}}$$

$$\text{Vapour \% Solids} = \frac{\text{VAPOUR in}}{\text{SOLIDS}} \cdot 100$$

$$\text{Wash \% Solids} = \frac{\text{WASH in}}{\text{SOLIDS}} \cdot 100$$

$$\text{Ratio (or split)} = \frac{\text{Mass of Component in Stream 1}}{\text{Mass of Component in Stream 2}}$$

where "Component" could be either SOLIDS, SUC, WATER or XTAL. This is where two streams merge or a stream splits in a given ratio.

Master segment

As already mentioned, a separate master segment is written for each configuration. The first part of the master segment assigns an alphabetic description to each main process stream (e.g. Stream No. 3 : FROM A-PAN TO A-CENTRIFUGAL) and an alphabetic description to each processing unit (e.g. Unit No. 5 : B-PAN).

The program then goes through the stages of calling the following sub-routines:

For reading in the input data and subsequently printing out what had been read in.

* This could apply to nutsch purities as well as overall purities. Purity rise can be negative, such as nutsch purities over a crystallizer, thus signifying a purity drop. Each of the purities in the above will, of course, be expressed in terms of the main stream variables SOLIDS, SUC and XTAL.

For setting up the equations for the process streams and the processing units.
For solving the equations.
For printing out the results.

If the program has to perform more than one iteration (when there are non-linear equations), the initial values are updated and the program loops back to where it calls the sub-routines for setting up the equations.

The various stages in the execution of the master segment are illustrated in Fig. 4, and will now be described in more detail.

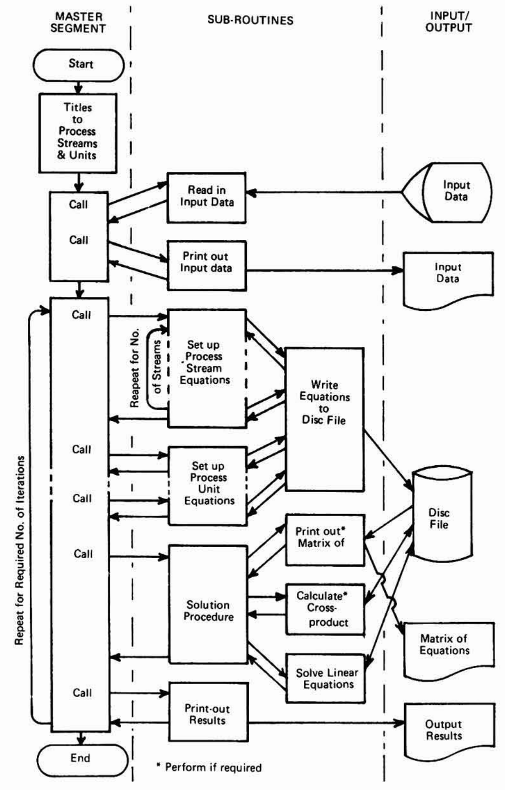


Fig. 4. Execution of the program

Input

The input is made via a visual display unit, and in free format, which means there is no need for a data item to appear in a specific column for correct interpretation. The only requirement is that the successive items be separated by either a blank space or a comma. The first few items of input describe the run and the number of iterations required.

The data to be used in setting up the equations are read in three sections:

(a) Main stream quantity data, in pairs of : (stream reference number; tonnage)

(b) Main stream property data in pairs of : (stream reference number; value of the stream property)

(c) Processing unit property data (including data on WASH and/or VAPOUR, where applicable) in pairs of: (processing unit reference number; value of the processing unit property).

The input ends with a list of initial estimate values for those main stream variables which will be involved in non-linear relationships.

For the information of the user, the input is then printed out in the same format as the eventual output of the run, but displaying only the given data, with the remaining spaces blank. An example is shown in Fig. 5.

Setting up the equations

As far as possible, the physical relationships are expressed in a linear form. When a sub-routine for setting up an equation is called, its first step is to examine whether the applicable data on the stream or processing unit property has been provided in the input. If so, the program will set up the equation in terms of those data, and write it to the disc file. If not, the next sub-routine is called.

Process Streams

(a) Example on quantity data : The mass of solids in Stream 1 is given as 100 tonnes. The program sets up the equation:

SOLIDS (1) = 100

(b) Example on property data: The purity of Stream 14 is given as 55 (or 0.55, when converted to a decimal), which implies:

SUC(14)/SOLIDS(14) = PURITY(14)
= 0.55

Because this is a non-linear relationship, the program is written to set it up in a linear form as:

SUC(14) – 0.55*SOLIDS(14) = 0,

where * means multiplication.

Processing units

(a) Example : The crystal growth factor in Unit 2 (A-crystallizer) with inlet stream No. 3 and outlet stream No. 4 is given as 1.069.

The applicable equation is:

XTAL(4)/XTAL(3) = X_GR_FACTOR(2)
= 1.069

which can be linearized as

XTAL(4) – 1.069*XTAL(3) = 0.

Some relationships, such as purity rise (whether for overall purities or nutsch purities) or massecuite exhaustion over a processing unit, cannot be linearized as in the above example. However, the Newton-Raphson method, as explained in Appendix 1 and by Myers & Seider[7], may be used to provide a linear relationship. Because such linearized relationships are only approximate, the procedure of setting up the equations, solving, and updating with the values from the previous solution has to be performed several times by the program to converge to a final answer.

[7] "Introduction to Chemical Engineering and Computer Calculations" (Prentice-Hall, New Jersey), 1976, Chapter 13.

For each processing unit, a materials balance subroutine for the 3 main components of SOLIDS, SUC and WATER (including WASH and/or VAPOUR, if applicable) must be called. Ingoing streams are considered as positive, outgoing as negative.

Example: The equations for the A-centrifugal (Unit No. 3) will be:

SOLIDS(4) – SOLIDS(5) – SOLIDS(6) = 0
SUC(4) – SUC(5) – SUC(6) = 0
WASH(2) + WATER(4) – WATER(5) – WATER(6) = 0

```
BOILINGHOUSE   OPERATIONS   OVERALL   BALANCE.          DATE:07JUN82          TIME: 08:03:06

RUN NO:  2        MILL: TMD PROJECT       OBJECT: PARTIAL REMELT 3-BOILING SINGLE CURING SYSTEM

SUMMARY  OF  INPUT  DATA.
```

DATA ON PROCESS STREAMS.

STREAM NO.	DESCRIPTION	TONNAGES: TOTAL MASS	TOTAL SOLIDS	TOTAL SUCROSE	TOTAL NON-SUC	WATER IN SOLN	XTAL SUCROSE	QUALITY: PURITY (%)	SOLIDS% TOTMASS	XTAL % SOLIDS	MUTSCH PURITY	NON-SUC :WATER
1	SYRUP FROM EVAPORATORS		100.00					87.70	65.00			
2	SYRUP + RECYCLE FEED TO A-PAN											
3	A-MASSECUITE FROM PAN TO XTALLISER											
4	A-MASSECUITE FROM XTALLISER TO CENTR.								93.00	64.00		
5	A-SUGAR PRODUCT							99.50	99.85			
6	A-MOL.FROM A-CENTR.TO A-BLOW-UP TANK								83.00			
7	A-MOLASSES FROM A-BLOW-UP TO B-PAN								70.00			
8	A-MOLASSES FROM A-BLOW-UP TO C-PAN								70.00			
9	B-MASSECUITE FROM PAN TO XTALLISER											
10	B-MASSECUITE FROM XTALLISER TO CENTR.								94.50	44.00		
11	B-SUGAR TO MINGLER							93.00	99.00			
12	B-MOL.FROM B-CENTR.TO B-BLOW-UP TANK								82.00			
13	B-MOLASSES FROM B-BLOW-UP TO C-PAN								70.00			
14	C-MASSECUITE FROM PAN TO XTALLISER							55.00				
15	C-MASSECUITE FROM XTALLISER TO CENTR.								97.50			
16	C-SUGAR TO REMELTER							85.00	98.50			
17	C-MOLASSES PRODUCT								80.00			
18	REMELT TO BLENDING WITH SYRUP								70.00			
19	MINGLER TO REMELTER								90.00			
20	FOOTING FROM MINGLER TO A-PAN								90.00			
21	WATER OR CJ DILUTION TO MINGLER											

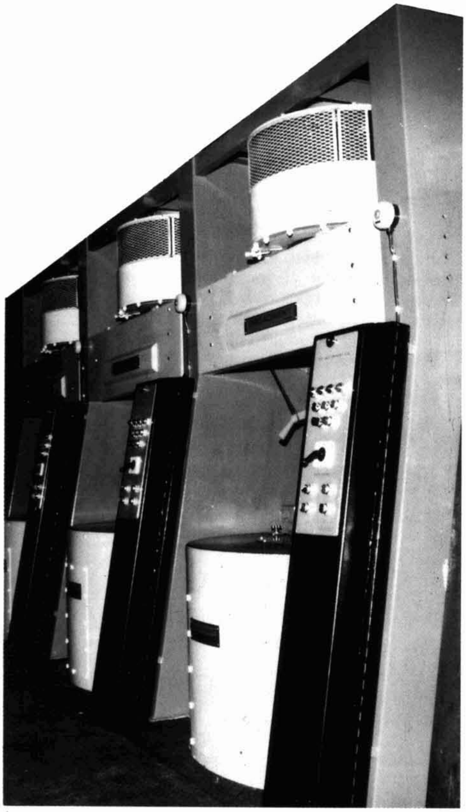
DATA ON PROCESSING UNITS.

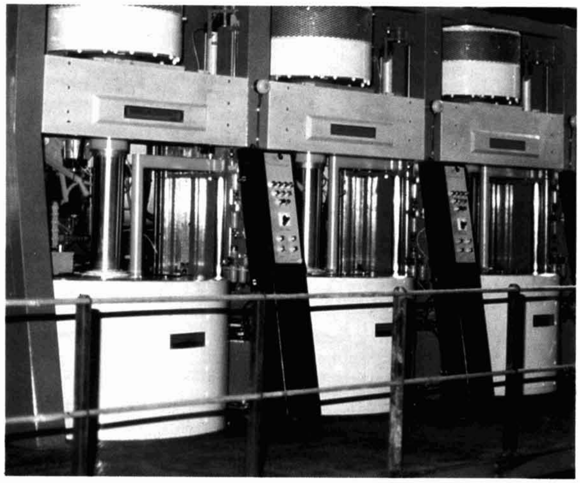
UNIT NO.	DESCRIPTION	SUCROSE RECOV %	M/CUITE EXH.%	XTAL GR FACTOR	PURITY RISE %	VAP.USE %SOLIDS	WASH % SOLIDS	VAPOUR (TONS)	WASH (TONS)	RATIO/ SPLIT
1	A-PAN						10.00			.050
2	A-XTALLISER			1.069						
3	A-CENTRIFUGAL				2.20					
4	A-MOLASSES BLOW-UP TANK									
5	B-PAN						10.00			
6	B-XTALLISER			1.130						
7	B-CENTRIFUGAL				2.60					
8	B-MOLASSES BLOW-UP TANK									
9	C-PAN						10.00			
10	C-XTALLISER			1.270						
11	C-CENTRIFUGAL		52.00		3.00					
12	MINGLER									
13	REMELTER									
14	MERGE OF REMELT & SYRUP TO A-PAN									
15	OVERALL SYSTEM									

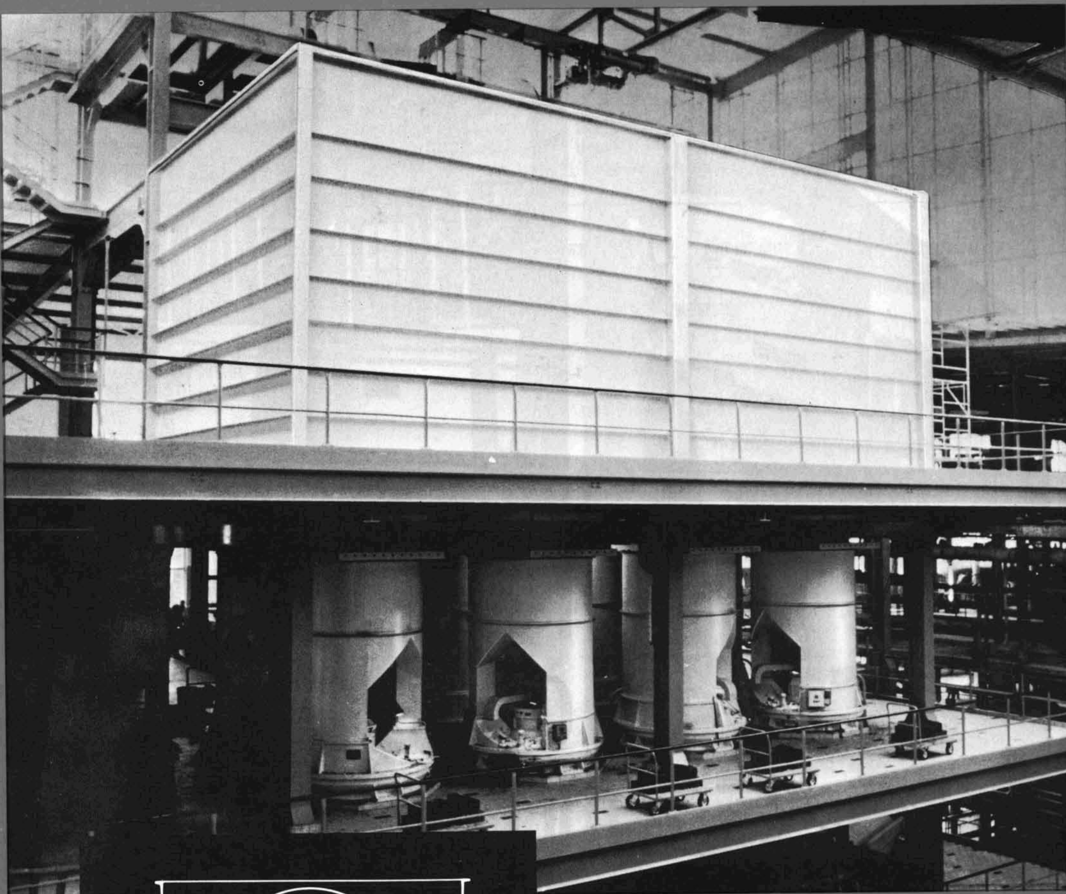
NO. OF ITERATIONS REQUIRED: 3

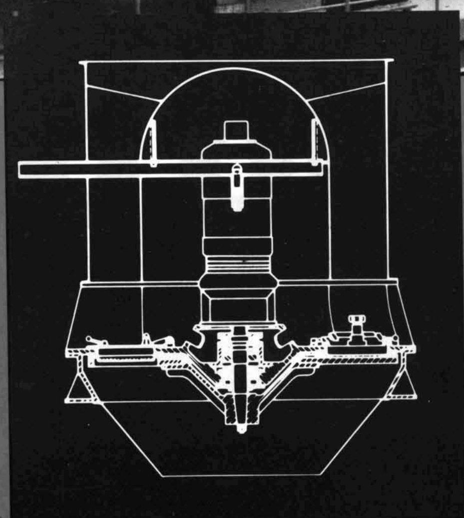
Fig. 5. Input data to a run

(To be contd.)









The Imacti process for juice decalcification

By P. L. MOTTARD*
(Groupement Technique de Sucreries, France)

Introduction

In this paper, we have collected the results obtained in the first factories which have dared to operate with the AKZO system of lime removal[1], and we have compared this with the existing classical and Gryllus solutions.

In Table I, we have summarized the four systems at our disposal for reduction of lime salts.

In broad outline, the main features of the solutions are the following:

Process No. 1 — Alkaline agent

- unfavourable to juice
- removes only a part of the lime salts
- increases the molasses sugar loss

Process No. 2 — Classical decalcification[2]

- needs quite an excess of NaCl
- gives noxious waste waters (chlorides)
- involves a risk of accidental corrosion
- increases the molasses sugar loss

Process No. 3 — Gryllus process[3]

- does not need any external agent for regeneration
- avoids waste water
- does not increase the molasses sugar loss
- entails some dilution
- the lime salts are collected in the second green

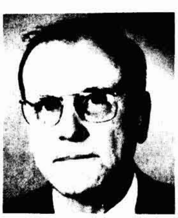
Process No. 4 — AKZO system

- no waste water
- the NaOH excess, going into the process, involves some additional molasses sugar, (in cases where the natural alkalinity of juice is high enough) in comparison with the classical regeneration.

In addition to this, we must confess we do not know all the details of the reactions that happen during an ionic exchange on resins. Some very interesting publications, for instance the studies by Oldfield, Shore, Broughton & Jones[4], point out the reaction is not quite as easy as shown in Table I, i.e. a simple substitution between the two cations Ca^{++} and Na^{+}. Moreover, the juice decalcification effect on molasses production is not certain; the opinions of investigators and research workers are not all in agreement, and the figures vary with a ratio of one to three. We have to be very careful indeed, for the conclusions sometimes given by authors do not clearly state the relevant conditions and in particular the lime salts level in the juice.

Table I. Decalcification systems

	1 Addition of alkali	2 Classical ion exchange	3 Gryllus process	4 AKZO process
Agents used	$NaOH/Na_2CO_3$	Acidic cation exchanger in Na form, with NaCl as regenerant	Acidic cation exchanger in K form, with second green syrup as regenerant	Acidic cation exchanger in Na form, with NaOH in juice as regenerant
Equilibrium	$Ca^{++} \rightleftharpoons Na^{+}$	Ca (organate)$_2 \rightleftharpoons$ 2 Na (organate)	Ca (organate)$_2 \rightleftharpoons$ 2 Na (organate)	Ca (organate)$_2 \rightleftharpoons$ 2 Na (organate)
Characteristics of the system	Limited efficiency Great excess needed Ca of low melassigenic power replaced by Na higher in melassigenic power	Great excess of NaCl $(R = \frac{eq.Na}{eq.Ca} = 6)$ Ca of low melassigenic power replaced by Na, higher in melassigenic power	$R = \frac{eq.(K + Na)}{eq.Ca} = 6$ to 7 Exhaustion: Ca replaced by K Regeneration: K replaced by Ca	Higher regeneration efficiency $R = \frac{eq.Na}{eq.Ca} = 1.5$ Ca, of low melassigenic power, replaced by Na, higher in melassigenic power, plus NaOH excess
Advantages and Disadvantages	Unfavourable to juice quality Molasses sugar loss increased	Waste waters contain chlorides Accidental risks of corrosion Molasses sugar loss increased	No external regeneration agent No waste waters Molasses sugar loss constant Little dilution All the lime salts are returned to the second green	No waste waters The excess of NaOH is going into the process with some more molasses sugar as a result (but depending on the campaign conditions)



P. L. Mottard

The AKZO system

During the last campaign three sugar factories in France have been operating with the AKZO system of

Paper presented to the 26th Tech. Conf., British Sugar plc, 1982.

* With the collaboration of MM. Le Blanc (Roye sugar factory), Kuipers (Etrepagny sugar factory), Bruzawa (Central Laboratory, GTS) and colleagues.

1 Pannekeet: *Ind. Alim. Agric.*, 1980, **97**, 757-760.
2 Landi & Mantovani: *Sugar Tech. Rev.*, 1975, (3).
3 *Zuckerind.*, 1975, **100**, 493-501, 554-561.
4 *I.S.J.*, 1981, **83**, 106-109, 131-136.

regeneration: the GTS factories at Etrepagny and Roye, and the factory at Arcis-sur-Aube. The idea of this system is to avoid sodium chloride as regenerant and to use instead caustic soda in a sucrose solution (in other words, in juice), provided that the temperature during regeneration does not exceed 60°C.

With this new system, the regeneration efficiency is considerably improved at 66%, instead of 19% with the classical system (when we speak in equivalents). While, with the classical decalcification, the quantity of sodium chloride is the same whatever the capacity, the AKZO system links the amount of caustic soda to the exchange capacity of the resin.

Essential data are shown in Table II which details the correlation between the lime salts level, the resin capacity and the regeneration level, all of which have to be considered when operating the process.

Table II

Lime salts in juice (inlet) mg CaO/l	1 Resin capacity meq/l resin	2* Regeneration NaOH meq/l resin	Ratio 2/1 (in theory)	Regeneration NaOH, g/l resin**
30	320			
40	350	500	1.43	> 20
50	425			
60	500			
70	575			
80	600	830	1.38	33
90	675			
> 100	715	1000	1.40	40
> 200	890			

* with the sodium chloride regeneration the corresponding quantity was 3500 meq/l resin.
** 200 g NaCl/l resin with the classical decalcification.

Table II shows three points:

(i) The correlation between the exchange capacity of the resin and the lime salts level in juice.

(ii) The modulation of the caustic soda quantity in relation to the exchange capacity and to the lime salts level.

(iii) The theoretical ratio of approximately 1.40 between the quantity of regenerant and the capacity (in terms of equivalents).

This modifies our view regarding the operating conditions for this new system.

Information for three French factories during the last campaign

Table III

Sugar factory	Columns: Number x Volume	Cycle (hours)	Efficiency η %	Extra molasses sugar loss % that of classical decalcification
ETREPAGNY	4 x 9 m^3	35	80.2	0.023
ROYE	3 x 16 m^3	18	falling	0.050
ARCIS	2 x 3 x 10 m^3	16	95	0.040

Etrepagny

This factory reached an average slice of 8150 tonnes beet in 1981/82 and ran for 107 days. The AKZO decalcification plant is two years old. In 1980, the results looked good, in spite of having too small an installation (it was adapted from an existing classical decalcification plant for a smaller slice).

In 1981, the volume of resin was increased from 7000 litres to 9000 litres in every column. The resin is the normal Imacti C 12 resin (highly acidic polystyrene beads).

The examination of the weekly lime salts shows a range of efficiency usually between 75% and 85%.

Table IV

Week	Lime Salts mg % Bx Inlet	Lime Salts mg % Bx Outlet	Exhaustion Efficiency %
1	20	4	80
2	20	4	80
3	20	7	65
4	20	3	85
5	20	3	85
6	20	2	90
7	20	5	75
8	20	2	90
9	20	3	85
10	20	5	75
11	20	4	80
12	20	4	80
13	20	5	75
14	20	4	80
15	30	6	80
General Average	20.7	4.1	80.2

These results have been confirmed by results from the GTS Central Laboratory which found figures between 81% and 87% for the exhaustion efficiency.

All the juice was treated in the resin station without any by-passing.

It is considered that, for Etrepagny,

— The exchange capacity is in agreement with the forecast, and even higher.

— The duration of the exhaustion phase is 35 hours.

— Etrepagny is the one factory (as far as we know) that has applied the "modulation principle" to the regenerant quantity in relation to the lime salts level. Obviously, in 1981, the steady level has been very favourable for this.

— It is estimated that the extra molasses sugar on beet is 0.023% or so, but a target of 0.015% may be expected, since the excess of caustic soda could probably be reduced, the practical ratio (eq Na/eq Ca) being approximately 2.0 now instead of 1.6.

— The policy at Etrepagny is to run the station with exhaustion cycles as long as possible. In 1981 conditions, that meant a slight loss (a leakage) of lime salts into the juice before evaporation: about 4 mg CaO % Bx as seen in Table IV. This leakage does not appear to alter the quality of the products.

Roye

The slice of this factory is 11,500 tonnes beet/day for a 110 days campaign. The decalcification station consists of three columns with 16 m^3 of resin each. Two columns are fitted with C 16 resin (highly acidic polystyrene macroporous beads), and one column contains the normal C 12 resin.

A lot of trouble has been encountered during the campaign with pressure rises to 4 bar in the columns (the normal working pressure is below 1 bar). As a result, the juice by-passing this station was 15% or so on average.

We tried to discover the reasons for these troubles. The second carbonatation juice is filtered using GP filters. A deposit of calcium carbonate was detectable in the filtered juice, even after the recirculation of the first filtrate (for 70 seconds). The fitting of the cloths must certainly be blamed.

Determination of the calcium carbonate in supersaturation in the filtered juice before the resin station gave figures three times as high as normal, at 18 mg CaO per litre. We observed, by means of a microscope, very small calcite crystals on the resin beads. Breakage at the stirrer in the batch retention after second carbonatation is suspected.

During the regeneration before the campaign, a mistake happened and the resins were treated with hydrochloric acid, followed by a caustic soda regeneration and rinsing with hard water; this may have been the origin of a calcium deposit on the beads.

Of these three, the filtration conditions are probably the main reason for the drawbacks of pressure rise and need to by-pass juice.

The exhaustion during the first five weeks reached an average of 77%; this is not too bad. But afterwards, the exhaustion decreased and the extent of the by-passing resulted in an overall efficiency of 63%. Table V therefore gives the factory's results in terms of overall removal, i.e. a comparison between the filtered juice after second carbonatation, and the thin juice before evaporation.

Table V

Week	Lime salts, mg % Bx		Removal, %
	Inlet	Outlet	
1	40	13	67.5
2	40	10	75.0
3	30	8	73.0
4	10	?	?
5	60	10	83.3
6	50	11	78.0
7	50	21	58.0
8	30	13	56.7
9	30	12	60.0
10	30	9	70.0
11	40	13	67.5
12	40	17	57.5
13	40	15	62.5
14	40	13	67.5
15	40	16	60.0
General Average	38	12	68.0

It is considered that, for Roye, the present results do not lay the AKZO process open to criticism; if we allow for the by-passing, we find the lime removal efficiency to be 86% or so, in other words, of the same order as for Etrepagny.

The level of lime salts at Roye is a little higher than at Etrepagny, and the duration of the effective cycle is only 18 hours, but the excess of caustic soda is higher, with a ratio (eq Na/eq Ca) = 2.8. The effect on the molasses sugar loss is evident, with a figure of 0.050% on beet higher than the classical process as against 0.023% at Etrepagny.

Table VI shows the two situations.

Table VI

Factory	Lime salts in second carbonatation juice, mg % Bx		Deliming efficiency, %	Increase in molasses sugar loss % beet
	Before treatment	After treatment		
ETREPAGNY	20.7	4.1	80.2	0.023
ROYE	38.0	12.0	68.0	0.050

For the next campaign, Roye is to improve the conditions of second filtration. The installation of an extra column would be favourable, as the percolating rate (i.e. the linear speed) would then be lower.

Arcis-sur-Aube

The third factory to be examined is at Arcis. The decalcification plant consists of two lines of three columns in parallel, with a total of 60,000 litres of resin, for a slice of 13,000 tonnes beet. This is a new installation planned for the treatment of juice at a lime salts level of 160 mg CaO/litre (110 mg CaO % Bx). 50% of the resin is Imacti C 12 (old) and 50% is Duolite C 20 (new). The running of this station was very good indeed with lime removal figures between 90.0% and 98.7% (Table VII).

Table VII

Week	Lime salts, mg % Bx			Removal, %	
	Inlet	Outlet			
		Line 1	Line 2	Line 1	Line 2
2	27	0.9	1.1	96.7	95.9
3	24	2.4	1.0	90.0	95.8
4	24	1.3	0.5	94.6	97.9
5	24	1.9	0.5	92.1	97.9
6	25	1.3	0.5	94.8	98.0
7	22	0.7	0.5	96.8	97.7
8	23	1.1	0.3	95.2	98.7
9	35	3.2	0.8	90.9	97.7
10	35	1.7	0.9	95.1	97.4
11	41	2.3	1.4	94.4	96.6
12	55	2.4	1.5	95.6	97.3
13	35	1.3	1.1	90.6	96.9
14	36	1.5	0.8	95.8	97.8
15	33	1.5	1.3	95.5	96.1
16	45	3.1	2.0	93.1	95.6
Average	32	1.8	1.0	94.4	96.9
17	97	14.1	12.7	85.5	86.9

Starting this first campaign with the AKZO process, the procedure adopted at Arcis factory is specific to that factory. The treatment time was fixed at 16 hours (under Arcis conditions, this means a waiting time of about four hours between two cycles on the same column) and regeneration is carried out at a constant rate whatever the lime salts level might be.

As a result of these two measures, very little leakage of lime salts occurs in the juice after treatment, but a greater excess of caustic soda is employed, increasing the excess molasses sugar, which reached 0.040% on beet more than that with the classical process.

The case of Arcis was very interesting, because of their long campaign. Indeed, we were permitted to follow the decalcification to the end of campaign, when the lime salts became very high; we are very grateful to the Management of Arcis for this friendly cooperation.

Table VIII details the main parameters at three stages of such a cycle. The cycle was reduced to check the efficiency change.

Table VIII

Time, hours	Lime salts, mg/litre		Removal, %
	Inlet	Outlet	
5.5	266	18	93.2
1.0	307	40	87.0
3.5	323	58 → 250	52.3
Total 10	280	60	78.4

This table gives interesting information since it should be remembered that the station is designed to treat juices with 160 ppm of CaO; the concentration was twice as high and, consequently, after a seven or eight hour cycle the resins were saturated. Nevertheless very good removal (greater than 90%) was achieved during two thirds of the cycle.

To obtain better results, in such a situation, it would have been necessary to work with the following system: 3 lines of 2 columns in parallel, with 4 hours treatment time, instead of 2 lines of 3 columns.

Whilst this first campaign at Arcis was a success, the management are well aware it will still be possible in the near future to optimize the regeneration and cycle times, in accordance with the lime salts level.

To ensure exceptionally good quality of second carbonatation filtrate at Arcis, an extra stage of check filtration is to be used.

General conclusions

For the time being, consideration of the three installations running in France indicates that:

(1) The new system is available and the results in respect of the operating conditions in the factories are, on the whole, in agreement with the theory, especially the exchange capacity.

(2) The new process uses classical cationic resins such as Imacti C 12. There is no point at all to using the C 16 resin which is somewhat more expensive (10 FF instead of 6 FF per kilo), since it does not give a better efficiency nor a longer lifetime. On the other hand, experiments by AKZO show that there is no difference between the lifetime of the resins as a function of the system of regeneration, i.e. using NaCl or NaOH.

(3) The AKZO method does not involve any dilution or waste waters, unlike the classical system.

(4) Regarding the extra molasses sugar loss due to the caustic soda excess, one has to be very careful when establishing the set point for the regeneration and the duration of cycles. This is in order to limit, as far as possible, the molasses sugar increase. In normal conditions, as has already been stated, the top limit would not exceed 0.030% on beet, when compared with the classical system.

(5) In the design of a new installation, the main point is to determine carefully the optimum number of columns. Basically, the regeneration of one column requires four hours, while the exchange capacity can be stated at 20 g CaO/litre of resin, or so: these two parameters allow us to determine the station size.

Let us take a factory running at 7,500 tonnes beet a day, which means a volume of thin juice of something like 360 $m^3.hr^{-1}$. Use of 12 m^3 of resin per unit means the regeneration of 12 m^3 every four hours; in other words, we may allow saturation at a rate of 3 m^3 resin per hour. With a capacity of 20 g CaO/l resin, we are able to remove 60 kg CaO per hour. The permissible level lime salts is accordingly:

$$\frac{60 \text{ kg}}{360 \text{ m}^3} = 165 \text{ mg CaO/litre or } 165 \text{ ppm}$$

This maximum level is for an installation fitted with either 3 columns or 2 columns. To cope with a maximum level of 220 ppm, we would need 16 m^3 columns instead of 12 m^3.

Table IX

Daily beet slice	Juice/day	Juice/hour
7500 tonnes	8640 m^3	360 m^3

Volume of resin in 1 column	:	12 m^3
Capacity	:	20 kg/m^3 resin
Regeneration time	:	4 hours
1 column or 12 m^3 resin in		4 hours
i.e. 3 m^3 resin in	:	1 hour
Capacity exhaustion	:	60 kg CaO/hour
Maximum lime salts removal	:	$\frac{60 \text{ kg}}{360 \text{ m}^3} = 165$ ppm

The only advantage of a 3-column line, rather than a 2-column one, is the flexibility. In addition to this, the three-column line makes it possible to save some caustic soda, when increasing the cycle time, especially with low lime salts.

Economic aspects

To compare the different systems for removal of lime salts, one has to specify the conditions considered in the calculations. Basically, we have made the following assumptions:

(i) Technical

Lime salts level in second carbonatation juice:
40 mg CaO % Brix (60 mg CaO/l)

Melassigenic coefficients of Ca and Na:

In the case of the classical process, and considering the amount of caustic soda strictly needed to exchange Ca removed from the juice, we suppose one equivalent of Ca lactate is replaced by one equivalent of Na lactate.

The reason for this assumption is that the difference between the sodium and calcium lactate melassigenic coefficients on the one hand, and the difference between overall melassigenic coefficients of Ca and Na (calculated on the hypothetical composition of anions given by Vavrinecz) on the other hand, are quite similar. In each case, the substitution of Ca by Na involves a melassigenic coefficient of about 1.

In addition to this, we have adopted a correction to take account of the different characteristics between "Silin normal" molasses and our average molasses. (Silin was limited to a viscosity of 44 poises owing to the capabilities of the then existing centrifugals.)

The excess of Na introduced with the AKZO system is considered to be in the caustic soda form with its own melassigenic coefficient. We have thus adopted the Silin value (4.6) corrected in the same way as mentioned above.

(ii) Financial

The sugar costs in Table X are as follows:

Sugar losses: the cost is considered on the basis of C-quota sugar (1.55 FF/kg).

Extra molasses sugar loss: the cost is the difference between C-quota sugar and molasses sugar (0.7 FF/kg).

The fuel price is 1160 FF/tonne fuel.

All the figures are per one thousand tonnes of beet.

Table X

	Classical decalcification	AKZO system	Gryllus system
Sugar losses	50 kg cost : 75 FF	-	-
Additional sugar loss	0.017 to 0.025 % beet cost : 119 FF to 175 FF	0.031 to 0.043 % beet cost : 217 FF to 301 FF	-
Water used in dilution (fuel)	200 kg cost : 232 FF	-	25 to 150 kg cost : 30 FF to 180 FF
Regeneration	cost : 272 FF	cost : 162 FF	-
Resin cost (consumption)	cost : 180 FF	cost : 180 FF	cost : 300 FF
TOTAL	cost : 878 FF to 934 FF	cost : 559 FF to 643 FF	cost : 330 FF to 480 FF

As a result of this study, we can conclude that the operating costs with the AKZO system are lower than with the classical system. In the case of higher lime salts levels, the difference would be reduced, the advantage staying on the AKZO side.

The Gryllus solution is by far the cheapest but, against this, in some cases, secondary effects have been noted with the Gryllus system. These include scaling on heating surfaces in the pans; slowing-down of crystallization; interaction has been alleged with the Quentin process in 2 factories, involving a loss in efficiency; and problems with white sugar, when the raw sugar is sent back into the standard liquor; indeed all the lime salts remain in the process.

It is very difficult to define exactly the extent of these secondary effects and to quantify their cost. Their effect is likely to be small and on the cost side of the balance. We also recognise that objections may be made regarding the low level of lime salts chosen in our comparison. However, in the case of juices with high lime salts contents, some caustic soda must be added to the juice, anyway, to compensate for the low natural alkalinity. The AKZO process with the caustic soda excess, does this perfectly well, which effectively reduces the running costs of the process.

To conclude, for the next campaign, three new installations (at least) will be running in France (Aiserey, Connantre and Origny); two installations in Italy (Fermo and Forli); one in Switzerland (Aarberg); and one in Spain (Guadalete). In Germany, Wevelinghoven and Lage are already operating.

In our opinion the period of trial and error has passed and we think the AKZO system could become the the classical one in the near future.

Summary

An account is given of the results of application of the AKZO Imacti deliming process for thin juice at three sugar factories in France. Conditions at each are different, so that the extent of calcium removal is also different, but the process is cheaper than the classical ion exchange process although not as much as the Gryllus process. However, the latter is reported to have some drawbacks while the only, slight, disadvantage of the AKZO process — increase of melassigenic Na ions in the juice — may be necessary anyway if the natural alkalinity is low.

Le procédé Imacti pour la décalcification des jus

On traite de l'application du procédé AKZO Imacti pour la décalcification du jus léger dans 3 sucreries en France. Dans chaque usine les conditions sont différentes, ce qui fait que l'importance de l'enlèvement de calcium était aussi différente. Bien que moins bon marché que le procédé Gryllus, le processus décrit est moins cher que le procédé d'échange ionique classique. Le procédé Gryllus a cependant quelques inconvénients tandis que le seul, léger, inconvenient avec le processus AKZO — l'augmentation de la concentration en ions Na mélassigènes — peut répondre à un besoin si l'alcalinité naturelle est basse.

Der Imacti-Prozeß für die Saftentkalkung

Berichtet wird über Ergebnisse mit dem AKZO-Imacti-Prozeß für die Dünnsaftenthärtung in drei französischen Zuckerfabriken. Die Bedingungen in den Fabriken sind jeweils verschieden, so daß die Calcium-Entfernung unterschiedlich ist. Das Verfahren ist billiger als das klassische Ionenaustauschverfahren, obwohl nicht so billig wie das Gryllus-Verfahren. Jedoch wird berichtet, daß letzteres Verfahren einige Nachteile hat, während der einzige, kleine Nachteil des AKZO-Verfahrens — nämlich die Zunahme der melassebildenden Na-Ionen im Saft — notwendig sein kann, wenn die natürliche Alkalinität gering ist.

El proceso Imacti para descalcificación de jugo

Se presenta un aprecio de los resultados de aplicación del proceso Imacti de la Sociedad AKZO para descalcificación de jugo clarificado de remolacha en tres azucareras en Francía. Condiciones en cada una estan diferente, y por consecuencia, el grado de separación de calcio es diferente también, per o el proceso es más barato que el proceso clásico empleando cambio de iones aunque no tan mucho que el proceso Gryllus. Sin embargo, es registrado que el último tiene desvantajes mientras que el sólo desventaje, y esto de menor importancia, del proceso AKZO — aumento de los melasigenicos iones Na en el jugo — esta necesario si quizás la alcalinidad natural es baja.

Sugar Industry Technologists

42nd Annual Meeting, 1983

Sugar Industry Technologists Inc. was established in 1941 to serve the professional interests of its members, then exclusively from the US sugar refining fraternity, and for its first three meetings selected the city of New York. It was with some pleasure, therefore, that the members of what is now a truly international organization met in New York for its 42nd meeting during May 15-19, 1983. More than 200 members registered at the Grand Hyatt hotel on Park Avenue. During the first day the Executive Committee met, followed by a meeting of the full board of Directors, representing the refining companies and organizations supporting the group.

After a welcome from the President, Dr. M. C. Bennett, the Executive Director, George W. Muller, Jr., presented his report. Membership has now reached a total of 666, including 53 sugar refining companies. The report of the Treasurer, Maxine Sautier, revealed the healthy financial state of SIT. Committee Chairmen presented their reports, including the decision that the Crystal Award of the Society be awarded to George Muller for his work for SIT as Executive Director over the years; his retirement from the post takes effect in 1983. As previously reported[1], the Meade Award was given to W. Barton and W. Knebel for their paper on the Canesorb carbon/bone char installation at Atlantic Sugar[2].

Members concerned with the organization of future meetings of the SIT reported on progress; these were well in hand for the 1984 meeting in Houston, Texas, the 1985 meeting in St. John, NB, Canada, and the 1986 meeting in Baltimore, Maryland. The Board then discussed an invitation to hold the 1987 meeting in Sydney, Australia, and at the end of their deliberations accepted it unanimously.

The majority of members attending were then able to get together for the first time at the SIT mixer, held in the evening of May 15, while the working sessions started the next morning. After a welcome to the attendance by Dr. Bennett, who also offered thanks to the three refining companies hosting the meeting, a paper was presented by C. Laur on continuous vacuum pan operation at the Nantes refinery in France, on behalf of the authors, J. Cuel and C. Longue Epee. This was followed by a paper on microprocessor control of sugar crystallization using refractive index and total density measurements, by J. Virtanen of Finland; abstracts of these and the other papers will appear in this Journal in due course.

Papers presented later in the morning included one on refining of VHP or VHQ raw sugar, by W. Simoneaux, another on recovery operations in Louisiana by R. S. Patterson, and a third on filtration-impeding impurities in raw sugar, by C. C. Chou. This was followed by a business meeting which confirmed election of a new Board of Directors for 1983/84; the individuals had all been proposed by the sponsoring refining companies to represent them. This was followed by a reception and official luncheon.

In the afternoon, Alan M. James read a paper on problems in refining damaged raw and refined sugars and syrups for the author, J. E. Somner, and this was followed by papers on packaging in Savannah sugar refinery by J. H. Dean, HPLC application in sugar factories and refineries, by Margaret A. Clarke and W. W. C. Tsang, and invert sugar analysis in cane sugar by M. Wnukowski.

After the end of the day's session, the new Board of Directors met to elect a new Executive Committee; this was the same as for 1982/83 except for the replacement of H. J. Fitzgerald, E. D. Stephenson and F. G. Trewren by J. B. Alexander, D. Humm and J. A. Harrison.

On the following morning, papers presented included those on a dust attrition test for granular carbon adsorbents, by V. R. Deitz, further laboratory and refinery studies on syrup clarification and decolorization with Ecosorb precoat formulations by A. Tavares, R. Forman and R. Kunin, use of ion exchange resin decolorization in a carbonatation refinery, by C. Loker, the production of areado sugar in Portugal by L. S. M. Bento, and energy savings in a refinery, by F. T. Desmond. In the afternoon, R. N. Falgout presented an up-date on the cane sugar refiners' short course offered at Nicholls State University in Louisiana, and a symposium on energy conservation in the sugar industry was held under the chairmanship of L. E. Mahoney. Panellists included B. Drean of Tate & Lyle Ltd., who discussed the psychology of energy saving and emphasized the need to make people at all levels aware of the worthwhile nature of measures for energy saving; reduction of steam usage at Thames refinery from 108 to 92% on melt (from 35 to 30 therms per long ton of sugar) between 1978 and 1982 provided savings of £2,000,000 per year.

G. Eng, of Amstar Corporation, described experience with oil and gas use at the Baltimore refinery, where variation in relative prices governs

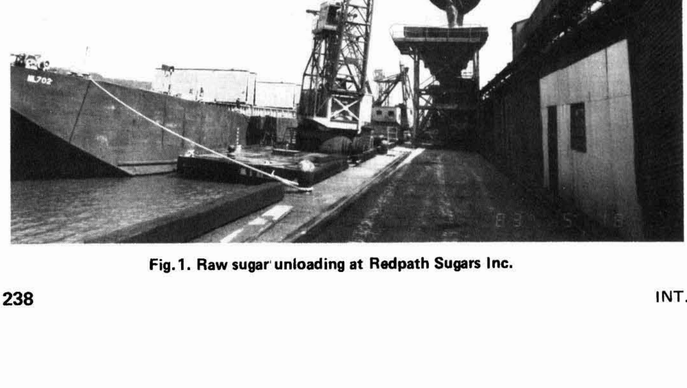


Fig. 1. Raw sugar unloading at Redpath Sugars Inc.

[1] *I.S.J.*, 1983, **85**, 31.
[2] *ibid.*, 14-18, 38-42, 72-76.

attended the Awards Banquet during which presentation of the Crystal and Meade Awards took place, and the Presidential gavel passed to Bruce Foster of St. Lawrence Sugar, Canada.

On the following day, members visited the Yonkers refinery of Refined Sugars Inc. Operated from the early 1900's as the Federal Sugar Refinery of the Spreckels company, this was bought in 1938 by Refined Syrups & Sugars Inc. which had previously operated a small liquid sugar plant in Brooklyn. Production expanded to more than 350,000 short tons by the early 1950's and crystal sugar was also manufactured. In 1957 the plant was bought by Corn Products Co., and introduced blends with corn syrups, used in the food industry. In 1976 the plant was bought jointly by Redpath Sugars Ltd. of Canada and Tate & Lyle Ltd. and the following year it was decided to raise granulated sugar from 20% to more than 70% of the total production. Members were able to see the equipment and changes installed, including two 1000-ton conditioning silos, a triple-effect evaporator, a new remelt facility, automatic centrifugals, a new granulated sugar pan, etc., as well as a computer control system for white sugar boiling. Currently the refinery can refine more than 500,000 tons a year, receiving its raws by ship up the adjacent Hudson river and unloading them by grabs on floating cranes at a rate of 4000 tons per 8-hour shift (Fig.1).

On May 19, members were taken to the Brooklyn refinery of Revere Sugar Co., a 1100 tons/day plant where sugar is received by ship, affined, the washed sugar melted in sweet-water and clarified by a lime-phosphate flotation system, filtered, decolorized using granular carbon columns, followed by decolorizing resin treatment, and boiled to white sugar. Part of the white sugar liquor is cooled and passed through sequential columns of strong anion and weak cation exchange resins, after which it is concentrated in a double-effect film evaporator, cooled and sent to storage.

the choice of fuel, balanced daily. Energy audits were established in Amstar to provide data for reducing losses; this has included a survey of all steam traps and showed up an unacceptably large proportion of faults. B. Karren, of BC Sugar in Canada, explained that his company owned both a cane sugar refinery as well as beet sugar factories and that evaporation efficiency was much higher at the latter owing to the use of a multiple-effect system rather than a single-pass unit. There is a need to balance steam efficiency with power generation needs, however. Also, in the refinery all heat eventually becomes waste heat at a relatively high temperature; in the beet sugar factories there are more opportunities to utilize waste heat which is at a lower temperature anyway. Utilization of waste heat at the refinery is an opportunity to improve energy efficiency and receives attention at BC Sugars; he gave examples of measures adopted.

T. Pearson referred to the energy audit carried out at Imperial Sugars in 1979 which showed the opportunity of saving $750,000 a year by various means. He described some of the measures taken and equipment acquired for this, including new boiler controls, insulation, recovery of heat from flue gases, and a steam trap inspection program.

After a discussion, the President closed the meeting, but in the evening, following the reception, members

Commission Internationale Technique de Sucrerie

17th General Assembly, 1983

174 members of the CITS, from 23 countries, participated in the 1983 General Assembly, held in Copenhagen during May 30 – June 3. Registration was at the Sheraton Hotel and took place during May 30, the only function of that day being an evening reception by A/S De Danske Sukkerfabrikker at the Danish Stock Exchange. They were greeted at the entrance by two men in Viking costume, blowing on lurs, the ancient horns originally used to strike terror into the hearts of the populations about to be pillaged. A gentler welcome was provided by Mr. Henning Brüniche-Olsen, Chief Executive Director of DDS, who thanked the foreign visitors to Denmark and promised that his company would do its best to ensure a successful meeting; a promise amply fulfilled during the following four days.

Mr. Brüniche-Olsen also spoke at the opening of the Assembly in the Sheraton Hotel the next morning, where he reviewed the history of the Commission since its founding as a group of 10-12 people (of whom he had been one) who held their first meeting in Brussels in October 1949. He described how efforts had in the early days been directed to labour saving with development of continuous diffusers, purification processes, etc. In the 1960's emphasis had changed to white sugar quality and from the mid-1960's on integrated and fully-automated plants. In his view, total automation was not desirable since the cost often outweighed the savings, while developments in equipment were so rapid that non-availability of spare parts became a problem after a relatively short time. In the 1970's there had been a move to counter oil price rises by improving thermal efficiency in sugar factories. He criticized research in the sugar industry, claiming that much was empirical in nature, intended to cope with new problems and on a trial-and-error basis; he would prefer to see greater weight given to basic, deductive research and the use of modern analytical techniques.

In reply, Karl Oberheide, speaking on behalf of the President of the Commission, B. Dieden of Sweden, who was ill, thanked Mr. Brüniche-Olsen for his welcome and offered his best wishes to Professor Giorgio Mantovani, new President of the Scientific Committee. He also welcomed Dr. A. Carruthers, former President of the Scientific Committee. He announced the new members of the Committee and new vice-chairmen, Mr. T. Rodgers and Mr. G. Duchateau. He thanked Dr. R. Pieck, General Secretary, and Mr. N. Loft and Mr. J. Laursen of DDS for their work in organizing the Assembly, and declared it open.

Professor Mantovani announced that Prof. Schneider had been elected Life Honorary President by the Scientific Committee and that a telegram informing him was to be sent. Dr. van der Poel had been elected a new Vice-President and three new members appointed. He asked for a moment's silence in memory of the late Prof. S. Zagrodzki and Dr. V. Prey.

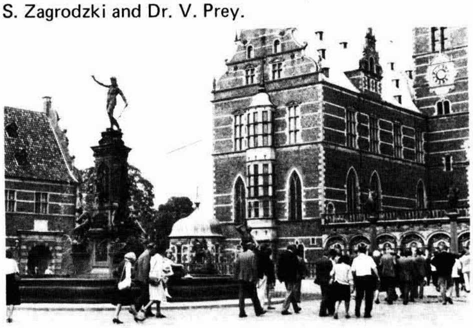


Fig. 1. Frederiksborg Palace

Presentation of papers then began and continued through that day and the next morning. Priority themes were "Crystallization" and "Reduction of energy requirements in sugar factories" and most of the papers were devoted to aspects of these two themes. Abstracts will be published in this Journal in due course.

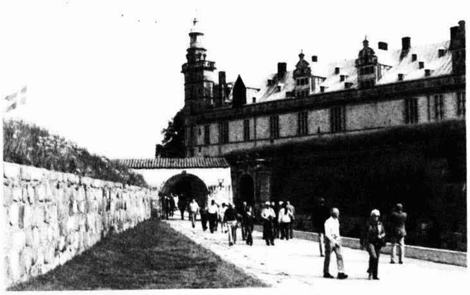


Fig. 2. Helsingborg Castle

On the afternoon of June 1 members had the option of either visiting Louisiana, a museum of modern art, or of taking a journey to Frederiksborg Palace, a royal residence and major historical museum, followed by visits to the smaller Friedborg Palace and Helsingborg Castle, the setting (as Elsinore) of Shakespeare's play "Hamlet".

Work recommenced the next morning with presentation of papers until late afternoon, when Prof. Mantovani summed up the papers and thanked the authors, session chairmen and all who had taken part in the proceedings. The Assembly ended with a banquet in the Nimb restaurant of the Tivoli Gardens, into which members dispersed afterwards.

Fig. 3. Maribo beet breeding station

Fig. 4. Maribo beet quality laboratory

On the following day an excursion was arranged to the Maribo sugar beet breeding station of DDS in Holeby, where members were able to see the laboratory for assessment of beet quality as well as studies on the physiology and biochemistry of the plant, soil analysis, beet pelleting, etc. The members were then taken to Saxkjobing sugar factory where they could see the packaging stations for granulated and cube sugar, as well as the factory equipment itself, some of which was undergoing repair and replacement. After luncheon they returned to Copenhagen for return to their homes.

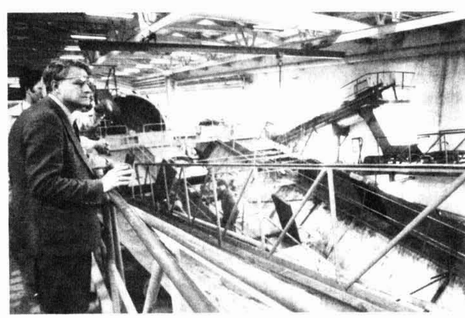


Fig. 5. Saxkjobing sugar factory

CANE SUGAR MANUFACTURE

Meeting steam requirement in a sugar house. B. M. Rodriguez and A. M. Blanchard. *Sugar J.*, 1982, **45**, (3), 28-30. — Details are given of the system used to meet the increased steam requirements at Bryant Sugar House when the daily cane crushing rate was increased from 10,000 to 14,000 short tons. The previous scheme, involving quadruple-effect evaporation, supply of 1st effect bled vapour to the vacuum pans and juice heaters and supplementing exhaust steam with live steam passed through a pressure-reducing valve, was replaced with a scheme embodying quadruple-effect evaporation, supply of low-pressure vapour to the vacuum pans from a vapour cell, heating of juice with condensate and 2nd effect vapour, and the use of thermo-compressors to provide exhaust steam make-up. Flow diagrams are given of the two schemes.

Development and application of a new rapid clarifier. C. H. Chen, J. F. Tong, H. C. Yang and H. T. Cheng. *Rpt. Taiwan Sugar Research Inst.*, 1982, (95), 25-32 *(Chinese)*. — Details are given of a new rapid clarifier which comprises two compartments with separate up-flow feed systems, overflow discharge and mud withdrawal, so that each compartment acts as a completely independent clarifier. Factory-scale trials conducted in 1979-80 showed that the working volume requirement of 165 m^3 for juice from 3000 tcd was half that of a Dorr clarifier. At a juice retention time less than half that in the Dorr clarifier and a higher hourly juice flow rate, the mud level was very much higher than in the Dorr clarifier. A rise of 4.5 units from a limed juice purity of 80 was recorded. An automatic control system for mud flow rate and hence mud level and density operated throughout the crushing season without any problems.

Colombian sugar industry in 1982. O. Marin and V. Izquierdo B. *Sugar y Azúcar*, 1982, **77**, (9), 34-35, 38-39, 42-43. — A survey is presented of the Colombian sugar industry, with tabulated data, including details of the 15 factories in operation.

Cane payment by sucrose content. A. D. V. Cortez. *Brasil Açuc.*, 1982, **100**, 25-36 *(Portuguese)*. — In Brazil cane has continued to be paid for on a weight-only basis, although the I.A.A. has been trying to introduce a sucrose content element since 1968. It has succeeded in Alagoas for the 1981/82 season, and the system recommended for weighing, core sampling and analysis of loads is illustrated, with a layout for a specimen record card, a diagram of alternative positions for load sampling, etc.

Evaluating the effectiveness of cane washing by the ash level in bagasse. J. C. P. Chen. *Proc. 1980 Meetings Amer. Soc. Sugar Cane Tech.*, 57-61. — The findings of various authors regarding the effect of cane trash on milling efficiency and sugar recovery are presented in tables of data, which are summarized to show that 1% fibrous trash causes a sugar loss of 2.1-3.0 lb per short ton of cane crushed, that 1% dirt tare causes a sugar loss of 2.5 lb per ton of cane crushed, while a 1% mixture of the two forms of trash results in a 4.1 lb sugar loss per ton of cane crushed. While spraying of water on the cane conveyor may remove some of the dirt, it is not generally effective, whereas use of a simple wash table, inclined at 45°, has resulted in a noticeable reduction in undetermined losses, filter cake losses and bagasse ash content at two Louisiana factories. Tests should be carried out on application of cleaning chemicals added to the cane wash water, it is suggested. The bagasse ash content as a criterion of cane washing efficiency is discussed. It is also useful as a guide to the fuel value of the bagasse — higher ash levels not only adversely affect boiler efficiency, but also result in a greater quantity of unburnt material for disposal.

The double magma system: a report of its performance and experiences with it at United States Sugar Corporation. B. M. Rodriguez. *Proc. 1980 Meetings Amer. Soc. Sugar Cane Tech.*, 68-73. — See *I.S.J.*, 1982, **84**, 55.

Ultrafiltration and the sugar industry. D. F. Day. *Proc. 1980 Meetings Amer. Soc. Sugar Cane Tech.*, 74-78. Ultrafiltration trials were conducted on clarified juice and diluted molasses. Details are given of the procedure used, and results are discussed. Juice purity was increased from 76.6 to 81.5 and the syrup produced from it had a viscosity of 75 centipoises compared with 94 without juice treatment. The colour and non-sugar solids of the 35°Bx molasses solution were reduced by about 67% and 47%, respectively. Despite the benefits of ultrafiltration, however, it is pointed out that the major problem is the large quantities of material to be treated and the relatively low flux properties of currently available membranes.

Recent developments in the South African sugar milling industry. M. Matic. *Proc. 1980 Meetings Amer. Soc. Sugar Cane Tech.*, 79-84. — Comparison is made between cane milling efficiency in South Africa, Louisiana and Florida, demonstrating the superiority of the South African factories in regard to extraction and bagasse pol. The rise in crushing rates and extraction in South Africa from 1925-34 to 1978 is indicated, and details are given of diffuser performance by comparison with milling. A typical 3-boiling remelt scheme as used in South Africa and the improvement in final molasses exhaustion up to 1978 are also discussed, as is the starch problem. Typical analyses are given of low-pol export sugar and affined sugar.

Computers in the Australian sugar industry. D. B. Batstone. *Sugar y Azúcar*, 1982, **77**, (10), 39, 42. — An outline is presented of two examples of computer application in the Australian sugar industry: (1) cane receival data acquisition, and (2) direct digital control of a vacuum pan.

Use of rice straw as fuel in sugar mills. B. S. Pathak, S. A. Bining and H. S. Khorle. *Indian Sugar*, 1982, **32**, 257-258. — Rice straw chopped into 10-cm pieces was mixed with bagasse at an approximate ratio of 1:3 on dry matter and used as fuel. Results of tests over short periods showed that the mixture was suitable for horseshoe-type furnaces and that 1 tonne of straw of medium-to-high moisture content could replace about 0.6 tonnes of bagasse of 50% moisture content, but that uniform chopping of large quantities of rice straw presents a problem, while long straw is difficult to mix with bagasse and tends to choke the feeder. The use of baled straw as fuel appears to be more convenient but requires a bale conveyor and appropriate feeder. An average 25% of bagasse was saved by replacing with rice straw, and the trials are to be resumed with the aim of saving 30-40% bagasse.

New water cooling system to replace spray pond. A. S. Chitale. *Sugar J.*, 1982, **45**, (5), 17-19. — Details are given of a mist cooling system designed to replace a spray pond; installed at an Indian sugar factory, the scheme reduces the condensate temperature to 7-10°C below ambient, and has a number of advantages for factory processing which are indicated.

A brief description of the Venezuelan sugar industry. F. Cordovez Z. *World Sugar J.*, 1982, **5**, (6), 21-23. Of the 17 sugar factories mentioned in this short survey, three are merely syrup plants from which the syrup, of 72-74°Bx and about 80 purity, is transported to sugar factories having refining sections for conversion to refined sugar. The scheme is well suited to Venezuelan conditions because of low fuel costs for syrup transportation and processing. Of the 14 other factories, only two produce raw sugar, while all the rest have refining sections. Sugar production has been declining since 1974, and Venezuela is expected to continue to import sugar for several years. Reasons for the fall in production are given as the inadequate selling price fixed by the government, the oil boom and associated inflated costs that occurred in 1974, and the incidence of cane diseases, particularly smut and rust.

Blanco Directo sugar J. E. Hamlin. *World Sugar J.*, 1982, **5**, (6), 26-29. — A description is given of the process for production of the title sugar, which has a typical pol of 99.7° and a colour content of 100-200 ICUMSA units, by comparison with one of 250 units for a typical plantation white sugar. Its keeping qualities are very much better than those of white sugar produced by double sulphitation or double carbonatation-double sulphitation. The process for Blanco Directo sugar manufacture involves sulphitation and clarification; the muds are filtered and the filtrate clarified and mixed with clear juice. This is evaporated and the syrup clarified by the Talodura process. The aims and results of the various processes are listed, as are the benefits of the sugar for the domestic and industrial consumer. The scheme may also be used, without sulphitation, to produce a very-high-purity raw sugar suitable for refining.

Copersucar: the sugar and alcohol cooperative of centre-south Brazil. J. Borges. *Rpts. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 33-36. — The aims, activities and advantages of Copersucar are recounted, covering marketing, technical and agricultural assistance to 71 sugar factories and three autonomous distilleries.

Mini-factory processing of smut-infected cane. K. Onna and S. Ferreira. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 42. — Juice from healthy cane and from smut-infected cane was processed to *A*-sugar and -molasses in a mini-factory. Results showed that the overall losses expressed as tons of recoverable pol per 100 tons of prepared cane were about 6, 12 and 57%, respectively, for cane containing 10, 20 and 100% diseased stalks (by weight), while 21, 47 and 435% more molasses resulted. Smut also created a number of processing problems and increased lime requirements. The losses mentioned have to be added to those resulting from a 10-20% fall in cane yield caused by the disease.

Evaluation of syrup clarification at the Haina factory of the Davies Hamakua Sugar Company. T. Moritsugu. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 100-101. — Tests were conducted on syrup clarification with Zuclar 1000ST at a concentration of 30 ppm on refractometric solids, after which the syrup was boiled to *A*-sugar. Composite samples of clarified and unclarified syrup, scum at the clarifier surface, *A*-massecuite, -molasses and -sugar were analysed. Results showed that clarification had little effect on syrup colour, whereas optical density was improved in all four tests, and the insoluble solids % refractometric solids was considerably reduced. The scum samples were of high purity and high optical density and contained much insoluble solids. Colour contents were higher than those of unclarified syrup in two tests and lower in the other two. The effects of treatment were limited because of the high quality of the initial syrup, it is suggested, and tests on syrup of high insoluble solids and high optical density are recommended.

Pioneer dewatering mill. K. D. Stapleton. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 102-103. Details are given of a bagasse dewatering mill, which has reduced the average bagasse moisture from 48.5% in 1975-80 (the average for 1980 being 49.17%) to 47.6% since 1981 and decreased steam consumption substantially by comparison with the system of two presses previously used. Running costs are also estimated to be substantially lower. Further improvement in dewatering was expected with replacement of the top roller with one of larger diameter.

Mill turbinization at HC & S Puunene factory. R. Kwok. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 104-106. — The program for installation of individual turbine drives with totally enclosed gear reduction units on the two milling tandems (each comprising five 3-roller mills) at Puunene from 1980 to 1985 is set out, and specifications are given of the turbines and gears. The maceration system is also to be modified, and both the existing and future schemes are outlined.

Energy saving projects at Oahu Sugar Company. R. Okawa. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 114-117. — Steps taken to reduce energy consumption at Oahu include insulation of the boiler feedwater tank and utilization of waste heat for seed cane treatment. Two major projects currently being pursued concern increasing transmission line voltage and using cane trash as fuel.

Areas for energy efficiency improvements in power plant systems. T. W. Vorfeld. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 118-122. — Possibilities of improving power plant efficiency are discussed. Reasons for boiler performances below those predicted by the manufacturers are given as high excess air, high bagasse moisture, high carbon carry-over, inadequate insulation and excessive blowdown. These factors are examined, as well as turbo-generator performance and its measurement. Evaporator inefficiency is, in the author's opinion, a factor that receives insufficient attention; some advice is offered on how best to monitor the controls. Also described is the replacement of a pressure reducing valve with a steam turbine and checking of steam temperature control efficiency.

BEET SUGAR MANUFACTURE

A simple, highly efficient juice purification process. K. Vukov. *Cukoripar*, 1982, **35**, 109-112 *(Hungarian)*. See Vukov: *I.S.J.*, 1983, **85**, 149.

Biothane — a process for anaerobic effluent treatment and biogas recovery. J. Tschersich. *Zuckerind.*, 1982, **107**, 838-842, 848-849 *(German)*. — The Biothane process developed by CSM in Holland is described[1] and details are given of the BMA plant installed at Brühl sugar factory in West Germany, where an average degradation of 87.5% (on uncentrifuged COD) was achieved over a 45-day period; rated throughput was 2400 m^3/day at a COD concentration of 7500 $mg.litre^{-1}$, representing a total daily COD load of 18 tonnes. Average methane yield was 0.447 m^3 per kg of degraded COD. It is calculated that 1 m^3 of methane can replace about 0.7 kg of fuel oil.

The Anamet process — treatment of sugar factory effluent with the aim of direct discharge into the outfall. L. Huss and A. Reinholdtzon. *Zuckerind.*, 1982, **107**, 842-846, 848-849 *(German)*. — A description is given of the Anamet effluent treatment process (developed in Sweden) in which the single-stage anaerobic process is carried out in a reaction vessel provided with a screw, which ensures thorough mixing of and intimate contact between micro-organisms and substrate. An aerobic stage following the anaerobic treatment ensures that the treated effluent can be discharged into the outfall. Performance data from Euskirchen and Jordberg sugar factories indicated campaign averages of 99.5% BOD_5 reduction and well over 90% COD reduction. Details are given of methane yields.

Investigation of two-stage fermentation for effluent treatment. G. Kaiser and W. Mauch. *Zuckerind.*, 1982, **107**, 850-857 *(German)*. — Laboratory trials were conducted on fermentation as a means of treating sugar factory effluent while simultaneously producing valuable degradation products such as ethanol, single-cell protein and methane. The most efficient was a combination of ethanol and methane fermentation; the *Saccharomyces cerevisiae* used in the first stage converts non-degradable carbohydrates into e.g. ethanol, organic acids and their esters which can then be easily converted into methane in the second stage. A yeast of this type is particularly suitable for treatment of sugar factory effluent because of the high sugars content and absence of toxic constituents. Of the various mixed cultures examined for methane fermentation, the most active was found to be a garden compost. More than 80% degradation was achieved at a COD load of 7 $kg.m^{-3}$ per day; the methane concentration in the gas from the second stage was about 90%, and more than 50% of degraded carbohydrate was recoverable as methane. When diluted vinasse was used as substrate, effluents containing 16.8 kg COD per m^3/day could be handled continuously, and a degradation rate greater than 90% was achieved.

Control of the boiling process by means of radioactive density measurement. G. Born. *Zuckerind.*, 1982, **107**, 862-863 *(German)*. — Mention is made of various types of Brix meter, based on radioactivity measurement, installed on vacuum pans; in all cases, precision has been very high (as found by comparison with other instruments such as rheometers), while maintenance requirements are low. As a result, the meters lend themselves well to boiling control. Strip chart samples are reproduced.

Electrical resistance heater for low-grade massecuite. J. Dyntar, J. Horak and Z. Krajcovic. *Listy Cukr.*, 1982, **98**, 200-204 *(Czech)*. — Details are given of a resistance reheater for low-grade massecuite designed for an hourly throughput of 10 tonnes and a massecuite temperature rise of about 10°C.

Special drives for the sugar industry. H. Grass. *Zuckerind.*, 1982, **107**, 863-864 *(German)*. — Information is given on Felten & Guilleaume A.C. and D.C. motors available for use with batch centrifugals. Particular mention is made of totally enclosed air-cooled D.C. motors that can be operated in a sugar-laden atmosphere; any film of sugar on the outer casing can be removed by spraying with water, while carbon dust from the brushes is easily removed from grids around the bottom-located commutator.

Some problems concerning continuous diffusion. E. Walerianczyk. *Gaz. Cukr.*, 1982, **90**, 129-131 *(Polish)*. Aspects of continuous diffusion in a DDS-type unit that are discussed include disinfection, cossette quality, temperature and the effects of these factors on losses. A temperature distribution scheme based on an average temperature of 68.5°C is proposed.

Vapour compression within the heat economy of a sugar factory. K. Urbaniec. *Gaz. Cukr.*, 1982, **90**, 134-136 *(Polish)*. — The question of thermo- and turbo-compression of vapour from a 1st evaporator effect and a vacuum pan is discussed, and comparison made between vapour consumption at a factory using a conventional heat scheme and one using pan vapours and thermo-compression. It is concluded that, because of the high capital costs of turbo-compressors, their use can only be recommended where cheap energy is available from outside the factory or where cheap liquid or gaseous fuel and a gas turbine are available.

Chemical disinfection of beets before the slicers. K. Mossakowska. *Gaz. Cukr.*, 1982, **90**, 145-146 *(Polish)*. Disinfection tests are reported in which only preparations based on isocyanurates or on chlorinated melamine were successful out of seven investigated. At 40 ppm and a concentration of 0.2-1.0%, the melamine-based disinfectant (SCM_3) substantially reduced the development of mesophiles in cossettes and juice when it was added to the beets in the hopper above the slicer.

Effect of residual mud in 1st carbonatation juice after filtration on the purity of thin juice. I. Oglaza and S. Zarzycki. *Gaz. Cukr.*, 1982, **90**, 146 *(Polish)*. — Since supplementrary filtration of 1st carbonatation juice is a laborious task that is often omitted in Polish sugar factories, the effect of small quantities of residual mud on thin juice purity was investigated. Results showed that supplementary lime dosage rate and juice invert content affected the influence of the residual mud (retained at

[1] See also Tschersich: *I.S.J.*, 1981, **83**, 365-370.

0.05-0.9 g dry solids per 100 cm^3 juice). At best there was a rise in juice purity, while at worst the residual mud caused a rise in ash content; colour and lime salts content could fall. Residual mud contained no colloids, so that the adsorptive properties of any additional carbonate were unimpaired.

Development of a method for recovery of sucrose from molasses by ion exclusion. W. Fornalek, T. Szulc, M. Ligowska-Ambroziak and W. Kosieradzki. *Gaz. Cukr.*, 1982, **90**, 146-147 *(Polish)*. — Problems involved in the operation of an ion exclusion unit and their solutions are briefly indicated. Particular mention is made of a system for automatic control of the liquid level above the resin bed and of fouling of the resin when the molasses contained a large quantity of lime salts. About 80% of the initial sugar in molasses has been recovered. Decalcification of the molasses before ion exclusion increased resin service life and had no adverse effect on sugar recovery.

Auto-purification of sugar factory effluents containing halogens used for disinfection of sugar beet. B. Zalicka. *Gaz. Cukr.*, 1982, **90**, 148-149 *(Polish)*. — Investigations showed that halogens in effluent at up to 1 $g.m^{-3}$, i.e. above the amount used for beet disinfection, had no adverse effect on auto-purification of the effluent.

Some problems concerning methane fermentation of sugar factory effluent. B. Polec. *Gaz. Cukr.*, 1982, **90**, 149-150 *(Polish)*. — Aspects of aerobic and anaerobic treatment of effluent discussed include the increase in treatment efficiency when the ratio of methane gas volume to that of liquid in a closed fermentation vessel is increased, the advantage of introducing air to the upper layers of liquid in an open fermentation vessel so as to increase degradation of volatile fatty acids, and the use of activated sludge for anaerobic treatment.

Auto-purification of sugar factory effluent containing liquid from flume and carbonatation mud in a storage tank. E. Glabski and B. Polec. *Gaz. Cukr.*, 1982, **90**, 150 *(Polish)*. — Comparison is made between the effluent treatment efficiencies in storage tanks at Krasnystaw and Krasiniec sugar factories. Reasons for the much poorer performance at the latter factory are given as overloading with undiluted carbonatation mud washings and use of a deeper tank, which impaired the final (aerobic) phase of treatment.

Aspects of stirrer installation in vacuum pans. K. Austmeyer and K. Kipke. *Ind. Alim. Agric.*, 1982, **99**, 507-513 *(French)*. — A series of investigations in which a five-bladed Ekato massecuite stirrer was installed in vacuum pans demonstrated the benefits in the form of accelerated boiling (as a result of increased heat and material transfer) and increased output (as a result of improved product quality). A method for determining the required stirrer capacity is described and illustrated by a sample calculation of low-grade boiling. In both white sugar and low-grade boiling, the stirrer had a noticeable positive effect on the evaporation capacity of the pan during the bringing-together and Brixing-up stages. As regards the mixing properties of the stirrer, it was found that a zone of higher fall in shear rate was created above the stirrer as a result of flash evaporation of incoming juice and caused intensive homogenization. The effects of stirrer diameter and rotary speed on capacity, power consumption and torque are discussed.

A modern boiling house. The new plant installed at Bucy-le-Long sugar factory. P. Lemaitre. *Ind. Alim. Agric.*, 1982, **99**, 531-537 *(French)*. — Details are given of the new boiling house at Bucy-le-Long sugar factory which has a daily slice of 8000 tonnes of beet (including 400 tonnes treated in the distillery section). The boiling house has been designed so that the standard liquor filters, 1st, 2nd and 3rd strike vacuum pans (all of which are Fives-Cail Babcock continuous pans), magma pans, steam scrubber, falling film evaporators for stored thick juice (from the neighbouring juice station at Vierzy, which had been a sugar factory until 1972), centrifugals and Quentin process ion exchangers are all on one floor (at a height of 8.5 m), while the vertical crystallizers, melters, minglers and massecuite and syrup pumps are installed on the ground floor. Information is given on the heat economy of the plant and its automatic controls.

Raw juice heating with heat from condensate in a plate heat exchanger. P. Hoffman. *Ind. Alim. Agric.*, 1982, **99**, 539-544 *(French)*. — Pilot-plant trials are reported in which condensate was used as raw juice heating medium in a plate heat exchanger of 1.00-1.50 $m^3.hr^{-1}$ throughput. At a juice:condensate ratio in the range between 1.0:0.60 and 1.0:0.77, the raw juice temperature was raised from 28-34° to 70-76°C in the 1st stage of trials (to verify the suitability of a plate heat exchanger) and to 56-60°C in the 2nd stage (aimed at establishing optimum conditions and obtaining design data), with condensate at 100° and 77°C initial temperature in stages 1 and 2, respectively. The lower condensate temperature favourably influenced a reduction in the amount of incrustation formed.

Adaptation of mechanical vapour recompression to continuous 1st strike sugar boiling. A. Gauthier. *Ind. Alim. Agric.*, 1982, **99**, 551-559 *(French)*. — The substantial fuel economies made possible at Bucy-le-Long and Erstein sugar factories, both of which operate a normal beet campaign plus post-campaign thick juice processing, by the use of mechanical vapour compression for continuous 1st massecuite boiling are demonstrated in detailed reports for both factories. At Bucy-le-Long, 1st massecuite boiling at 10 tonnes. hr^{-1} evaporative capacity is only possible with vapour compression, whereas at Erstein the use of vapour compression for 1st massecuite boiling at 5 $tonnes.hr^{-1}$ evaporative capacity is only possible during the post-campaign thick juice processing — during the beet campaign the pan is heated with evaporator bleed. Neither factory is able to generate electricity during post-campaign processing, so that all power, including that needed to drive the vapour compressor, has to be extracted from the public utility.

Methane treatment of effluent. Application of the Biothane UASB process in sugar factories and distilleries. P. Boulenger, B. Versprille, K. C. Pette and R. J. Zoetemeyer. *Ind. Alim. Agric.*, 1982, **99**, 565-569 *(French)*. A description is given of the Biothane UASB (Upflow Anaerobic Sludge Blanket) effluent treatment method, developed by CSM, which has been applied to sugar factory waste water and distillery waste treatment. Typical performance data and cost factors are given, including the fuel value of the gas (containing up to 90% methane) obtained.

Béghin-Say: Connantre sugar factory. Anon. *Ind. Alim. Agric.*, 1982, **99**, 601-615 *(French)*. — An illustrated description is given of the equipment, both conventional and of modern design, installed at Connantre sugar factory to allow expansion of the daily beet slice to 24,000 tonnes.

Choice of flocculants for acceleration of 1st carbonatation juice particle settling. I. A. Oleinik, I. G. Bazhal and R. M. Polishchuk. *Sakhar. Prom.*, 1982, (9), 25-27 *(Russian)*. — Instead of the usual empirical means of choosing flocculants on the basis of the filtration coefficient and the settling velocity of $CaCO_3$ particles in the first five minutes, studies were conducted on selection of flocculants using their ionization constants and optimum pH of the medium as criteria. A 0.1% solution of a water-soluble polymer in alkaline medium (0.5-5.0 ml NaOH in 0.5 ml intervals) was titrated potentiometrically, and its ionization constant determined at each pH; the optimum pH, at which 1st carbonatation mud particle adsorption on $CaCO_3$ was maximum, was then established in terms of this constant, the first-stage instability constant of the water complex and the ionic water product. An empirical formula was derived for calculation of the ionization constant as a function of temperature; calculated and experimental values at temperatures in the range 20-80°C were in close agreement. The optimum pH for flocculant adsorption fell with temperature rise and was in the optimum pH zone for 1st carbonatation juice. Tests in which the flocculant was compared with a non-hydrolysed polyacrylamide confirmed the validity of the selection method.

Trial of a dryer/cooler at Lenin sugar factory. V. I. Kruglovenko, E. M. Belen'kaya and V. A. Serkin. *Sakhar. Prom.*, 1982, (9), 28-29 *(Russian)*. — A horizontal rotary drum dryer/cooler was modified in order to increase white sugar throughput and the drying section divided into two zones: with air feed at 140-150°C and at 100-120°C, respectively. Trials showed that at an average throughput of 4.43 $kg.sec^{-1}$ the sugar moisture content was reduced from 0.499% to 0.034%, compared with a reduction from 0.309% to 0.036% at a throughput of 2.58 $kg.sec^{-1}$ in single-zone drying in the original equipment, with air at 100°C. However, the temperature reduction from 50.1° to 42.2°C in the modified dryer/cooler (compared with a reduction from 47.9° to 40.2°C in the original) was considered inadequate for sugar to be stored, and additon of a fluidized bed compartment to the drum is suggested.

An indicator electrode for pH measurements. Z. S. Voloshin, A. V. Pogrebnyak, M. A. Marushchenko and I. N. Savranskii. *Sakhar. Prom.*, 1982, (9), 32-33 *(Russian)*. Details are given of an indicator electrode in which the sensing element is a tungsten ring with an impedance transformer located in the recess of a metal body. Tests on measurement of 1st and 2nd carbonatation juice pH during September-December 1981 showed an accuracy of ± 0.1 units with a temperature fluctuating between 72° and 80°C, or ± 0.07 units within a temperature range of 75-77°C.

Juice purification efficiency. J. Dobrzycki. *Gaz. Cukr.*, 1982, **90**, 153-156 *(Polish)*. — Raw juice purification, with particular emphasis on the action of $CaCO_3$, is discussed in regard to elmination of specific non-sugars and groups of non-sugars and to factors affecting efficiency. The various beet agricultural parameters affecting juice composition and hence purification have such a marked influence that comparison of methods of juice treatment based on purification efficiency is valid only when all the juice samples used emanate from the same source or from the same period during the campaign.

Effect of the evaporator station on fuel economy in the sugar factory. S. Niespodzinski, A. Gatys and D. Szwedowicz. *Gaz. Cukr.*, 1982, **90**, 161-163 *(Polish)*. The evaporator is the chief energy consumer in the sugar factory, and its operation and performance as well as the range of uses to which its vapours are put have a decisive influence on the fuel consumption of the factory. The subject is discussed, and results of investigations conducted at twelve Polish sugar factories are tabulated, permitting comparison of evaporator performance covering the years from 1956 to 1979. These show that all the factories have a potential for improving their heat economy by optimum evaporator operation.

Operation of AWO-1000 centrifugals at Malbork sugar factory. E. Maczkowski and E. Zabierek. *Gaz. Cukr.*, 1982, **90**, 169 *(Polish)*. — The operation and performance of five AWO-1000 fully-automatic centrifugals at Malbork are reported, and modifications carried out and proposed are indicated.

Application of ferritic stainless steels for tubes in sugar factory evaporators and heat exchangers. L. Pennec. *Aciers Spéciaux*, 1980, **52**, 13-21; through *S.I.A.*, 1982, **44**, Abs. 82-1290. — Changes in beet factory processes since about 1950 have led to corrosion of copper and brass tubes in evaporators. Of various preventive measures tried, the use of 17% Cr stainless steel tubes gave best results; a ferritic rather than an austenitic stainless steel is recommended. In practice, the thermal conductivity differs little from that of copper. Experiences in use are described: a long life can be expected for these tubes, but problems may arise if acid descaling is used, or if the juice has a high Cl content; the metal must be thick enough to resist cracking at the level of the upper tube plate, and during installation any deposits on the lower tube plate must be removed.

Beet soil dewatering by means of sedimenting centrifuges. I. Introduction. R. Walther. *Zuckerind.*, 1982, **107**, 921-922, 929-930. **II. Experiences at Frauenfeld sugar factory.** R. Armbruster. *ibid.*, 922-926, 929-930. **III. Experiences at Gross-Gerau sugar factory.** R. Hurasky. *ibid.*, 926-930 *(German)*.

I. The need for mechanical dewatering of mud from the beet flume and washer at Frauenfeld was a consequence of shortage of land for its application, infiltration of the water from the mud into ground water, and official complaints about odour emission. A dry solids content of about 55% was considered by the local authority to be the lower limit at which there was no absorption of rainwater and no leaching. In order for sedimenting centrifuges to be able to accomplish the required dewatering, it was necessary to pre-treat the mud for sand particle removal before the clarifier preceding the centrifuge, to remove as much beet debris before the clarifier (or at least before the centrifuge) as possible, to use a header tank to regulate concentration, and to optimize flocculant preparation. Since 1979 successful dewatering has been carried out at the factory, where the total of highly polluted effluent is less than 10% on beet and there is no smell.

II. Details are given of the equipment used for mud dewatering at Frauenfeld, particularly the horizontal flow-through centrifuge, of which a battery of three increases the dry solids to about 55%. The mud from the Brukner clarifier is pumped into a vertical vessel after screening; the pulp particles are mixed with flume water and returned to the factory, while 600 $m^3.hr^{-1}$ of mud is transferred to the centrifuges. Polymeric flocculant is made up into solution and also pumped to the centrifuges for mixing with the mud suspension. All the equipment for beet mud dewatering is housed in a special building. Some performance data for 1981 are presented. III. Operation of the battery of three centrifuges at Gross-Gerau in 1981 is reported. The need for a hydrocyclone to remove sand particles is discussed, and performance data are given for the centrifuges before and after installation of the cyclone. Of the three centrifuges, the most suitable for the task was that equipped with a 200-kW motor which permitted an hourly throughput of 80 m^3 in contrast to 74 m^3 for a machine with a 160 kW motor and 71 m^3 with a hydraulic drive. All three achieved an increase in dry solids from 16% to 57%.

Know-how and experiences in the planning of sugar factory capacity expansion. H. Wunsch. *Zuckerind.*, 1982, **107**, 932-934 *(German)*. — A representative of IPRO Industrieprojekt GmbH describes the procedure in planning expansion of a beet sugar factory, covering the more important data that the factory management must provide, the technical and technological calculations that can then be made, and capital costs and their distribution.

Examples of automation concepts in sugar factories. L. Wenzel. *Zuckerind.*, 1982, **107**, 934-936 *(German)*. A description is given of the system of automation used at the expanded Groningen sugar factory in Holland, where the system of measuring and control was completely revised so as to provide central control of all the processes from the beet yard through to sugar drying, including the power house, lime kiln and pulp dryer operations; in addition, two local control stations are provided for beet yard operations and the boiling house. Latest trends in process technology based on digital systems using micro-processors and highly integrated semi-conductor memories are outlined, and two examples are briefly described showing how a small outlay of money for measuring and control systems permitted savings in primary energy.

Thoughts on development of primary energy utilization — steam and electricity in the sugar industry. H. U. Reichel. *Zuckerind.*, 1982, **107**, 936-939 *(German)*. Factors to be considered in the choice of fuel for sugar factories are discussed, and possible ways of reducing energy consumption described. A low-temperature pressed pulp drying system used at Artenay sugar factory in France is described; it consists of five parallel belt conveyors, one above the other, each 4.68 m wide and almost 40 m long; the pulp is fed onto the top conveyor and passes down through each stage. The layer of pulp gradually increases from 80 mm on the uppermost conveyor to 180 mm on the bottom one. Fresh air is blown through pairs of heat exchangers above the conveyors in the top four stages, while the warm air from the 4th stage is transferred to the 5th stage, which has no blower. The upper heat exchanger of each pair is heated with condensate that has been brought to 60°C with pan vapours; the air passes through the lower heat exchanger, which is fed with the same condensate but which has been subsequently heated to 90°C with turbine exhaust steam. The system is applicable to pressed pulp containing a maximum of 30% moisture; where, as at Artenay, the initial moisture content is higher, the system must be supplemented with drum drying. However, calculations show that the system can pay for itself within 3½ years; its power and steam consumption totals 960 kJ per kg of evaporated water, by comparison with some 2850 kJ per kg with a conventional high-temperature system. By raising the pressure and temperature of steam passing to turbines, e.g. from 40-60 to 140 bar and from 450-500° to 535°C, it would be possible to achieve a specific steam consumption of about 5.2-5.3 kg per kWh to meet the increased power requirements predicted for modern sugar factories at a constant power:steam ratio of approx. 1:4. However, it is considered very probable that in the distant future it will not be economical to produce all of a factory's electricity requirements in a pure steam-heated power plant, and possible alternatives are discussed.

Contribution to economic evaluation of a sugar factory with vapour compression and a gas turbine for pulp drying. M. Bruhns. *Zuckerind.*, 1982, **107**, 945-957 *(German)*. — Reference is made to the energy scheme proposed by Baloh[1] in which a pulp drying drum would be heated with gas turbine exhaust, and the electricity generated by the turbine used to operate vapour compressors. While the fuel consumption for such a scheme would be noticeably lower than for conventional schemes, the additional capital expenditure would be considerable. The author of the present article sets out to determine the conditions under which the scheme would be economical, assuming it was incorporated in an overall scheme for expansion of a factory from 3000 to 5000 tonnes daily slice at a pressed pulp solids content of 25%. Comparison with a conventional system based on drum drying with normal hot gases supplemented with boiler flue gas (as well as a cooling tower for pan vapour condensate) showed that conversion to vapour compression is one of a number of possible arrangements that would be feasible, but that the capital investment would depend on whether the existing power plant was adequate for the requisite increased capacity or whether new plant was needed.

Calculation of the optimum Brix of low-grade massecuite at a given temperature. J. Burianek. *Listy Cukr.*, 1982, **98**, 217-220 *(Czech)*. — Calculation of the optimum low-grade massecuite Brix at which the amount of recovered crystal sugar is maximum for a given temperature is discussed and a series of tables presented of optimum Brix as a function of temperature and mother liquor purity at massecuite purities of 76, 78 and 80, supersaturations of 1.15 or 1.20 and mother liquor:temperature ratios of 56—74% per °C in intervals of 2 units. Diagrams of Brix *vs.* temperature are also reproduced for supersaturation of 1.15 and 1.20 at 78 massecuite purity.

Protection of stored sugar beet with Fundazol 50 WP. J. Zahradnicek. *Listy Cukr.*, 1982, **98**, 224-226 *(Czech)*. Experiments are reported in which Fundazol 50 WP (a fungicide containing Benomyl as active ingredient) sprayed as a 0.3% suspension on factory beet piles at 10 $litres.tonne^{-1}$ was effective against a number of microorganisms such as *Penicillium expansum, Botrytis cinerea, Alternaria tenuis, Cladosporium herbarum* and *Mucor hiemalis* while reducing daily sugar losses and reducing matter. A 0.5% concentration was not considered economically justifiable despite a slightly better performance in terms of loss reduction.

[1] *Zuckerind.*, 1980, **105**, 50-61.

Application of mechanical vapour recompression to processes in the agricultural and food industries. A. Gauthier and J. Huchon. *Ind. Alim. Agric.*, 1982, **99**, 801-807 *(French)*. — A survey is presented of vapour compression applications in a number of industries including alcohol distillation and sugar manufacture. Vinasse concentration at a distillery using sugar beet as raw material is mentioned, while a greater amount of space is devoted to the use of vapour compression in the distillation process proper, the scheme used at the Buchères plant of Distilleries de l'Aube being outlined; distillation is used during the beet campaign, while rectification of the low wines takes place during the post-campaign period. In both cases, the vapour from the condenser that handles the alcohol vapour from the columns is compressed by a two-stage compressor and reintroduced into the column. A centrifugal compressor is used to raise the pressure of the vapour from the continuous vacuum pan at Erstein sugar factory from 0.24 to 1.11 bar before it is re-introduced in the pan. Use of the compressor for 3300 hours per year gives a saving of 1115 tonnes of fuel. Allowing for capital investment, a payback period of 4 years is calculated.

Vapour recompression in a sugar factory. M. Bourée. *Ind. Alim. Agric.*, 1982, **99**, 819-821 *(French)*. — Details are given of the evaporation scheme at Connantre and of various approaches to optimization in view of post-campaign processing of a substantial quantity of thick juice. After detailed studies of the requirements, the decision was taken to install a single-stage centrifugal compressor to handle 49 tonnes of vapour per hour. Payback time of the compressor is calculated as a little over two campaigns.

Prevention of sugar adhesion to working surfaces of a vacuum pan. A. I. Ukrainets, V. O. Shtangeev, I. S. Gulyi and I. G. Bazhal. *Sakhar. Prom.*, 1982, (10), 40-42 *(Russian)*. — Investigations are reported in which formation of a film of sugar above the massecuite-vapour interface in a continuous vacuum pan was prevented by injecting condensate from reheat steam to form a film along the surface (at least 0.05 cm thick) which dissolved any crystals. Addition of a surfactant such as a monoglycerol stearate was only partly successful.

The quality of raw juice obtained by an electro-chemical method. I. G. Bazhal, M. P. Kupchik, I. S. Gulyi, I. M. Katrokha and V. A. Zaets. *Sakhar. Prom.*, 1982, (10), 42-43 *(Russian)*. — Treatment of raw juice in an electric field was studied at 20-70°C and a voltage in the range 2.5-12.5 $V.cm^{-1}$. Results showed that temperature change affected juice Brix and sugar, betaine and colloid contents, while voltage change substantially influenced colloid, sulphate ash, K^+, Na^+ and sugar in the exhausted cossettes, and the total N, reducing matter, pectin and betaine contents to a lesser extent. Juice colour fell sharply with increased voltage. Treatment resulted in a juice purity rise of 4 units maximum (at highest voltage tested) and a 50-60% reduction in colour by comparison with conventional diffusion, while a voltage of 7.5-10 $V.cm^{-1}$ reduced thermophile and mesophile counts by 10% and slime-forming bacteria by 20%, but had no effect on moulds. For production of juice of adequate quality at minimum electricity consumption, a temperature of 50-60°C and voltage of 7.5-10 $V.cm^{-1}$ are recommended. (See also Bazhal *et al.*: *I.S.J.*, 1983, **85**, 118.)

Means of reducing manual labour in sugar factories of the Vinnitsa region. V. E. Zhmaka and V. S. Kuchuk. *Sakhar. Prom.*, 1982, (10), 44-45 *(Russian)*. — Various sugar factory operations are examined in regard to the possibility of replacing manual labour with mechanization. While a general reduction in manual labour is considered desirable, there is a complexity of problems at national level, and these are discussed.

No-waste technology of white sugar manufacture. M. M. Makhinya, B. A. Melent'ev, V. A. Fes'kov and V. L. Mar'yanchik. *Sakhar. Prom.*, 1982, (10), 45-48 *(Russian)*. Increase in sugar output by minimizing the amount of molasses formed is discussed, mention being made of well-known processes such as those for molasses sugar recovery and ion exchange and active carbon treatment of juices and syrups. Other methods suggested include concentration of filtered 2nd carbonatation juice to a syrup or drying to granules, either form then being transferred to food factories, and drying of pulp which is then ground to form a powder for use in preparation of various foodstuffs. The economics are discussed.

Experience at Salivonkovsk and Yares'kii sugar factories in reducing undetermined sugar losses in manufacture. A. Ya. Zagorul'ko, S. I. Rud', L. S. Mukhatova, P. P. Gaidenko and V. A. Melechko. *Sakhar. Prom.*, 1982, (10), 49-50 *(Russian)*. — Details are given of measures adopted to prevent spillage and leakage from pipelines, pumps, vessels, etc. at the two title factories as a means of reducing undetermined losses.

A new filter for single-stage filtration of 1st carbonatation juice. A. Sokolowski. *Gaz. Cukr.*, 1982, **90**, 181-182 *(Polish)*. — A rotary disc filter is described, and the performance of a prototype during three campaigns at Lagiewniki sugar factory is recorded. Each of the vertical discs is divided into 12 segments linked at their narrowest part to collectors running the length of the central shaft. Six of the segments are intended for filtration, two for rinsing, three for draining the cake and one for cake dislodging. Hourly throughput of 1st carbonatation juice, at a suspension content averaging 50 $g.dm^{-3}$, was 55 m^3 (1.8 m^3 per m^2 filtration surface) at a pressure of 0.1-0.2 $MPa.m^{-2}$ and a rotary speed of 6-12 rph. Filter cake losses after sweetening-off averaged less than 1%.

Rationalization of the consumption of energy carriers in the sugar industry. II. The heat consumption of manufacturing and technological processes. A. Laudanski. *Gaz. Cukr.*, 1982, **90**, 193-194 *(Polish)*. — The amount of steam consumed in DDS diffusion for heating purposes, including prescalding, is calculated.

Attempts to improve the quality of sugar factory effluent. D. Hadjiantoniou. *Hellenic Sugar Ind. Quarterly Bull.*, 1981, (47), 559-569 *(Greek)*. — The water economy of a beet sugar factory is outlined and the chief sources of waste water indicated, with details of their levels of pollution: flume-wash water of 200-250 $mg.litre^{-1}$ BOD_5 (of which there are large quantities), filter cake of 10-15,000 $mg.litre^{-1}$ BOD_5 (of which the quantities are relatively smaller), and other waste waters from varying sources, having a BOD_5 between 2000 and 3000 $mg.litre^{-1}$ but also relatively low in quantity. Means used to treat each type of waste water are described.

STARCH BASED SWEETENERS

Starch syrups. M. Remiszewski and K. Byszewski. *Gaz. Cukr.*, 1981, **89**, 97-100 *(Polish)*. — A survey is presented of corn starch syrup manufacture by acid hydrolysis or enzymatic hydrolysis, with brief reference to glucose isomerization to fructose. Flow diagrams are given of the various schemes described.

Continuous chromatographic separation of fructose/glucose. T. Hirota. *Tech. Bull.*, (GEPLACEA), 1981, (18), 3 pp. — The principle of the simulated moving bed method of chromatographic separation of fructose and glucose developed by Mitsubishi Chemical Industries Ltd. is outlined. Factors governing selection of a suitable separating agent (fractionation ability, pressure drop and life) and design optimization and operation (temperature, concentration of raw material, separation medium load and number of packed beds) are briefly discussed. A simulation model and computer program have been developed, and pilot plant trials carried out. Results showed a fructose recovery of 96.7% from a HFCS of 40.5% fructose and 52.3% glucose, giving an extract fraction of 97.3% fructose.

The Taloflote corn syrup clarification process. R. J. Harradine. *Sugar y Azúcar*, 1982, **77**, (2), 28-29, 32-33. Application of the Taloflote flocculation (using aluminium sulphate) and flotation process to glucose syrup production is described. Comparison of the process, using flotation plus six filter-presses, with a conventional one based on use of thirteen filter-presses for a plant producing 5 $m^3.hr^{-1}$ syrup shows the smaller quantities of carbon and filter aid consumed, the lower glucose loss and reduced quantity of sludge with the Taloflote process. The syrup produced by both processes was of the same turbidity, i.e. 10 ppm. Use of the process in the USA is described, and the economics compared with those of conventional processing.

Optimizing the use of filter aids in rotary vacuum precoat filters. A. J. Basso. *Sugar y Azúcar*, 1982, **77**, (2), 34, 36, 40-41. — Advice is given on optimum use of filter aids in the production of corn syrups, particularly regarding the preparation of a kieselguhr precoat slurry of required concentration, selection of filter aid, filter septum, vacuum control, filter drum speed and submergence, suitable liquid for precoat suspension (water or filtered liquor) and general advice on filter operation.

Weakly basic ion exchange resins for the deionization of high-Brix syrups in the corn syrup industry. W. Fries. *Paper presented at 41st Meeting, Sugar Ind. Technol.*, 1982, 13 pp. — Laboratory tests on the use of Amberlite XE-361 resin, based on condensation of epichlorohydrin and a polyamine, for decolorization of a 48°Bx HFCS are reported. While the total and operating capacities of the resin were higher than those of a styrenic and a phenolic resin and the rinsing requirements were much lower, the resin had a somewhat inferior physical stability and underwent significant degradation if 1N NaOH was used as regenerant in the presence of sulphate ions in the syrup, although regeneration with ammonia or sodium carbonate presented no problems. Commercial-scale application of the resin for HFCS and glucose treatment showed that the resin had major advantages over a phenolic resin used previously.

Biotechnology and the sugar industry. J. A. Polack. *Paper presented at 41st Meeting, Sugar Ind. Technol.*, 1982, 7 pp. — The author explains the meaning of the term "biotechnology" and the importance of enzymes in various processes, including fructose isomerization of glucose, glucose formation from starch and sucrose inversion.

Purification of fructose solutions with active carbon. N. A. Arkhipovich and T. Ya. Chernyakova. *Sakhar. Prom.*, 1982, (5), 48-51 *(Russian)*. — Investigations were conducted on the use of powdered active carbon for removal from fructose solutions of colour in the form of hydroxymethyl furfural (HMF) and its polymeric derivatives. Results conformed to the Freundlich equation, and a nomogram has been developed for establishing the quantity of carbon required as a function of initial HMF concentration and Brix.

Influence of peptone and cobalt levels on glucose isomerase production by *Streptomyces fradiae*. N. Kowser and R. Joseph. *Starch/Stärke*, 1982, **34**, 172-175. Investigations have shown that cobalt chloride must be included in the cultivation medium for glucose isomerase production by *S. fradiae* SCF_5. Inclusion of high levels of peptone caused low yields of the enzyme by chelating the Co^{++} ions and thus making them unavailable for enzyme production at a critical period in the life cycle of the organism.

Chromatographic recovery of glucose. A. Jarosz. *Gaz. Cukr.*, 1982, **90**, 19, *(Polish)*. — Tests are reported on ion exchange chromatography of hydrol (the residue from corn syrup manufacture that corresponds to molasses in cane or beet sugar manufacture) for recovery of glucose. The hydrol, of 58% dry solids, 2% ash content, pH 4.7, 72% reducing sugars (on dry solids), 81% glucose (on reducing sugars) and the remainder disaccharides, was treated on a column of Lewatit TSW 40 cation exchange resin, which was then eluted to produce three fractions, of which the glucose-rich fraction had a dry solids concentration of 12% and contained 95-98% glucose, representing 70% of that in the initial hydrol.

A novel debranching enzyme for application in the glucose syrup industry. B. E. Norman. *Starch/Stärke*, 1982, **34**, 340-346. — Most starches used in the manufacture of glucose syrups contain 75-85% amylopectin, which is a highly branched polysaccharide consisting of linear chains of 1,4-α-linked D-glucose residues joined together by 1,6-α-glucosidic linkages; these linkages act as a type of barrier to the action of exo-acting, saccharifying amylases, and the efficiency of the saccharification reaction could be improved by incorporating a specific debranching enzyme in the system. Although certain debranching enzymes have been known for some years, they have not been widely used in the glucose syrup industry. However, after an extensive screening program, the author's laboratories succeeded in isolating a *Bacillus* sp. that produced a thermostable, acidophilic pullulanase free from glucoamylase, α-amylase and β-amylase side activities. Some of the properties of the enzyme are described. It is stable at higher temperatures and lower pH than previously described enzymes of the type, and can be used with *Aspergillus niger* glucoamylase to improve the efficiency of starch conversion to glucose.

LABORATORY STUDIES

Measurement of the impedance of saturated sucrose solutions in the presence of a solid phase. V. I. Tuzhilkin and N. M. Podgornova. *Izv. Vuzov, Pishch. Tekh.*, 1982, (4), 35-37 *(Russian)*. — Measurements of the impedance of saturated sugar solutions of varying crystal content and purity (obtained by mixing white sugar with molasses) showed that the relationship between impedance and the two parameters over a wide range of values (purity ranging from 58 to 92 and crystal content from 0 to 50%) was of a highly complex nature and multifactorial, so that it could overlook certain factors involved in massecuite boiling. Hence, there is need to introduce corrections where impedence is used for automatic boiling control.

Electrification of food materials during pneumatic conveying. K. V. Romanov, V. A. Snisarenko and S. A. Pozigun. *Izv. Vuzov, Pishch. Tekh.*, 1982, (4), 78-81 *(Russian)*. — Investigations showed that the degree of static electrification of powdered materials passing along a metal or plastic pipeline at a velocity of 10 $m.sec^{-1}$ was governed by the nature of the material as well as the flow parameters. The importance of evaluating the electrification parameters as a contribution to fire and explosion prevention is indicated. Icing sugar was among the materials used in the studies.

Analysis of sugars by high-pressure liquid chromatography. B. Fournet, J. Parente, Y. Leroy and J. Montreuil. *Spectra 2000*, 1982, **9**, (73), 28-31; through *Anal. Abs.*, 1982, **43**, 4C12. — Methods for HPLC of sugars on bonded phases, ion-exchange materials and silica are briefly reviewed, and conditions for separation of certain mixtures are summarized in tabular form.

Liquid chromatography applied to oligosaccharide fractionation. A. Heyraud and M. J. Rinaudo. *Liqu. Chromatogr.*, 1981, **4**, (Suppl. 2), 175-293; through *Anal. Abs.*, 1982, **43**, Abs. 4C13. — The applications of column chromatography to the separation of monosaccharides and oligosaccharides are reviewed. Gel-permeation, ion-exchange adsorption and liquid-liquid partition chromatography and HPLC are described, with details of applications. Systems for monitoring the carbohydrate content of the eluate are described, and applications of the technique in various fields, including the food industry, are summarized. 263 references are given to the literature.

Equilibrium reactions of sugars during chromatographic analysis and their influence on elution time, peak width and molar response in modern separation systems. L. A. T. Verhaar. *Starch/Stärke*, 1982, **34**, 351-354. Since sugars can be present in solution in several forms, e.g. reducing sugars having open-chain, furanose and pyranose ring forms existing next to one another, with each of the ring structures having two anomeric forms, and these forms have different chemical and physical properties, their equilibrium reactions (mutarotation, lactonization, isomerization, complex formation and combinations of these) can affect liquid chromatography parameters such as elution time, peak form and width, and molar response. Knowledge of this fact is essential in order to avoid erroneous interpretation of results, and the various reactions mentioned above are described.

Determination of the sucrose content in sugar beets of reduced processing quality. H. Gruszecka. *Gaz. Cukr.*, 1981, **89**, 138-140; 1982, **90**, 156-160 *(Polish)*. — A review is presented of polarimetric, iodometric and enzymatic methods for determining sugar in beet of inferior processing quality; 74 references are given to the literature. In most cases polarimetry gave higher sugar values than the other methods, irrespective of the condition of the beet. Clarification with 80% ethyl alcohol plus a small quantity of basic lead acetate has given clear juices of high filtrability and prevents certain non-sugars dissolving while permitting rapid coagulation and precipitation.

The problem of optimum final temperature in molasses exhaustion. K. Wagnerowski. *Gaz. Cukr.*, 1982, **90**, 164-168 *(Polish)*. — A formula is derived for calculation of the relative crystallization velocity V_{rel} on the basis of the maximum crystallization velocity during the final phase of molasses exhaustion at optimum supersaturation and standard molasses purity:

$$V_{rel} = \frac{s.C_{sat}(C_{sup} - 1).T.P_{sat}}{(0.5\,\eta_{sup} + 0.5\,\eta_{sat})^2},$$

where s = sucrose solubility in water, C_{sat} = saturation coefficient, C_{sup} = supersaturation coefficient, T = temperature (°C), P_{sat} = purity of saturated solution and η_{sup} and η_{sat} = viscosity of supersaturated mother liquor and of saturated solution, respectively. The main factors affecting the optimum final temperature in crystallization are the saturation functions m and b. In Polish sugar factories the optimum final temperature was found to be in the range 43-61°C (average 50°C). A nomogram has been developed for establishing the effective concentration of non-sugars as a function of m and b and of the optimum final temperature in low-grade cooling.

Effects of dextran hydrolysate on sucrose crystal elongation. M. Saska and J. A. Polack. *Zuckerind.*, 1982, **107**, 941-943. — Sucrose was crystallized in the presence of both partially hydrolysed and unhydrolysed dextrans. Previous analysis had shown that a wide variety of isomaltose oligosaccharides resulted from the hydrolysis, and the effects on sucrose crystal elongation would be expected to increase with the hydrolysis if some of the oligosaccharides were active agents in modification of the sucrose crystal habit. However, this was not observed; it was found that the effect of the hydrolysate diminished, in agreement with the known theory that crystal elongation is a function of dextran molecular weight. Hence, an effect of 1-6 bonded oligosaccharides cannot be ruled out. The importance of statistical analysis of results increases for samples of deviating form, as affected by dextran. The sample should contain at least 50 crystals. Comments made by F. H. C. Kelly on the article are appended.

Influence of non-sugar on sucrose crystallization in impure beet syrups. V. Maurandi, G. Mantovani and G. Vaccari. *Sucr. Belge*, 1982, **101**, 243-253. — Experiments are reported that were aimed at confirming the exponential relationship between the resistance to the surface reaction W_r and non-sugars concentration in both traditional and Quentin molasses. The study was extended to include overall resistance to crystallization W_t and resistance to materials transfer by diffusion W_d. Values of W_r were calculated in terms of the non-sugars: water ratio N:W by a linear equation at 40° and 50°C; activation energies obtained were found to change little in the presence of non-sugars. Logarithms of W_t and W_d proved to be linear functions of N:W, while the ratio W_d:W_t increased with non-sugars concentration, i.e. at constant temperature and N:W, non-sugars concentration behaves as temperature. From the relationship between W_t and N:W at 70°C, methods have been devised for calculating the time of boiling of intermediate strikes. Crystallization kinetics are traced for beet syrups.

Identification of cane sugar and beet sugar by gas chromatography. Y. Miyagi, N. Nakagome, S. Kawabata and K. Mizuki. *Kanzei Chuo Bunsekisho Ho,* 1980, **20,** 117-121; through *S.I.A.,* 1982, **44,** Abs. 82-1319. – The behaviour in GLC of the trimethylsilyl (TMS) derivatives of some pure sugars (fructose, glucose, sucrose and raffinose) was investigated. Beet and cane sugars were analysed by GLC of the TMS derivatives; raffinose was detected in both raw and refined beet sugar, but was practically absent from raw cane sugar and completely absent from refined cane sugar. The method can thus be used to distinguish between cane sugar and beet sugar.

Spectrophotometric determination of reducing sugars with aromatic nitro compounds. R. Soloniewicz and M. Teodorczyk. *Mikrochimica Acta,* 1982, **1,** (1-2), 105-114; through *S.I.A.,* 1982, **44,** Abs. 82-1327. – The determination of reducing sugars (aldopentoses, aldohexoses, ketohexoses and disaccharides) by 2-, 3- and 4-nitrobenzoic and 3-nitrobenzene sulphonic acids was investigated. Reduction of these reagents with sugars gives a yellow product which can be determined spectrophotometrically. The method can also be used for determination of the number-average molecular weight of dextran fractions if the molecular weight is not too high (not above 2.5×10^4).

Modification of sugar beet pectin during processing. J. M. Le Quere, A. Baron, E. Segard and J. P. F. Drilleau. *Sci. des Aliments,* 1981, **1,** (4), 501-511; through *S.I.A.,* 1982, **44,** Abs. 82-1342. – Modern methods of analysis have led to more precise knowledge of the relative proportions, composition and structure of the different pectic fractions extracted from sugar beet. Water-soluble, oxalate-soluble and acid-soluble pectin can be distinguished by means of their acetyl contents, degrees of methoxylation, average degrees of polymerization, and proportion of neutral sugars linked to the galacturonic units, as well as by their elution patterns on ion exchange and gel filtration columns. The pectic fractions in beet are similar to those in apricots, but are quite different from apple and cherry pectic fractions. During the processes carried out in a beet sugar factory, the pectins become modified.

High-precision polarimeter-saccharimeter for an automatic testing line. I. D. Rogovoi *et al. Optiko-Mekh. Prom.,* 1980, **47,** (5), 20-23; through *S.I.A.,* 1982, **44,** Abs. 82-1356. – The Soviet USL-1 automatic line for determination of sugar in beet is based on a PEA saccharimeter. The operating principles of this instrument are described; it uses a magneto-optic Faraday element. Emphasis is placed on the choice of optical system and polarimetric cell in order to attain a high accuracy.

Amperometric determination of total assimilable sugars in fermentation broths with use of immobilized whole cells. M. Hikuma *et al. Enzyme and Microbial Technol.,* 1980, **2,** (3), 234-238; through *S.I.A.,* 1982, **44,** Abs. 82-1358. – A microbial sensor was used for continuous determination of glucose, fructose and sucrose in pure or mixed solutions, and of total assimilable sugars in a molasses-based fermentation broth for glutamic acid production. The sensor consisted of immobilized living whole cells of *Brevibacterium lactofermentum* and an oxygen electrode. The ratio of the sensitivities to glucose, fructose and sucrose was 100:80:92. Additivity of the responses was good, observed and calculated values differing by less than 8%. Selectivity was satisfactory for use in fermentation processes.

The effect of certain non-sugars on sugar losses in molasses. I. Oglaza. *Gaz. Cukr.,* 1982, **90,** 193 *(Polish).* The juice from beet brei obtained from different sugar factories at different periods during the campaign was subjected to laboratory carbonatation, and the effects of lime dosage on invert, ash and total acids contents and hence on molasses losses determined. The results are discussed.

New physico-chemical methods of analysis. II. Enzymatic determination of carbohydrates and lactic acid. S. Rydel. *Gaz Cukr.,* 1982, **90,** 195 *(Polish).* – An enzymatic method for determination of fructose, glucose, raffinose and lactic acid is outlined.

Continuous-flow determination of reducing sugars and sucrose in natural and industrial products with periodate oxidation and a periodate-sensitive flow-through electrode. E. P. Diamandis and T. P. Hadjiioannou. *Analyst,* 1982, **107,** 1471-1478. – A continuous-flow method for determining mixtures of reducing sugars and sucrose is described. The sample, before and after sucrose hydrolysis, reacts with an excess of periodate in a flow system, and the decrease in periodate activity is monitored with a periodate-sensitive flow-through electrode. The recorded peak heights are indirectly linearly related to reducing sugars concentration in the range 3-18 mM. The sucrose concentration is calculated by difference. The analysis is completely automatic, requires no sample pre-treatment (except for the sucrose hydrolysis), and samples can be analysed at a rate of 30 per hour at a relative error and relative standard deviation of ± 1-3%. Comparison with Fehling's method shows good agreement.

Chemical studies on non-fermentable reducing substances in the Egyptian sugar industry. A. Abou El Ela and A. Z. Abd El Latief. *Sugar y Azúcar,* 1982, **77,** (11), 26-27, 30, 34. – The quantities of unfermentable reducing matter formed (1) by heating 5% glucose and glucose:glycine solutions at 95°C for 2, 4, 6 and 8 hours, (2) by heating mixtures of 5% glucose with certain amino-acids at 95°C for 4 hours, (3) by heating samples of cane juice at 95°C for various periods, and (4) in various cane sugar factory intermediate products are discussed. In the first three sets of experiments, the pH was adjusted to various values by addition of $Ca(OH)_2$. Results confirmed that the quantity of unfermentable reducing matter formed is governed by a number of factors, including the amount of lime added, temperature of heating, time of treatment, purity, invert content and type of amino-acid present. The greatest quantity formed was a result of condensation.

BY-PRODUCTS

Practical aspects of paper making from bagasse. V. S. Rao, J. S. Ram and T. K. R. Setty. *Maharashtra Sugar,* 1982, **7,** (10), 13, 16-21. — A description is given of bagasse paper manufacture, with details given of typical whole bagasse analysis and strength properties of pulp and creamwove paper as made at the authors' mill.

Sugar cane as an energy resource for the Caribbean area. J. E. Lima. *Sugar y Azúcar,* 1982, **77,** (9), 62-63, 66-67, 70-71. — The technology and economics of a scheme are presented in which cane would be milled as normally, the juice clarified and concentrated by evaporation to 18-20% solids and cooled to ambient temperature before being fermented and distilled to yield alcohol; bagasse would be burnt for steam generation, the mills being operated by back-pressure turbines. All condensate would be recovered for use as boiler feedwater. Energy balances are given.

An alternative production system to the fuel alcohol program. R. G. Camuruñgan. *Crystallizer,* 1982, **5,** (2), 6-7, 19; (3), 7, 16-21. — The technical and economic aspects of fuel alcohol manufacture from cane molasses in a distillery attached to an existing sugar factory are discussed. The scheme described would involve ferment-tation of all of the *A*-molasses originating from the factory and would alleviate the Philippines of the burden of considerable oil imports.

Today's special: pressed pulp! J. P. Vandergeten and R. Vanstallen. *Le Betteravier,* 1982, **16,** (168), 10-11 *(French).* — Pressed beet pulp as a silage or as a mixture with molasses, urea and minerals has proved suitable as a high-energy animal fodder. Illustrated descriptions are given of the stages in pulp ensilage, and brief reference is made to feeding trials.

Preliminary trials on the utilization of fish silage and final molasses for the supplementation of grazing calves. J. Plaza and R. Alvarez. *Cuban J. Agric. Sci.,* 1982, **16,** 27-35. — Trials in which crossbred calves were fed on pasture plus a mixture of final molasses and fish silage showed that, when good-quality pasture was available, the molasses:fish silage adversely affected daily weight gain and metabolism; on the other hand, a 2:1 mixture as supplement to low-quality, unirrigated pasture is recommended, although its performance is still not as good as that of a concentrate supplement. Consumption and utilization of the molasses mixture was enhanced by adjusting the pH to 6.5 with a palatable neutralizer.

Effects of final molasses inclusion in the diet on some digestibility indices of processed swill for growing pigs. A. Maylín and A. Cervantes. *Cuban J. Agric. Sci.,* 1982, **16,** 57-68. — In pig feeding trials, in which mixtures of processed swill and final molasses of varying proportions were made up, feed consumption rose with the proportion of molasses and was greater than when no molasses was included. No significant differences were found between digestive utilization coefficients nor between N retention with the various molasses concentrations, although the processed swill contained more digestible energy than the molasses (3.94 compared with 2.84 Mcal per kg of dry matter).

Apparent retention of dry matter, organic matter and N in chickens fed final molasses. Preliminary data. R. J. Alvarez. *Cuban J. Agric. Sci.,* 1982, **16,** 85-90. In chicken feeding trials in which final molasses was incorporated in the diets up to 66% of the dry matter, the apparent retention of dry matter, organic matter and nitrogen fell with increase in the proportion of molasses. This reduction is considered to be a limiting factor in the use of molasses as chicken feed.

Effects of cutting age and final molasses levels on the quality of king grass silage ***(P. purpureum* x *P. typhoides).*** G. H. Dominguez, C. Hardy and J. R. Ayala. *Cuban J. Agric. Sci.,* 1982, **16,** 91-96. — The effects of cutting age and three levels of final molasses on the fermentation characteristics of grass silage were determined. Results showed that the protein contents did not differ between the various treatments, while the lactic acid content rose with molasses proportion but was unaffected by cutting age. Total volatile fatty acids and ammonia-N contents differed significantly between cutting ages but not between molasses levels, while pH was significantly affected by the factors studied. It is concluded that there is no advantage in adding final molasses to grass silage.

The recovery boiler of a new bleached bagasse pulp factory with the sulphate process. H. Y. Tao. *Taiwan Sugar,* 1982, **29,** 122-131. — Details are given of a recovery boiler supplied by Ishikawajima-Harima Heavy Industries Co. Ltd. to a Kawasaki-built bagasse pulp factory in Taiwan. The boiler has a rated evaporative capacity of 64 tonnes.hr^{-1} at maximum continuous rate, with a working steam pressure of 65 kg.cm^{-2} and temperature of 460°C (both at superheater outlet) and a feedwater temperature of 150°C at the economizer inlet. Operational and maintenance feature of the boiler are described, and information is given on its instrumentation and controls. Some performance data are tabulated.

Effect of various factors on the aconitic acid content of molasses. A. M. Shahabaz and A. R. Qureshi. *Pak. J. Sci.,* 1980, **32,** (1-2), 87-90; through *S.I.A.,* 1982, **44,** Abs. 82-1366. — Samples of molasses from four Pakistan factories and two khandsari units were tested. Aconitic acid was recovered by precipitation with $CaCl_2$ + $MgCl_2$ and recrystallization from dilute H_2SO_4. Average aconitic acid contents were: *B*-molasses, 3.3%; *C*-molasses, 3.7%; khandsari molasses, 2.7%. Molasses from a factory using double carbonatation contained less aconitic acid than that from factories using defecation-remelt-carbonatation. The aconitic acid content of cane decreased considerably as the cane matured, and that of molasses decreased during two months' storage. The aconitic acid recovered was 82% pure.

Tower fermentation of sugar cane juice. I. G. Prince and J. P. Barford. *Biotechnology Letters,* 1982, **4,** (7), 469-474; through *S.I.A.,* 1982, **44,** Abs. 82-1381. — A clarified cane juice medium, containing 100-180 g fermentable sugars per litre, was simply and rapidly fermented to ethanol in a 10-litre tower fermenter, using a naturally flocculant yeast. Stable cell densities of 65-80 g.$litre^{-1}$ dry weight were obtained. Data are given on ethanol yield and productivity as a function of throughput and initial feed concentration. Fermenter throughput was limited by carry-over of non-fermented sugars, principally fructose, rather than by washout of the yeast flocs. The optimum concentration of sugars in the feed was 100-130 g.litre^{-1}.

Determination of mineral nutrient requirement during accelerated fermentation of molasses wort. L. V. Levandovskii *et al. Ferment. Spirt. Prom.*, 1981, (1), 11-13; through *S.I.A.*, 1982, **44**, Abs. 82-1382. — Wort at 21-22°Bx, prepared from molasses containing 1.12% N, was fermented at 28-30°C, pH 5.3-5.4, with an initial yeast concentration of 5, 30 or 60 g.litre^{-1}, either without supplementation or with 0.06% H_3PO_4 or 0.1% urea + 0.06% H_3PO_4. Parameters of fermentation and ethanol quality are tabulated and briefly discussed. With high initial yeast concentration, ethanol yield (% by volume) was 9.1, 9.24 and 9.17, respectively; final biomass was 78.4, 74.6 and 79.2 g.litre^{-1}; residual sugar was 2.24, 1.96 and 2.32 g.litre^{-1}. Thus, with high yeast concentration, the medium should be supplemented with P but not N for maximum ethanol synthesis and minimum sugar consumption toward biomass accumulation. In a 5-day pilot test with yeast concentration, 50-70 g.litre^{-1} (achieved by recycling biomass from the 5th cell to the 1st) and no added N, ethanol yield was 0.85% above normal and quality was normal.

Purification and use of condensates formed during the boiling-down of methane wash. G. A. Nikitin, R. S. Bashirova and A. P. Lysogor. *Ferment. Spirt. Prom.*, 1981, (2), 28-30; through *S.I.A.*, 1982, **44**, Abs. 81-1383. — Molasses was subjected to alcoholic fermentation after dilution with (a) tap water, (b) unpurified condensate from evaporation of the wash from "methane + vitamin B_{12}" fermentation at the same alcohol factory, (c) this condensate, after removal of volatile acids, and (d) ditto, after removal of NH_3. The last gave the highest yield of CO_2 and ethanol; the yeast obtained had high maltase activity and fairly good raising power.

Hydrolysis of cellulosic wastes by ***Aspergillus fumigatus*** **cellulase.** L. S. Trivedi and K. K. Rao. *Indian J. Exp. Biology*, 1980, **18**, (4), 425-427; through *S.I.A.*, 1982, **44**, Abs. 82-1404. — Seven cellulosic wastes, including bagasse, were hydrolysed with cellulase from *Aspergillus fumigatus* M 216. If the bagasse was not pretreated, conversion to sugars was only 3.6% in 48 hours. Pretreatment with NaOH or ammonia increased this to 18% and 11.4%, respectively.

Acetone-butanol fermentation of cane molasses by ***Clostridium acetobutylicum.*** M. A. Qadeer *et al. Pak. J. Sci. Res.*, 1980, **32**, (3-4), 157-163; through *S.I.A.*, 1982, **44**, Abs. 82-1408. — The yield of acetone-butanol was higher from cane molasses than from beet molasses or defatted rice bran. In laboratory tests, maximum yields were obtained with 6% sugars in the medium (w/v) + 0.25% $CaCO_3$ and 0.3% $(NH_4)_2SO_4$. In a 1000-litre fermenter, output of solvent containing 10:86:4 acetone:butanol:ethanol was 26 ml.litre^{-1}.

Process improvements in a distillery for increasing alcohol production. P. K. Agarwal and L. Viswanathan. *Sharkara*, 1977, **16**, (4), 3-5. — Recommendations are made on means of improving alcohol distillery performance, including the use of molasses that is at least 3 months old and preferably from a sulphitation rather than a carbonatation factory (because of a lower ash content in molasses from the latter), acidification of the molasses with sulphuric acid followed by steaming (which would also reduce scaling of the distillation column), and clarification with use of flocculants. Desirable properties of a suitable yeast strain are listed, and general advice is given on optimum fermentation and prevention of contamination. Mention is also made of a number of innovations introduced in the fermentation process.

Pressed pulp — feed value and use. H. Meyer. *Die Zuckerrübe*, 1982, **31**, 255-257 *(German)*. — Advice is presented on ensilage of pressed beet pulp, and its value as fodder for fattening bulls, dairy cattle and farrowing pigs is discussed.

Production of compost with bagasse and vinasses for the cane crop in Brazil. Y. K. Park and R. J. H. C. Gomez. *Sugar J.*, 1982, **45**, (5), 14-15. — Reference is made to experiments on production of compost from a mixture of bagasse and poultry manure or from bagasse alone, to which vinasse was added to raise the moisture content to 65%. During the 3 months of preparation, the mixture was turned on three occasions to permit aeration. The temperature of the mixture was determined regularly during composting. Factors affecting compost quality are C:N ratio, moisture content, aeration and temperature (which should be at least 60°C).

Possible agricultural and industrial uses of distillery wastes in Puerto Rico. G. Samuels. *Proc. 1980 Meetings Amer. Soc. Sugar Cane Tech.*, 62-67. — See *I.S.J.*, 1982, **84**, 62.

Ethanol feasibility study for Hilo Coast Processing Company. J. E. Allen. *Proc. 40th Ann. Conf. Hawaiian Sugar Tech.*, 1981, 127-131. — The Hilo Coast Processing Co. is a non-profit-making cooperative owned by members of the United Cane Planters' Cooperative and the Mauna Kea Sugar Co. Inc., sugar cane growers on the Hilo coast of Hawaii Island. The sugar factory is the second largest in Hawaii. Details are given of a distillery to be set up adjacent to the factory for a feasibility study of motor fuel-grade ethanol manufacture from molasses; while the plant is designed for batch fermentation, provision will be made for continuous fermentation if it is found to be economically advantageous. An initial capacity of 11.4 million gallons is planned, which would be used as a 1:9 anhydrous alcohol:gasoline blend.

Utilization of agro-industrial and plant biomass in tropical areas: methane fermentation in Madagascar. M. Gaydou, L. Menet and —. Ravelojaona. *Ind. Alim. Agric.*, 1982, **99**, 989-996 *(French)*. — A survey, with 46 references to the literature, is presented on methane fermentation of various types of waste; it includes an outline of the process, with data on bacteria and substrates used, and describes possible means of using the methane gas as energy source. Examination of the energy balance of a molasses distillery using methane fermentation of the vinasse shows that treatment of material having a COD of 30,000 mg.litre^{-1} can provide 9.3 kWh per hectolitre of vinasse, or some 30% of the energy consumed in the distillery. On this basis, it is calculated that the projected distillery at Ambilobe, producing 68,000 hl of pure alcohol annually, should recover 6.4 million kWh by methane fermentation of the vinasse, giving a net amount of power necessary for the annual requirements of a town of 10,000 population.

TRADE NOTICES

Automatic process polarimeter. Dr. Wolfgang Kernchen Optik-Elektronik-Automation, Postfach 129, D-3016 Seelze 2, Germany.

The Propol automatic process polarimeter has been designed for continuous measurement of the concentration of optically active substances on the basis of the Faraday effect (magneto-optical compensation). It consists of two units connected by cable up to 100 m apart: an optical unit that can operate at an ambient temperature of up to 40°C without artificial cooling (for operation at higher temperatures, a heat exchanger for connexion to a cold water supply is available as option), and an electronic unit provided with a digital display in angular degrees at a resolution of 0.001° (a second digital display may be calibrated in units of concentration). The measuring range is ± 1.1° with sodium light (589 nm) or ± 1.3° with mercury light (546 nm). Precision is of the order of 0.0001° for angles of rotation smaller than 0.2°, or 0.001° for angles of rotation of 0.2° or more; at maximum sensitivity, as little as 2 ppm sucrose is detectable. Relative accuracy is better than ± 0.1%.

Filter cake and bagasse composting. Biopost, 64 rue de Richelieu, 75002 Paris, France.

Biopost BP "C" is a yeast product that can be mixed with filter cake and/or bagasse in a 5:95 weight ratio to produce, within one month, an organic fertilizer that is suitable for application to a number of crops, including sugar cane. The minimum recommended quantity of filter cake and/or bagasse is 225 tonnes, and its moisture content, before mixing, at least 55% (optimum 55-60%). Advice on preparation and use of the compost is available from Biopost.

Alcohol filtering agent. Oy. Alko AB, Process Engineering Division, P.O. Box 350, SF-00101 Helsinki 10, Finland.

Alko, the Finnish state-owned alcohol organization, have developed a new filtering agent which can contribute to an improvement in the quality of potable alcohol such as manufactured from molasses, e.g. by removing undesirable odour. Alko is also exporting its fermentation know-how. As an example, it is involved in a turn-key molasses distillery project in Burma; the distillery, due to commence operations at the end of 1983, will produce 5000 litres of alcohol daily.

Automatic centrifugal. Technoexport, 56 Vaclavske nam., Praha 2, Czechoslovakia.

Newly announced from Czechoslovakia are the ARO 1250 and 1500 automatic centrifugals (of 1250 and 1500 kg massecuite capacity, respectively). Use of a thyristorized converter permits minimization of power consumption and floor space while making it possible to increase the number of working cycles to 26 per hour, corresponding to a daily throughput of 660 or 800 tonnes of massecuite.

PUBLICATIONS RECEIVED

Pumps. Netzsch-Mohnopumpen GmbH, D-8264 Waldraiburg, Germany.

An article reprinted from a 1978 issue of a German publication concerns the applications in confectionery manufacture of the special type of rotary displacement pump manufactured by Netzsch-Mohnopumpen GmbH, which can be used to handle a large range of products in many industries, including the sugar industry, particularly for highly viscous materials such as syrup and liquid sugar. The article describes the basic design of the pump and its operation.

Apron conveyors. Ewart Chainbelt Co. Ltd., Colombo St., Derby DE3 8LX, England.

A new 8-page brochure describes Ewart Chainbelt COBRA conveyor out-board roller assemblies, which are overlapping apron conveyors of a particulary robust type, capable of handling a wide range of products from heavy castings and forgings to sugar cane. The brochure contains clear diagrams and photographs of typical applications, and indicates advantages of these apron conveyors over conventional multi-strand conveyors; information on assemblies employing 6-, 9- or 12-in pitch chain is tabulated, and arrangements of outboard rollers to meet different loading conditions are shown. The brochure, No. 631, is available in both English and Spanish versions.

Reverse osmosis unit. Paterson Candy International Ltd., Reverse Osmosis Division, Laverstoke Mill, Whitchurch, Hants. RG28 7NR, England.

A new leaflet, TPRO 60.1, describes a laboratory-scale reverse osmosis/ultrafiltration unit which may also be used for small production requirements. Available fitted with any of the wide range of P.C.I. membranes, including the company's non-cellulosic R.O. membrane ZF 99, the unit is normally supplied with only one module, although a maximum of six modules may be supplied to give a membrane area of up to 5.4 m^2. The B1 module is a commercially proven system having a tubular configuration that allows turbulent flow of process liquor within the membrane tube, producing a self-cleaning action that minimizes fouling of the membrane. The membranes can be easily replaced on the spot.

G-type centrifugal. BMA Braunschweigische Maschinenbauanstalt, Postf. 3225, D-3300 Braunschweig, Germany.

The G-type centrifugal is an automatic batch machine for use in handling white sugar and middle-product massecuites. Available in two sizes, for charges of 1500 and 1750 kg, it has been successfully used for *A*-massecuite curing at Uelzen and has been installed in three other West German sugar factories. Details of the centrifugal and its operation are given in brochure G/4, which is available from BMA.

Anti-foam agents. Dow Corning Europe, Chaussée de la Hulpe 154, B-1170 Brussels, Belgium.

A recent brochure from Dow Corning describes the new series, the 1500, of antifoam agents specially formulated for use in the food and allied industries and conforming to European and US (FDA) legal requirements for food additives and process aids. The 1500 can be used in non-aqueous applications, while the 1510 is suitable for use in fermentation systems and food processing; the 1520 is suitable for use in fermentation and alcohol distillation, including molasses foam control, and is also applicable to effluent treatment.

Filter papers. Schleicher & Schüll GmbH, Postf. 4, D-3354 Dassel, Germany.

A hundred years of experience have gone into the making of Schleicher & Schüll filter papers, which are applicable for many different tasks. Recently, the company has produced a booklet of samples of filter paper, with information (in English, French, German and Spanish) on their properties, weight and field of application. All 36 samples are original papers, and the booklet will be of great assistance in the selection of papers for given tasks.

BGMA Buyers' Guide. British Gear Manufacturers Association, P.O. Box 121, Sheffield S1 3AF, England.

The 1982 Buyers' Guide of the BGMA lists the major UK manufacturers of gears and gear units, a number of whom have supplied equipment to the sugar industry. The publication is obtainable free of charge from the above address.

Small-scale sugar factories. Stork-Werkspoor Sugar B.V., Postbus 147, 7550 AC Hengelo (OV.), Holland.

The latest publication from Stork gives information on SWS small-scale sugar factories of 350, 650 or 1000 tcd capacity. It offers advice on choice of equipment, allowing for maximum economy. The company is currently completing orders for two small-scale factories to be erected in Burma, each with an hourly cane crushing capacity of 15 tonnes, and for a mini-distillery with a daily output of 5000 litres of 96% alcohol.

Liquid/liquid separation. KnitMesh Ltd., Sanderstead Station Approach, South Croydon CR2 0YY, England.

A recent brochure from KnitMesh Ltd. gives information on their coalescers for liquid/liquid separation, which are applicable in a number of process, including effluent treatment.

Weighers. Canadian Scale Co. Ltd., 305 Horner Ave., Toronto, Ontario M8W 1Z4, Canada.

A folder illustrates mechanical and electronic weighing systems available from Canadian Scale Co. Ltd. for a wide range of applications.

Heat exchangers. Alfa-Laval AB, Box 1721, S-221 01 Lund 1, Sweden.

Two brochures are available from Alfa-Laval, describing compact heat exchangers used in the beet sugar industry and the cane sugar industry, respectively. Flow diagrams are given of the typical beet sugar manufacturing process, and of the variants of cane raw sugar manufacture (carbonatation and sulphitation) as well as cane raw sugar refining. Descriptions are given of Alfa-Laval plate and spiral heat exchangers, with advice on selction and appropriate technical data.

Valves in the sugar industry. Saunders Valve Co., Cwmbran, Gwent NP44 3XX, S. Wales.

A new 4-page fact sheet issued by Saunders Valve Co. illustrates the many applications of their valves in the sugar industry. The information is given in the form of a typical sugar factory process diagram, pinpointing where one of five different types of valve is used, and as tabulated data showing details of the valve required to handle specific materials and intermediate products.

Floating alcohol plant. Nippon Kokan K.K., 1-2, 1-chome, Marunouchi, Chiyoda-ku, Tokyo 104, Japan; Tsukishima Kikai Co. Ltd., 17-15 Tsukuda 2-chome, Chuo-ku, Tokyo 104, Japan.

Nippon Kokan and TSK have jointly developed a floating plant for manufacture of alcohol from cane. The Flo-Biohol plant is mounted on a barge, which is then towed to the site; it is available in three capacities: 60 kl/day alcohol from 1000 tonnes of cane, 120 kl/day from 2000 tonnes of cane and 180 kl/day from 3000 tonnes of cane. The system has a number of advantages over a land-based alcohol plant.

Australian sugar factory equipment manufacturers. The Sugar Industry Manufacturers and Services Group of Australia (SIMASGA), P.O. Box 128, Spring Hill, Queensland 4000, Australia.

The 2nd Edition of the SIMASGA source book features equipment manufactured by Australian companies for the cane sugar industry. Besides illustrations of the equipment and its application, the book contains a Buyer's Guide with equipment, products and services listed alphabetically as well as an address section listing 50 companies.

Bagasse pelleting plant. Creusot-Loire Enterprises, Pulp & Paper Dept., P.O. Box 303, 92156 Suresnes Cedex, France; Doger de Speville & Co. Ltd., P.O. Box 100, Port-Louis, Mauritius.

A bagasse pelleting plant, developed by T. Davies Co. in Hawaii and licensed to CLE and DdS for supply to most countries in the world, is outlined in a leaflet. The bagasse is conveyed to a dryer heated by boiler flue gas and controlled by an automatic process developed by T. Davies Co. in their Haina factory in Hawaii. Surplus bagasse is compacted into an easily transportable and storable form for use as fuel.

Board manufacturing plant. Bison-Werke, D-3257 Springe 1, Germany.

Literature from Bison-Werke describes the various types of board that can be manufactured from different waste materials such as bagasse in plant supplied by Bison-Werke.

Filter aid. Witco Chemical Corporation, International Chemical Marketing, 520 Madison Avenue, New York, NY 10022, USA.

Filtration techniques using Kenite diatomaceous earth filter aids are described in an 8-page, 4-colour brochure entitled "Kenite diatomite: filter aids and mineral fillers", which is available from Witco Chemical Corp. The brochure discusses the use of the filter aids in vacuum and pressure filtration systems in numerous applications, and gives advice on formation of a suitable precoat cake and how to choose filter screens and cloths.

Eur-Control News. Eur-Control Säffle AB, P.O. Box 96, S-661 00 Säffle, Sweden.

A brochure specially devoted to the use of Eur-Control equipment in the sugar industry, particularly in French sugar factories, describes the MEK41-BS in-line density meter for automatic supersaturation control in boiling, VST and AV40 steam conditioning valves as well as the DA4 steam desuperheater, the VBG30 ball valve for use in centrifugal feed lines, and the VBG3 butterfly valve for low-pressure steam control and shut-off. Mention is also made of other Eur-Control equipment used in the sugar factoy.

Finnsugar Engineering technology. Finnish Sugar Co. Ltd., Finnsugar Engineering, SF-02460 Kantvik, Finland.

Brochures available from Finnsugar Engineering describe various activities of the company in sugar process technology, including the Finnsugar-Pfeifer & Langen chromatographic process for sugar recovery from molasses, fructose manufacture from starch and ion-exchange decolorization of refinery syrup.

Conveyors. Universal Conveyor Co. Ltd., Humberstone Lane, Leicester LE4 7JT, England.

A 26-page brochure from Universal Conveyor illustrates the many types of conveyor manufactured by the company for use in a wide range of applications.

Steam generation equipment. Babcock & Wilcox Canada, P.O. Box 310, Cambridge, Ontario, Canada N1R 5V3.

A 15-page brochure describes and illustrates the activities of Babcock & Wilcox Canada in the manufacture of various types of boilers for use in many different applications. The company is a leading supplier of steam generating equipment and related services to Canadian markets and to more than 30 other countries.

Water cooling. Carter Industrial Products Ltd., Bedford Rd., Birmingham B11 1AY, England.

Carter Industrial Products Ltd., manufacturers of cooling towers, have issued a "water audit" checklist to help water users carry out a systematic examination of their water consumption and identify ways of reducing waste. The 4-page checklist is available free from the above address.

Pipework for a turbo-generator. — Press Construction Ltd. have been awarded a £115,000 contract for the supply, fabrication and erection of primary pipework for the new 10 MW turbo-generator power plant at the King's Lynn factory of British Sugar plc. The order covers both steam main and exhaust steam systems. The 6- and 8-in pipework of the main will be made of high-grade chrome molybdenum steel to withstand pressures of 62 bar at up to 510°C, while the 24-in exhaust piping, of carbon steel, will be built for service at 2 bar and a maximum temperature of about 426°C.

Dominican Republic sugar estates reorganization. — ABA International Inc., the Hawaiian-based agribusiness and aquaculture consultants, have been awarded a contract for the administrative reorganization of 12 government-owned sugar estates in the Dominican Republic. ABA will be working in close cooperation with Sercitec C.p.A. and Gomez, Santos & Associados, and will provide 11 systems and sugar experts for a period of two years. The project, funded by the World Bank, will include an evaluation of current practices, design of management information systems, selection of computer hardware and software, and implementation of the new systems.

Refinery decolorization plant order. — A £10 million contract has been awarded to Davy McKee (London) Ltd. and Davy Bamag Ltd. for the design, supply and construction of an ion-exchange decolorization plant for raw sugar at the Thames refinery of Tate & Lyle Refineries Ltd. The plant will be the largest of its kind in the world, with a design capacity up to 1 million tonnes per year, and is planned for completion in 1984.

Cane mill gear order. — David Brown Gear Industries Ltd. have received an order for the manufacture and supply of six sets of final reduction cane mill gears and pinion, worth £350,000, to Mitr Phol Sugar Corporation Ltd., Thailand. Three existing 1400-hp steam turbines, previously driving six mill gear sets in tandem arrangement, will now drive three single gear trains with pinions and 13-ft diameter final reduction spur gear wheels at 100 in centres distance, providing a mill speed of 6.2 rpm. The other three gear sets will drive an additional three single mills, thus uprating mill throughput and improving extraction.

India sugar imports and exports[1]

	1982	1981	1980
	tonnes, raw value		
Imports			
Brazil	0	24,958	195,215
EEC	0	103,778	1,261
Korea, South	0	24,796	0
Philippines	0	8,613	0
US	0	69,768	0
	0	231,913	196,476
Exports			
Bangladesh	0	0	10,804
China	92,809	0	0
EEC	10,696	0	26,406
Egypt	18,421	0	12,479
Indonesia	301,153	90,756	0
Korea, North	0	0	5,672
Lebanon	327	0	0
Maldive Is.	1,080	0	0
Nepal	0	0	1,621
Sri Lanka	44,089	15,126	0
Sudan	14,262	0	12,479
US	21,204	0	0
	504,041	105,882	69,461

Symposium on Industrial Crystallization. — The Royal Netherlands Chemical Society (KNCV) and the Royal Institute of Engineers in the Netherlands (KIvI), in association with the Dutch Association for Crystal Growth (KKN), are organizing the 9th Symposium on Industrial Crystallization, to be held in The Hague, Holland, during September 25-28, 1984. The objectives of the symposium are to gather scientists, designers and engineers to give them an opportunity to communicate and discuss new ideas leading to a wider and deeper appreciation of crystallization fundamentals and phenomena and better understanding of the design, operation and performance of industrial crystallizers. Contributions will be welcomed, especially those concerning fundamentals such as thermodynamics, mechanisms, kinetics, population balance concept, etc., crystallization processes, the role of additives and impurities, and transport phenomena in industrial crystallization. The official language of the symposium will be English and contributors should write for details, submitting the original and three copies of an extended abstract by September 30, 1983, to Mr. S. J. Jancic, c/o KIvI, P.O. Box 30424, 2500 GK The Hague, Holland.

Texas cane sugar production, 1982/83. — The 1982/83 Texas cane harvest, the 10th of Rio Grande Valley Sugar Growers Inc., began in October and ended in April. During the 172-day crop, 38.7 days were lost owing to bad weather. The 14,455 hectares of harvested cane yielded 1,105,534 gross tonnes (76.46 tonnes.ha^{-1}), 1,005,042 net tonnes (69.37 tonnes.ha^{-1}), from which was produced 87,174 tonnes, raw value (6.11 tonnes.$^{-1}$). The 30 Claas and a Cameco CH 111 B cane harvesters operated at an average of 28.83 tonnes gross cane per harvester hour, equivalent to 0.38 hectares per harvester hour. The total tonnes per man-hour for harvesters and infield tractors, used to haul the cane for transloading onto highway trucks, was 4.26. The South Texas region sustained the driest growing season since 1914 and, as a result, river water of higher than normal salinity was used for irrigation and the benefits of leaching by rainfall were absent. The added salts undoubtedly reduced pol content and the cane sugar content was the lowest of any non-freeze season. The rice borer, *Eoreuma loftini*, continued its depredations. The cane borer parasite *Apanteles flavipes*, released in large numbers, did not control the rice borer, but a recently released parasite, *Allrhogas* sp., which was recovered in Mexican cane, promises positive activity against the pest. Efforts are underway for mass propagation and release. With the recent installation of a fourth evaporator effect the factory was able to divert more steam to the milling plant and thus increase throughput. As a result a new record of 9351 tonnes/day was established for the actual crushing time and 6465 tonnes/day for the total elapsed time. The increased throughput improved bagasse burning efficiency with the result that natural gas usage as supplemental boiler fuel dropped from 11.28 m^3/tonne in 1981/82 to 3.02 in 1982/83.

Ecuador distillery[2]. — A new alcohol manufacturing facility, Ecualcoholes, is expected to start operating some time in late 1983. It is a joint project between private investors and the Municipality of Yaguachi. Estimated molasses usage is about 16,000 short tons per year.

USSR sugar imports and exports, 1982[3]

	1982	1981	1980
	tonnes, raw value		
Imports			
Argentina	127,473	149,637	12,501
Australia	157,000	0	0
Austria	50,214	14,052	36,067
Brazil	362,115	346,612	465,653
Bulgaria	41,099	2,746	0
Canada	21,652	13,641	0
Colombia	36,000	12,000	10,826
Cuba	4,224,329	3,089,809	2,647,497
Czechoslovakia	0	0	10,824
Dominican Republic	193,777	14,478	33,449
EEC	1,263,322	873,107	856,370
Finland	4,300	62,157	19,085
Gabon	0	5,413	0
Germany, East	21,652	4,209	10,806
Guatemala	64,373	0	15,240
Hungary	76,223	0	75,806
Mozambique	24,700	0	0
Nicaragua	5,079	0	12,900
Peru	0	0	23,808
Philippines	215,585	280,889	332,787
Poland	0	0	3,248
Rumania	45,255	28,742	50,513
El Salvador	0	0	26,016
Swaziland	0	0	10,160
Thailand	428,692	265,552	139,654
US	0	40,381	0
Yugoslavia	0	506	173,379
Zimbabwe	0	0	14,610
	7,362,840	5,203,931	4,981,219
Exports			
Afghanistan	147,387	84,984	60,635
Bulgaria	0	4,333	4,050
Guinea Bissau	0	0	1,300
Iran	65,728	20,843	0
Laos	0	0	650
Mali	0	2,707	6,002
Mongolia	32,854	43,357	36,204
Vietnam	10,826	10,825	10,823
Yemen, North	9,841	16,146	23,791
	266,636	183,195	143,455

Spanish beet sugar factory closure[4]. — Azucarera Antequerana S.A. is to close its beet sugar factory, one of the oldest in Spain. It was supplied from the provinces of Málaga, Granada and Sevilla and its closure is likely to cause problems for growers.

Cane finance in Thailand[5]. — The Sugar Cane Planters Federation of Thailand is reported to be planning to seek loans of at least 2000 million Baht (£57,388,000) for lending to assist cane growers as there are indications that many may switch to growing other, more profitable crops in view of what is considered to be the generally unsatisfactory price structure for the 1982/83 crop. As a result of an estimated 30% drop in sugar cane production for the 1982/83 season, Thailand's sugar exports this year are expected to decrease to about 1.4 million tonnes, valued at some 7700 Baht (£220 million), compared with the 2 million tonnes, valued at 12,900 million Baht (£370 million) exported in 1982.

Algeria beet sugar conversion[6]. — The Guelma beet sugar factory in Algeria has been converted so that it can now refine 300 tonnes of imported raw sugar per day. It can produce 200 tonnes of crystal sugar and 100 tonnes of cubes.

Süddeutsche Zucker-AG 1982/83 interim report. — In the latest campaign, which lasted only 94 days, compared with 109 days in 1981/82, a total of 6,547,000 tonnes of beet were sliced at the Südzucker factories against 7,599,000 tonnes previously. The average yield of beet was lower, at 58.0 *vs.* 61.3 tonnes.ha^{-1}, and the sugar content lower at 15.85% *vs.* 16.01%. Sugar production was 899,000 tonnes, against 1,048,000 tonnes, a fall of 14.2%.

1 *I.S.O. Stat. Bull.*, 1983, **42**, (2), 22-23.
2 *Westway Newsletter*, 1983, (114), 13.
3 *I.S.O. Stat. Bull.*, 1983, **42**, (3), 42-43.
4 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 248.
5 *Standard Chartered Review*, April 1983, 34.
6 F. O. Licht, *International Sugar Rpt.*, 1983, **115**, 288.

Fiji sugar exports, 1982[1]

	1982	1981	1980
	tonnnes, raw value		
Canada	16,936	0	20,717
China	43,708	0	32,630
EEC	168,961	189,686	149,102
Japan	14,092	41,177	43,507
Malaysia	36,547	62,282	63,720
New Zealand	71,763	54,027	80,775
Singapore	30,972	26,470	16,574
USA	31,746	40,520	42,399
	414,725	414,162	449,424

Uruguay sugar situation[2]. – During the 1982/83 beet sugar campaign only two of the four beet sugar factories in Uruguay were in operation; the La Sierra plant is being converted to HFCS manufacture[3] and the Arinsa plant is still closed. The two factories processed 395,392 tonnes of beets harvested from 12,350 hectares and produced 46,430 tonnes of white sugar. Cane sugar production in Uruguay in 1982/83 is estimated at 35,000 tonnes, white value. Consumption of locally produced sugar declined to below 80,000 tonnes last year, owing to an increase in illegal imports from Brazil where the price is lower because of different economic and exchange policies.

China sugar production, 1982[4]. – China's sugar cane output in calendar year 1982 rose 24.3% to 36.89 million tonnes and sugar beet output rose 5.5% on the 1981 figure to 6.71 million tonnes. The estimate of sugar production in the 1982 crop year has recently been reduced to 3.7 million tonnes, white value, from 3.9 million tonnes earlier.

Bangladesh sugar industry rehabilitation[5]. – The Australian Development Assistance Bureau has funded a project for assessment of needs for rehabilitation of the sugar industry in Bangladesh. This began in 1978 and is now nearing completion. It has involved the areas of agronomy, engineering, extension, mill technology and transportation and has provided a market for Australian sugar equipment, technology and consulting services worth more than $A10 million. The object of the project has been to raise the efficiency of sugar production so as to increase self-sufficiency and permit conservation of limited foreign exchange.

Morocco sugar consumption and imports, 1982[6]. – Sugar consumption in Morocco in 1982 reached 600,340 tonnes against 587,317 tonnes in 1981. Sugar imports during 1981 were 310,000 tonnes, of which 269,643 tonnes was raw sugar for refining (105,000 tonnes from Thailand, 70,628 tonnes from Brazil, 38,000 tonnes from the Philippines, 15,015 tonnes from Belgium, 14,000 tonnes from Argentina, 14,000 tonnes from West Germany and 13,000 tonnes from the Dominican Republic). Imports of loaf sugar were 24,900 tonnes while imports of cube sugar reached 9500 tonnes. Crystal and powder sugar imports were 6000 tonnes, all coming from Italy.

Bagasse board plant in Cuba[7]. – In June 1982 a new bagasse board plant was prepared at Central Primero de Enero sugar factory, for the production of 36,000 tons per year of resin-faced bagasse board in 6 x 12 ft panels of thicknesses between 8 and 12 mm. The boards will be used for furniture, etc. The factory provides employment for 256 workers and cost 13 million pesos.

Reduced Trinidad sugar production, 1983[8]. – Trinidad's state-owned sugar company, Caroni Ltd., has produced only 75,000 tonnes of raw sugar this year, which is far below the original target of 102,000 tonnes and even below the revised target of 81,000 tonnes. Fires and shortage of labour have caused the shortfall, which may also prompt the closure of two of the company's four factories, according to a company spokesman. Because of the decrease, the company is expected to declare a shortfall of about 10,000 tonnes of its export quotas to the EEC and United States.

East Germany campaign results, 1982[9]. – The 1982 campaign was the most successful for several years, with white sugar production reaching 745,000 tonnes, about 50,000 tonnes more than the planned figure. This was largely due to the high beet sugar content of 16%, while the beet yield was 30.8 tonnes.ha^{-1} against 27.6 tonnes.ha^{-1} in 1981, and is expected to rise to 32.5 tonnes.ha^{-1} in 1983. More than 8 million tonnes of beet were harvested in 1982 from 261,000 ha, of which three-quarters was used for sugar manufacture and the remainder as fodder.

Zimbabwe sugar exports, 1982[10]

	1982	1981	1980
	tonnes, raw value		
Algeria	34,794	23,196	12,020
Botswana	32,074	31,755	36,969
EEC	20,402	0	0
Finland	0	12,652	68,881
Israel	0	0	7,160
Portugal	12,652	11,598	21,464
USA	94,092	84,992	12,758
USSR	0	0	15,404
Zaire	0	0	1,476
Other countries	34,495	33	42,527
	228,509	164,226	218,659

Cuban cane mill tandem[11]. – The first cane mill tandem constructed within Cuba was delivered in June 1982 to Central Villa Clara and will crush more than 6800 t.c.d. It comprises six mills, a crusher, high- and low-speed gearing, intermediate carriers, rollers, knives, motors etc., and represents a considerable financial saving.

Bolivian sugar exports, 1982[12]. – Bolivia, which in 1980 exported 107,483 tonnes, mostly to Chile and the US, exported only 20,375 tonnes in 1981 but exports rose last year to 77,066 tonnes, including 35,850 tonnes to the US.

Greek sugar factory modernization[13]. – The Serrae sugar factory of Hellenic Sugar Industry is to be modernized and expanded from 2300 to 4000 tonnes/day slicing capacity. The program includes measures against environmental pollution, will cost about 500 million drachmae (£4.5 million), and will be completed by 1985. The beet area in the Serrae neighbourhood will be increased from 4000 to 6000 ha.

Pepsico usage of HFCS[14]. – The second largest cola drink company in the US, Pepsico Inc., announced at the end of April that it had decided to allow the use of a blend containing up to 50% HFCS as a sweetener in its bottled and canned drinks. The move is calculated to result in a loss of 300-400,000 short tons of sugar per annum from the US sugar market.

Australia sugar crop results, 1982[15]. – The 1982 sugar season, which began at Broadwater mill on May 25 and ended at Harwood mill on January 15, 1983, resulted in a record production of sugar, the provisional figure of 3,537,736 tonnes 94 n.t. sugar being the first crop to exceed 3½ million tonnes. The output record was aided by the highest average c.c.s. in Queensland for five years, while a drop of nearly 500,000 tonnes of cane meant that the season's cane crop was only the second highest on record, at 24,908,035 tonnes, harvested from 318,693 hectares. Cane yield averaged 78.16 tonnes per ha, and sugar 11.10 tonnes.ha^{-1}. In the 1981 season, 25,139,328 tonnes of cane yielded 3,434,988 tonnes of 94 n.t. sugar.

PERSONAL NOTES

On July 1, **Tom Rodgers** retired from the post of Deputy Chairman after 38 years of service with British Sugar plc. He joined the British Sugar Corporation Ltd. in 1945 and in 1949 was a shift superintendent at Bury St. Edmunds, transferring to Newark factory in 1952. The following year he was promoted to Works Manager at Ipswich factory and in 1958 became manager of King's Lynn. After five years he joined the headquarters staff at Peterborough as Planning and Development Engineer, and later as Assistant to the Production Director. He succeeded to the post of Production Director in 1970, remaining on the Board during the rest of his career, as Assistant Chief Executive from 1978 and as Deputy Chairman following the Beresford take-over of British Sugar in 1982. He became a member of our Panel of Referees in 1980 and we are grateful that he is willing to continue in this capacity following his retirement from British Sugar.

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15 *Australian Sugar J.*, 1983, **74**, 588-589.

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