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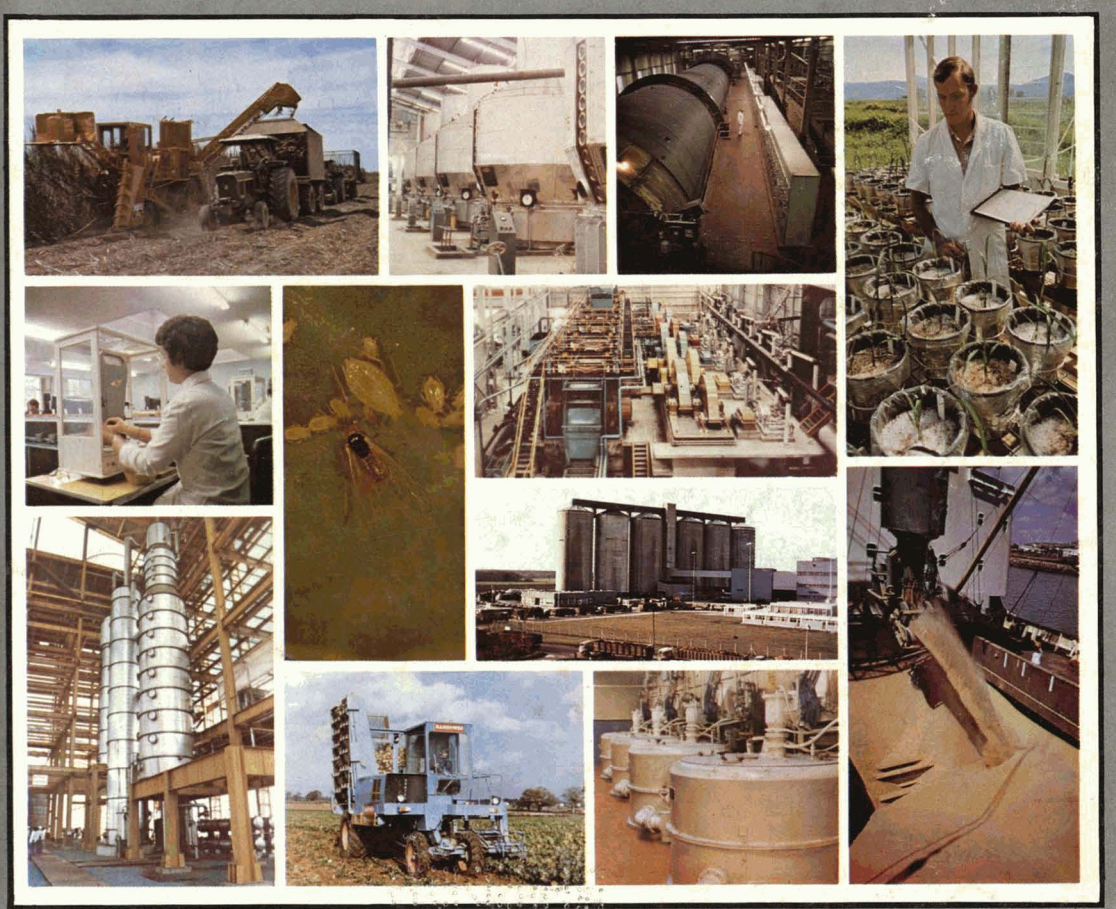

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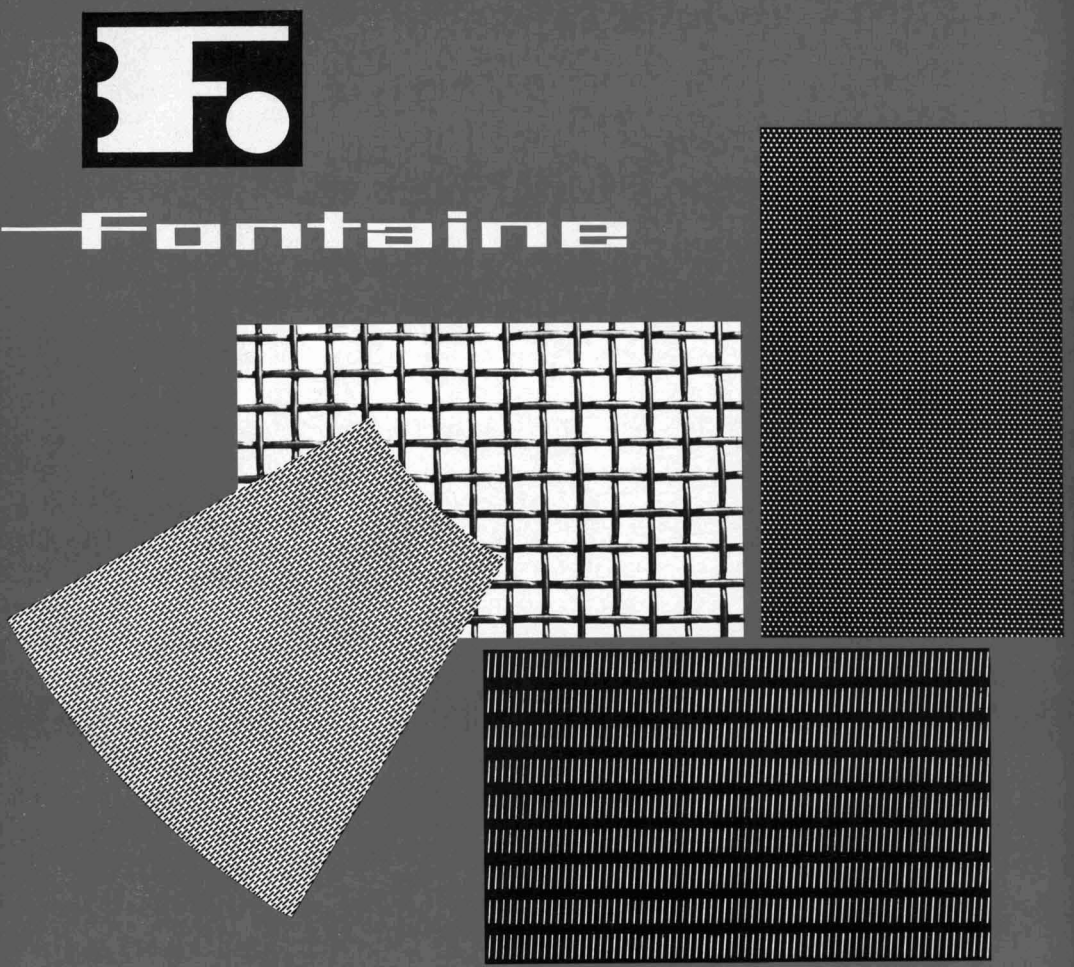

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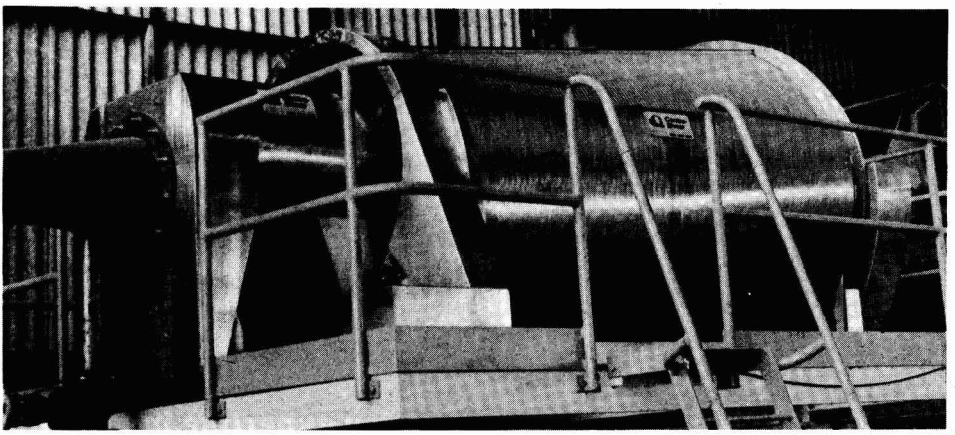

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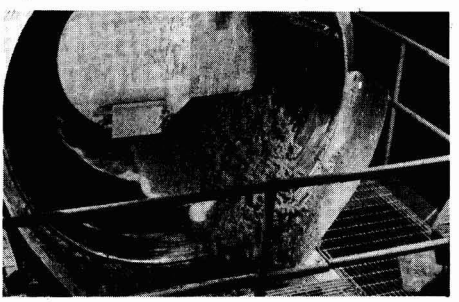

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NOTES AND COMMENTS

USSR sugar production and imports[1]

Before 1960, Soviet sugar policy was to increase production at approximately the same rate as consumption. In the 1960's, following the Cuban revolution, Soviet purchases of Cuban sugar increased substantially, primarily for political reasons. Having guaranteed a market for Cuba, the Soviet government decided, in effect, to regard Cuban sugar as part of the Soviet Union's domestic supply in its economic planning and to divert to other sectors resources previously directed to the indigenous sugar industry. By 1969, the Soviet sugar industry had virtually ceased to expand and domestic production actually fell by 20%. Then, in 1971/72 and 1972/73, both Cuba and the USSR had poor crops owing to weather conditions. Poor crops in the USSR in 1979/80 and 1980/81 again coincided with Cuba failing to hit her production targets.

The need to resort to large-scale free market purchases to maintain sugar consumption prompted the Soviet Union to reappraise its sugar policy; large-scale assistance to Cuba continues but, at the same time, the USSR is promoting expansion of its own industry. The five-year plan which ran from 1976 to 1980 projected an increase in sugar production to 12.7 million tonnes, of which 9.2 million tonnes was to come from domestically grown beets. Actual beet production in 1980 was 18% short of the target while beet sugar production reached just over 70% of the plan figure.

In the whole Soviet Union, approximately 3.6-3.7 million hectares are now sown to beet, an area considerably larger than that in Western Europe, but low yields mean that output is still lower than that of the West. Yields averaged 23.7 tonnes per hectare in 1976-80, against 44.3 tonnes in the EEC and 41.9 tonnes in Western Europe generally. Soil and climate are major factors in this but poor management, lack of fertilizer and obsolete varieties are other important causes. Other problem areas are transport, which is often deficient, and prolonged storage which results in losses through deterioration.

The industry also suffers from inefficient use of plant capacity, with frequent mechanical breakdowns because of poor maintenance, shortage of skilled labour and organizational deficiencies. While beet sugar production declined in the 1970's, consumption increased, outpacing the growth in population. Public demand for sugar is such that the authorities spent scarce foreign exchange to raise per caput consumption from 40.2 kg to 44.4 kg between the first and second halves of the 1970's.

The 1981-85 Plan, as recently updated at a recent session of the Communist Party Central Committee, promises radical changes in the organization of Soviet agriculture, with decentralization of the farm system down to regional level and encouragement of private plots, small-scale cooperative farming and new incentive payment schemes. If these are implemented, the efficiency of Soviet agriculture is likely to improve, including sugar beet production.

A major effort is being made to produce more sugar, with a beet crop target of 100 million tonnes, 13% above the 1960-80 average, and a white sugar target of 11.7 million tonnes for 1985. To this end, capital investments are to total 1850 million roubles ($2400 million), raising the total daily capacity of the industry by 140,000 tonnes or 18%, including 54,000 tonnes for seven new factories and the balance by reconstruction and expansion of the existing 324 factories.

The target is only 600,000 tonnes below the projected level of consumption while the USSR is committed to the import of at least 2 million tonnes of Cuban sugar. If the targets are reached there could be a return to the situation of before 1971 when the USSR was a major exporter, of 1-1.5 million tonnes annually, compared with no more than 300,000 tonnes in the past ten years. Even if the target is not met completely, it seems likely that, in the absence of any major disaster in Cuba, the Soviet Union is unlikely to require substantial supplies from the world free market and thus cannot be counted on to provide an outlet for Western surpluses as it has in the past.

World sugar prices

The announcement by the Brazilian authorities that there would be a reduction in the proportion of the cane crop devoted to sugar production in 1983/84 and an increase in the proportion devoted to alcohol was probably the main reason for the strengthening of the London Daily Price for raw sugar to £91 per tonne on October 8 after the strengthening US dollar had brought about a sharp fall from the £87 of October 1 to a four-year low of £81 on October 5. Reports of raw sugar purchases by Cuba helped to strengthen the market and the LDP remained within the range £90-£95 through the rest of the month, rising to £99 on October 29 on news of a 200,000-tonnes sale of white sugar to Mexico. White sugar values were less volatile and from an initial £110 on October 1 the LDP(W) fell to £105 by October 6, returned to £110 by October 12 and then stayed within the range £109-£120 during the rest of the month, reaching the highest value on October 29.

Although the market remains at disastrously low levels for producers the end-October values represent a welcome increase on the lowest levels reached. *Public Ledger's Commodity Week* notes[2] that: "Analysts point out that the present rise is based on a number of minor bullish factors rather than one solid consideration and in the long term the outlook is still very bearish.

"The weather in Europe remains a background feature to the market, but a number of observers say that this is a very shaky supportive factor. It is true that the wet conditions facing farmers lifting beets this autumn will probably delay the campaign somewhat, but substantial losses – at least while the weather remains mild – seem unlikely. A more serious area of concern is the USSR where there have been heavy frosts. However, even here the bullish elements can be overplayed. Anxiety over the Soviet harvest is, by now, a traditional autumn occupation for sugar traders. Lack of transport and the risk of frost damage are now established features of the Soviet sugar industry.

"Imports by Cuba, meanwhile, continue to worry dealers. Purchases by Havana to date are estimated at 100-300,000 tonnes. This may be evidence that the authorities exaggerated the last sugar crop (officially put at 8.2 million tonnes) but a number of trade sources feel it is more probable that Cuba is facing a temporary shortage because of its heavy sales early on to the USSR

[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 477-481.
[2] November 6, 1982.

and China – in which case Moscow may not be such an eager buyer on the free market.

"Other bullish scraps for the market to mull over at the moment include the apparent willingness of the International Sugar Organization and the EEC to discuss joint price support actions; the Dominican Republic's continued withdrawal from the market; and Peru's surprise plan to import 100,000 tonnes."

US sugar import quota, 1982/83[1]

Details of the individual country entitlements in the overall quota for the year which began on October 1[2] have recently appeared and are reproduced below. The overall total was announced as 2,800,000 short tons but, because of changes in the "basket" group of small suppliers, the real quota amounts to 2,890,600 tons, raw value.

Country	Annual quota	
	%	STRV
Dominican Republic	17.6	492,800
Brazil	14.5	406,000
Philippines	13.5	378,000
Australia	8.3	232,400
Guatemala	4.8	134,400
Argentina	4.3	120,400
Peru	4.1	114,800
Panama	2.9	81,200
El Salvador	2.6	72,800
Colombia	2.4	67,200
South Africa	2.3	64,400
Nicaragua	2.1	58,800
Swaziland	1.6	44,800
Costa Rica	1.5	42,000
Thailand	1.4	39,200
Mozambique	1.3	36,400
Taiwan	1.2	33,600
Guyana	1.2	33,600
Zimbabwe	1.2	33,600
Mauritius	1.1	30,800
Ecuador	1.1	30,800
Jamaica	1.1	30,800
Belize	1.1	30,800
Canada	1.1	30,800
Honduras	1.0	28,000
Bolivia	0.8	22,400
India	0.8	22,400
Barbados	0.7	19,600
Fiji	0.7	19,600
Malawi	0.7	19,600
Trinidad & Tobago	0.7	19,600
St. Kitts	MQ	16,500
Madagascar	MQ	16,500
Haiti	MQ	16,500
Paraguay	MQ	16,500
Mexico	MQ	16,500
Ivory Coast	MQ	16,500
		2,890,600

MQ = Minimum Quota

OAS sugar exporters seminar

A three-day seminar of sugar exporting members of the Organization of American States was held in Santo Domingo in October. The intention was to seek joint responses to the difficulties faced by exporters in placing their sugar and in meeting the increasing competition from starch-based and non-caloric sweeteners. The fundamentally depressed outlook for sugar was emphasized, and poor demand would keep prices low, it was acknowledged. The seminar urged producers to examine the possibility of establishing more alcohol programs[3].

In their press release announcing the seminar, the OAS had pointed out that "Producing countries will have to modernize their industries and abandon the concept of limiting utilization of cane to the production of sugar without considering its potential as an efficient source of renewable energy". The same theme has been emphasized by other sources: *World Sugar Journal* recently observed[4]: "Owing to some practical problems encountered during its implementation this (fuel alcohol) industry does not seem to be growing at the rate once thought possible. Perhaps what is missing from the equation is not the willpower but rather conviction regarding the timeliness of such an investment. It would appear to us that a low sugar price should be sufficient to create as strong an incentive as a high petrol price did not too long ago. After all, what is the alternative?"

Peru sugar organization study[5]

Peru has received a $500,000 World Bank credit to finance a study of a reorganization of its debt-plagued sugar industry, to be carried out by the National Institute of Cooperatives under an agreement with the Ministry of Agriculture. The sugar cooperatives will themselves contribute 80 million soles ($102,500) to the study. The twelve cooperatives, set up under the former military regime, have joint debts totalling almost $100 million. Sugar production, down to a record low of 478,000 tonnes, tel quel, in 1981, recovered this year to an estimated 740,000 tonnes which is below earlier expectations because of a rain shortage. It is feared that the drought problem could recur in 1982/83.

World sugar balance

World Sugar Journal recently issued in their telex service their latest estimate of world sugar supply and demand in a new form as reproduced below:

	1982/83	1981/82	1980/81
	tonnes, raw value		
Initial stocks	22,176,000	15,255,000	18,262,000
Production	95,615,000	98,285,000	87,680,000
Total supply	117,791,000	113,540,000	105,942,000
Local consumption	66,324,000	61,761,000	62,830,000
Available for trade	51,467,000	51,779,000	43,112,000
Trade	26,270,000	29,603,000	27,857,000
Ending stocks	25,197,000	22,176,000	15,255,000
Commercial stocks	16,581,000	15,440,000	15,708,000
Surplus/Deficit	8,616,000	5,736,000	–453,000
Pressure index	51.04%	57.17%	64.62%

Commercial stocks are calculated as 25% of local consumption and the surplus includes the ISA special stocks (1.0 million tonnes in 1981/82 and 1.4 million tonnes in 1982/83). The pressure index is defined as "Trade" as a proportion of "Available for trade" and so is a relative measure of the surplus; the smaller the index the greater the surplus in relation to requirements. It thus provides an indicator of likely price movements.

[1] *Westway Newsletter*, 1982, (107), 5-6.
[2] *I.S.J.*, 1982, **84**, 321.
[3] *Public Ledger's Commodity Week*, November 6, 1982.
[4] 1982, **5**, (4), 5.
[5] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 523-524.

ICUMSA
International Commission for Uniform Methods of Sugar Analysis
18th Session 1982

RECOMMENDATIONS

The following Recommendations were adopted at the 18th Session of ICUMSA in Dublin during the period 14 to 18 June 1982. They will be reproduced, together with the Referees' Reports, Discussions, etc., in the bound volume of the 18th Session Proceedings which will be available early in 1983 from ICUMSA Publications Department, P.O. Box 35, Wharf Road, Peterborough, England, PE2 9PU.

Subject 1: Constitution and bye-laws

Referee: E. REINEFELD (Germany)

No Recommendations were put forward.

Subject 1A: Method and subject specification

Referee: E. REINEFELD (Germany)

1. The work of the Steering Committee, which was active during the 17th Session at Montreal in 1978, should be permanently taken over by Subject 1A.
2. The method specifications laid down in Appendices 1 to 3 of the present Report should serve as guidelines for the work of the Referees and for decisions taken during the Sessions.
3. The Subject specifications should be kept under permanent review and improved by the members of Subject 1A, bearing in mind the responsibilities of the Executive Committee.
4. Collaboration between the Referees and Associate Referees should be improved, by means of a timetable, to enable careful preparation for the Sessions.

Subject 2: Laboratory apparatus

Referee: M. FRIML (Czechoslovakia)

1. ICUMSA should give further consideration to the specification of polarimeters in terms of performance, with the continued co-operation of OIML and appropriate national bodies, in order that standards may be set without delay, while avoiding any restriction on the development of new polarimetric techniques.
2. The specifications given in Appendix 1 to the present Report for determination of the Brieghel-Müller filtration coefficient and in Appendix 2 for an automatic proportional balance for the determination of sugar content in beet should be studied.
3. Referees for other Subjects should consider what instruments or apparatus are suitable for international standardization, and cooperate in this matter with the Referee for Subject 2.

Subject 3: Sampling of sugar and related products

Referee: E. G. MULLER (UK)

1. The sampling procedure described in Recommendation 1, Officially adopted at the 16th Session in 1974, should also be Officially adopted for liquid sugar products and molasses.
2. The scheme described in Appendix 1 to the present Report should be Officially adopted for the sampling of liquid sugar products and molasses for technical purposes.
3. The design of the continuous and automatic samplers for liquid sugar products and molasses should be further studied.
4. The special techniques required for the sampling of sugar products for microbiological purposes should be studied under Subject 21, in cooperation with the Referee for Subject 3.

Subject 4: Specifications and tolerances for pure sucrose and reagents

Referee: W. BRAUNSTEINER (Austria)

1. The Schneider, Emmerich & Ticmanis modification of the Karl Fischer method, Tentatively adopted the 17th Session in 1978, should be further studied in order to establish whether it is suitable for Official adoption.
2. The use of new, more stable, two-component reagents in the Karl Fischer procedure should be further studied for the determination of water in pure sucrose.
3. The procedure described in Subject 14, Appendix 1, for the enzymatic determination of glucose and fructose in pure sucrose should be Tentatively adopted.
4. The specifications and tolerances for analytical grade enzymes, intended for use in the determination of glucose and fructose, as set out in Appendix 1 to the present Report, should be Tentatively adopted.
5. The method of Rens for the determination of total and basic lead, having been tested by two independent collaborative tests, should be Officially adopted.
6. Studies into the application of clarification agents, including Carrez reagent, should be undertaken.

Subject 5: Polarimetry

Referee: F. SCHNEIDER (Germany)

NOTE: Adoption of three of the Recommendations in the Referee's Report was postponed after extensive meetings and discussions between interested parties in conjunction with the following Presidential statement.

'The physical basis of the Recommendations of the Referee of Subject 5 concerning the new definition of the International Sugar Scale is acknowledged and fully accepted.

'A decision concerning the Official adoption of the new International Sugar Scale, corresponding to these new results, will be postponed on account of commercial and possible legislative consequen-

ces. These latter should be considered in such a way as to make a change in the scale possible at the 19th Session in 1986 or earlier.'

The Recommendations which were adopted are as follows:

1. The formula of Emmerich, as included in the 1978 Report *(Proceedings 17th Session ICUMSA, 55)*, is Officially adopted for the temperature correction of polarizations to 20.00°C.
2. A Sub-Committee should be appointed to develop guidelines in connexion with questions relating to a polarimetric 'tropical scale'. These questions should be further studied in close co-operation with the Referees for Subjects 7 and 12.
3. The rotatory dispersion of sugar solutions after acid inversion or enzyme treatment should be studied.
4. The use of invariable standards other than quartz should be studied.

Subject 6: Quartz control plates

Referee: K. ZANDER (Germany)

1. The wavelength (632.9914 nm) of the helium-neon laser shall be Officially adopted as a reference wavelength for the calibration of quartz control plates.
2. The conversion to the standard wavelength of 546.2271 nm and to the reference wavelength of 589.4400 nm shall be made by applying the formula for the relative rotatory dispersion of quartz given by NBS in the report of the US National Committee (See Appendix 1 to the present Report.)
3. The low pressure mercury-spectral lamp is Officially adopted as a suitable light source for achieving the standard wavelength if the emission line at 546 nm is carefully selected by means of a double monochromator or filter pack.
4. There is no wavelength difference when the standard wavelength is achieved by means of a dye-laser locked to the 546.2271 nm emission line of a mercury-neon hollow-cathode lamp or a mercury-spectral lamp. This problem, which had been stated by NBS *(Proc. 17th Session ICUMSA,* 1978, 63) was finally solved by PTB and by comparison of the measuring values obtained when long quartz cylinders were interchanged between NBS, NPL and PTB.

Subject 7: Density

Referee: H. WAGENBRETH (Germany)

1. Studies aimed at the establishment of improved density data for aqueous sucrose solutions should be given priority during the forthcoming four-year working period of ICUMSA.

Subject 8: Sucrose in factory and refinery products excluding beet, cane and crystalline sugars

Referee: J. V. DUTTON (UK)

1. The Tentative status of both the CSR isotope dilution method and the Bruijn & Carreyett isotope dilution method is withdrawn. Further testing of modifications to the Bruijn & Carreyett method, such as have been proposed by Emmerich & Reichel, should be carried out to establish a completely defined method.
2. The GLC method of Schäffler for the determination of sucrose, as described in Appendix 1 to the present Report, is Tentatively adopted. Further testing of other GLC methods is recommended.
3. Liquid chromatographic techniques should be further studied. Consideration should be given to alternatives to the refractive index method of determining sucrose in column eluates.
4. Enzymatic methods for the determination of sucrose and total fermentable sugars should be further studied. The method of Devillers *et al.* is particularly recommended for these studies.
5. The Dutton double polarimetric method, with corrections for oligosaccharides, should retain its Tentative status.
6. Since the Jackson & Gillis Method IV has inherent inaccuracies, it should be improved, or replaced, by a method taking into account interfering substances; until further notice it should be retained as an Official method.
7. Further investigations should be undertaken to assess the feasibility of utililizing Lane & Eynon titration results for total reducing sugars and initial reducing sugars with a nominal correction applied, in order to determine sucrose for factory control use.
8. High performance thin layer chromatographic methods should be investigated.
9. The Lane & Eynon constant volume method for determination of total reducing sugars after hydrolysis according to the United Molasses Company specifications, as described in Appendix 2 to the present Report, is Officially adopted.
10. Further studies of methods for the determination of purity should be undertaken.

Subject 9: Sucrose in sugar beet

Referee: W. MAUCH (Germany)

1. In view of the importance of samples being both representative and homogeneous, proposals should be evolved for standardizing the preparation of brei and its characteristics; consideration should also be given to the treatment of beet slices or cossettes.
2. The use of non-toxic clarification agents, which are not harmful to the environment, should be further studied, taking into account possible influences on the determination of other components such as sodium, potassium and α-amino nitrogen.
3. The hot aqueous digestion and double extraction methods should no longer be used and should lose their Official ICUMSA status.
4. In view of the widespread use of mixing/filtration tracks, proposals for the standardization of relevant instrumental and analytical parameters should be evolved.
5. In order to check polarimetric methods and to determine correction factors, as and when required, a suitable gas- or liquid-chromatographic method should be developed; such a method should exclude the systematic errors which occur during the preparation of the solution as well as in the polarimetric measurement.
6. GLC methods (including that of Karr & Norman, Tentatively adopted at the 16th Session) for the determination of sucrose in filtrates from brei after treatment with lead acetate or other clarification agents should be further investigated.
7. The study of enzymatic and biological methods for the determination of sucrose should be continued. Such studies should include the preparation of the solution, and the method of Devillers *et al.* should be given special consideration.

Subject 10: Sucrose in sugar cane

Referee: M. A. BROKENSHA (South Africa)

1. Comparisons of core and grab sampling of whole or chopped cane with hatch sampling of prepared cane, for bias and precision, should be continued.
2. The hydraulic press method should be further studied, with emphasis on the effects of cane variety and extraneous matter.
3. The various disintegration methods in use should be studied and evaluated with a view to proposing a Tentative method for sucrose (pol) analysis at the 19th Session.
4. The GLC and HPLC methods for the determination of sucrose in cane juice should be further studied.
5. Methods using non-toxic reagents instead of lead salts for clarification in analysis should be further studied.

Subject 11: Polarization of raw sugars

Referee: M. R. PLAYER (Australia)

1. A statement should be added at the end of the method description, stating that the repeatability of the method (definition according to ISO 5725, 95% confidence limit) is 0.10°S.
2. In the specification of the basic lead acetate solution, the desirability of narrowing the range of basicity values should be further studied, with a view to establishing a total lead content consistent with a density of 1.240 ± 0.002 g/cm^3 and a basic lead content of 10.0 ± 0.2 g PbO/100 cm^3.
3. Recommendation 5 of Subject 4 should apply equally to Subject 11, with the intention that the method of Rens should replace the NBS method for the determination of basic lead, but that the determination of total lead should be carried out either by the method of Rens or by the present density procedure.
4. A total lead specification, expressed as g PbO/100 cm^3, should augment the present density specification of the basic lead acetate solution; the appropriate equivalence to a density of 1.24 ± 0.01 g/cm^3 should be 24.4 ± 1.0 g PbO/100 cm^3.
5. With the Tentative adoption of more exact temperature correction formulae within the framework of Subject 5, these formulae should be incorporated into the Official method for polarization of raw sugars by way of revised wording of the relevant sections. These revised sections are given in Appendix 1 to the present Report.

Subject 12: Refractive index

Referee: K.-J. ROSENBRUCH (Germany)

1. The coefficients given in the Referee's Report as ICUMSA Table (1982) for the refractive index, in standard air, of aqueous solutions of D-glucose, D-fructose and invert sugar at concentrations from 0 to 85%, temperatures of 15 to 30°C and wavelengths of λ = 589.3 nm and λ = 546.1 nm are Tentatively adopted.
2. The validity of the simple linear interpolation formula and the accuracy of such formulae in respect of aqueous solutions of mixtures of sucrose and invert sugar should be further studied.

Subject 13: Dry substance in sugar products other than sugars

Referee: G. MANTOVANI (Italy)

1. Evaluation of the Karl Fischer method for determination of water, Tentatively adopted at the 17th Session and fully described in Appendix 2 to the Referee's Report, should be continued.
2. The method using vacuum drying on sand, Tentatively adopted at the 17th Session, should be further studied.
3. The Hawaiian methods for removing suspended solids prior to the measurement of refractive index or density, as described in Appendix 1 to the Referee's Report to the 17th Session, should be further studied.
4. Procedures for the measurement of refractive index should be submitted to further collaborative studies.
5. Methods for the determination of water by means of gas-liquid chromatography, nuclear magnetic resonance, near infra-red spectroscopy and microwave techniques should be further studied.
6. The corrections required to convert refractometer solids to true solids should be further studied, with particular reference to glucose syrups, blends and similar products.

Subject 14: Reducing sugars

Referee: G. RENS (Belgium)

1. The Luff-Schoorl method should be further studied in order to improve the procedure, special attention being given to the composition and preparation of the Luff-Schoorl reagent.
2. A study of the calibration of the apparatus (including micropipettes, optical cells and wavelength), used in the enzymatic photometric method, should be undertaken with a view to improving the precision of the method.
3. The enzymatic photometric method (described in Appendix 1 to the Referee's Report), supplemented by the standardization procedure (described in Appendix 3 to the Referee's Report), is Tentatively adopted for the determination of glucose and fructose.
4. Enzymatic methods involving the use of immobilized enzymes should be further studied.
5. The GLC method of Schäffler (as described in Appendix 4 to the Referee's Report) should be submitted to a collaborative study to establish the precision of the method.
6. Methods for the determination of glucose and fructose by HPLC should be further studied.

Subject 15: Oligosaccharides and glycosides

Referee: H. SCHIWECK (Germany)

1. The method of Schiweck & Büsching gives the sum of raffinose, galactinol, polygalactans and free galactose, expressed as raffinose, but does not give absolute values. The Tentative status of the method should be retained.
2. The HPLC method for the determination of raffinose, galactinol, 1-kestose, 6-kestose and neokestose, as outlined in the Referee's Report, is Tentatively adopted.

Subject 15A: Pectin and polysaccharides

Referee: J. F. T. OLDFIELD (UK)

NOTE: For the collaborative studies required by Subject 15A Recommendations, it is particularly stressed that the assessment of these experimental

methods should be made with due regard to the objectives of the various research, control or commercial tests to which the methods will be applied.

1. The methods of Carruthers & Oldfield and of Schneider, Emmerich & Laudien should be retained on a Tentative basis for the determination of pectic acid in raw and diffusion juices (originating from beet) at concentrations in excess of 50 mg/dm^3.
2. The method of Reinefeld, Thielecke & Lücker should be Tentatively adopted for the determination of pectic acid in raw and diffusion juices at concentrations in excess of 50 mg/dm^3.
3. The British Sugar method should be retained on a Tentative basis for the determination of dextran at concentrations in excess of 100 mg/dm^3.
4. The CSR method for the determination of dextran in raw cane sugar, Tentatively adopted within the framework of Subject 27 at the 17th Session, should be retained on a Tentative basis for the 'haze' assay of dextran-like material in raw cane sugar.

   NOTE: This Recommendation is recorded here to aid cross-reference and any up-dating of it under Subject 27 should also be recorded under Subject 15A.
5. The method of Reinefeld, Thielecke & Lücker should be Tentatively adopted for the determination of dextran, laevan and araban at concentrations in excess of 10 mg/dm^3.
6. The British Sugar method should be retained as a Tentative method for the determination of laevan at concentrations in excess of 100 mg/dm^3.
7. The British Sugar method should be retained as a Tentative method for the determination of araban at concentrations in excess of 50 mg/dm^3.
8. Collaborative studies of the procedure of Roberts, involving reprecipitation with alkaline copper sulphate, for the determination of dextran in raw cane sugar and in cane juice, should be undertaken.
9. Collaborative studies of the immunological, nephelometric and gel-diffusion techniques of Goodacre & Martin as research procedures for the assay of dextran in white sugar should be undertaken.
10. Further studies should be undertaken to define more precisely the ranges of application of the methods covered by Recommendations 1 and 2.

Subject 16: Ash

Referee: P. DEVILLERS (France)

1. The gravimetric method for determination of sulphated ash with two incinerations at 550 and 650°C should be maintained on an Official basis with the revised operating procedure given in Appendix 1 to the present Report, but further studies should be undertaken in respect of incineration temperature, particularly in relation to the composition of cane products.
2. The conductivity method at 50 mg dry matter/cm^3 for the determination of ash has given excellent results in inter-laboratory trials in which conductimeters were calibrated with a solution of potassium chloride. The Official status of this method is confirmed (procedure as described in "Sugar Analysis: ICUMSA Methods").
3. An additional conductivity method for the determination of ash should be adopted on a Tentative basis. It is carried out at a concentration lower than 50 mg/cm^3 without the addition of sugar and it has been established that it gives results as reproducible as the method of Recommendation 2. The following formula gives the coefficient to be applied:

   $$K = (16.2 + 0.36D) \times 10^{-4}$$

   where D = concentration (g dry matter/100 cm^3) of the measured solution.

   The method procedure is given in Appendix 2 to the present Report.
4. The method for the determination of insoluble ash should be further studied before the 19th Session.

Subject 17: Inorganic non-sugars

Referee: R. DETAVERNIER (France)

1. In the determination of heavy metals by atomic absorption, with or without flame, methods of sample preparation should be subjected to inter-laboratory study.
2. The method using zinc dibenzyldithiocarbamate for the determination of copper in white sugars should be Tentatively adopted and, together with the method using oxalyl dihydrazide, should be subjected to collaborative studies.
3. For the determination of sulphite in molasses, the modifications of the Monier-Williams method, as described in Appendices 3 and 4 to the present Report, should be Tentatively adopted.
4. For the determination of sulphite in pulp and other products, the methods outlined in Appendices 3 and 4 to the present Report should be subjected to inter-laboratory study.
5. The Perez & Kara-Murza method for the determination of phosphate in cane sugars should be subjected to inter-laboratory testing.
6. X-ray fluorescence as a possible Reference method for the determination of inorganic components should be studied.
7. Methods using ion selective electrodes for the determination of inorganic components should be jointly studied in the programs of Subjects 17 and 24.

Subject 18: Organic non-sugars

Referee: N. KUBADINOW (Austria)

1. The enzymatic method for the determination of citric acid, Tentatively adopted at the 16th Session in 1974, should be Officially adopted.
2. The transamination method for the determination of L- and D-lactic acid, recommended for further study at the 17th Session in 1978, should be Tentatively adopted.
3. The method of Carruthers, Oldfield & Teague, Tentatively adopted at the 14th Session in 1966 for the determination of betaine, should. for the time being, be restricted to the testing of sugar beet juices and plant material.
4. The determination of betaine in white sugar should be further studied.
5. The development of a standardized procedure for the colorimetric determination of betaine, using Reineckate, should be undertaken.
6. The HPLC method of Steinle & Fischer for the determination of betaine should be further studied, with particular reference to the betaine retention time.
7. The method of Burba & Georgi for the fluorimetric determination of α-amino acid nitrogen should be further studied on an urgent basis.
8. The enzymatic determination of L-glutamic acid should be further studied.

9. The determination of pyrrolidone carboxylic acid should be further studied, with particular reference to HPLC and GLC methods.
10. Comparative studies on methods for the determination of aconitic acid in cane sugar products should be undertaken.
11. The enzymatic determination of formic acid in technical sugar juices should be further studied.
12. The determination of organic acids resulting from fermentation of pressed sugar beet pulp should be studied, with particular reference to HPLC and GLC methods and to procedures for sample preparation.
13. The determination of herbicides and pesticides, taking into account the methods of Reinefeld, Bliesener & Urban, should be further studied, with particular reference to sample preparation.
14. For the determination of total nitrogen using the Kjeldahl procedure, further comparative studies should be undertaken with a view to finding a suitable catalytic system free from environmental problems.
15. The use of immobilized enzymes in the determination of organic non-sugars should be further studied.

Subject 19: Characteristics of white sugars

Referee: D. HIBBERT (UK)

1. Collaborative studies on the present Tentative method for determining loss on drying should be undertaken on an urgent basis to allow the formulation of a precise method for Official adoption. Such studies should give consideration not only to weighing temperatures but also to the effect of variations in laboratory temperature and sample temperature.
2. The Rens procedure for the evaluation of particle size determination should be further studied.
3. The modifications to the Coca-Cola acid floc determination procedure proposed by Huberlant and outlined in the present Report should be accepted as allowable alternatives in the method already Tentatively adopted.
4. The problems associated with the determination of insoluble matter in commercial dextrose should be further investigated and these studies should include the use of hydrophobic-edge membranes.
5. The procedure described in Appendix 2 to the present Report, for the determination of the polarization of white sugars, should be Tentatively adopted in place of the method adopted at the 17th Session.
6. The method described in Appendix 3 to the present Report, for the determination of calcium phosphate in powdered sugars, should be collaboratively studied with a view to its Tentative adoption at the 19th Session of ICUMSA.
7. The method described in Appendix 4 to the present Report, for the general determination of anti-caking agents in powdered sugars, should be further studied, with particular reference to the washing procedure and to the effect of the water content of the additives.

Subject 20: Deterioration of sugars

Referee: D. S. MARTIN (UK)

1. Instruments depending upon measurement of the resistance of an electrolyte solution should continue to be favoured for the ready measurement of the RH of sugars and field trials should be carried out to test the effectiveness of such instruments.
2. Studies should be made of means to accelerate the arrival of a sample of freshly-made sugar to the ERH that would result after conditioning.
3. The relationship between Dilution Indicator and RH of sugars should be studied in different parts of the world.
4. Data relating to any aspects of sugar deterioration should be monitored.

Subject 21: Microbiological tests

Referee: H. P. HOFFMANN-WALBECK (Germany)

NOTE: The descriptions of the media referred to are given (media 1 to 13) in *Proc. 16th Session ICUMSA*, 1974, Appendix 1, 283-284 and (media 10A and 14 to 17A) in *Proc. 17th Session ICUMSA*, 1978, Appendix 1, 336-337.

1. Media 1, 2, 3 and 5 shall be Tentatively adopted for the enumeration of bacteria. For the enumeration of slime-forming bacteria, media 13, 14, 15 and 15A should be further studied.
2. For the enumeration of yeasts and moulds, media 6, 7, and 9 and the media proposed by ISO should be comparatively studied. For the enumeration of osmotolerant and osmophilic yeasts media 8, 17 and 17A should be comparatively studied.
3. For the enumeration of bacterial spores, media 10 and 10A and glucose agar should be comparatively studied.
4. For the determination of bacteria by the membrane filter techniques, membranes with a pore size of 0.2 to 0.45 μm shall be Officially adopted.
5. For the determination of yeasts and moulds by the membrane filter techniques, membranes with a pore size of 0.6 to 0.8 μm shall be Officially adopted.
6. For the enumeration of bacterial spores, the elimination of vegetative organisms by heating at 100°C for 5 min, already Tentatively adopted by ICUMSA, should be compared with the procedure of Shapton & Hindes. The heating procedure and the size and volume of the vessel used for heating should be studied and defined.
7. Methods for the enumeration of bacteria, yeasts and thermophilic anaerobic spores with considerably decreased incubation times (see section headed "Recommendation 8" in the present Report) should be compared with the more time-consuming methods hitherto recommended by ICUMSA. The elaboration of other rapid methods for the enumeration of microorganisms should be continued.
8. For the determination of the thermophilic spores, the membrane filter technique — including incubation of the media in a nitrogen-filled anaerostat for anaerobic thermophilic spores (see section headed "Recommendation 7" in the present Report) — and the plate count and tube methods should be submitted to further collaborative study.
9. When nutrient cardboard discs of the same composition as agar-containing media, recommended by ICUMSA, are available, they may be used as an alternative.
10. The sampling under sterile conditions of sugar, especially liquid sugar, and the evaluation of the results obtained should be studied and defined.
11. Methods for the evaluation of *Streptococcus* spp. in sugars should be studied.

Subject 22: Colour and turbidity

Referee: F. G. CARPENTER (USA)

1. Further studies should be undertaken to improve the precision of the colour measurement method.
2. Procedures for improving the pH adjustment step in the colour measurement method should be studied, and such studies should include, in co-operation with the Referee for Subject 24, investigation of the possible use of buffer solutions.
3. Further studies should be undertaken to improve the filtration step of the colour measurement method.
4. Further studies should be undertaken to develop a practical method for the determination of turbidity.
5. The optical systems and geometry of instruments for colour measurement should be further studied.
6. Further studies should be undertaken on the errors introduced by fluorescence and on the use of fluorescence as a separate index of impurities.

Subject 22A: Reflectance and visual appearance of white sugars

Referee: A. EMMERICH (Germany)

1. Studies on the influence of size, gloss and surface structure on visual grading and on reflectance measurements should be continued.
2. The application of visual and reflectance techniques to the evaluation of brown sugars should be further studied.
3. Methods involving the measurement of transluminescence in relation to white sugars should be studied in close co-operation with Subject 22.

Visual methods

4. The visual grading of white sugars with the Braunschweig colour type series shall be Officially adopted; the conditions of measurement and of preparation of the colour type series shall be those specified in "Sugar Analysis: ICUMSA Methods", p.129, with the amendments incorporated in Appendix 3 to the present Report.

Reflectance measurements

5. Since the relationship between the chromaticity coordinate z(E) and the saturation p(E) for samples with a dominant wavelength in the region of 576 nm is purely mathematical and not experimental, the use of z(E) instead of p(E) in evaluating tristimulus measurements shall be Officially adopted.
6. Investigation of reflectance measurements for the evaluation of colour of white crystalline sugars should be continued.

Subject 23: Rheological properties

Referee: T. MORITSUGU (USA)

1. Factors influencing the rheological properties of molasses and massecuites should continue to be investigated.
2. The pipeflow method should be Tentatively adopted as an alternative to the rotating cylinder method for determining the viscosity of molasses.
3. The pipeflow method for determining the rheological properties of massecuites should be further evaluated with a view to developing it as a standard technique.
4. Other viscometric methods, such as the orifice method, for determining the rheological properties of molasses and massecuites should be evaluated with a view to developing them as standard techniques.

Subject 24: pH and ion selective electrodes

Referee: J.-P. LESCURE (France)

1. Recommendation 54 of OIML, "pH scale of aqueous solutions", should be Officially adopted.
2. Work should be continued with a view to adopting a satisfactory method for measuring the pH of unbuffered solutions of white sugar at 50°Bx and, meanwhile, the method of Dubourg should be retained on a Tentative basis.
3. The error inherent in the standardization of electrodes by means of an aqueous solution of the ion analysed is of no significance in the measurement of hydrogen ion activity and is negligible up to 28°Bx in the use of a gaseous diffusion electrode for measurement of sulphur dioxide, but should continue to be studied for other electrodes and especially in the determination of nitrates.

Subject 25: Crystallization qualities of sugar solutions

Referee: F. HEITZ (France)

1. Studies concerning crystallization should be encouraged, particularly those involving the melassigenic power and composition of molasses.
2. Exhaustion of molasses should be determined by the saturoscope method or by the "Polish test". These two methods are Tentatively recommended, but should be further comparatively studied.

Subject 27: Refining qualities of raw cane sugar

Referee: J. S. KENIRY (Australia)

1. The Tentative status of the "haze" assay for dextran-like material in raw cane sugar should continue. The Referee will advise on tighter method descriptions to improve reproducibility.
2. The collaborative studies called for by Recommendation 8 (Subject 15A) into the Roberts procedure for dextran determination should also concern the relationship with the refining qualities of raw cane sugar.
3. Studies of the determination of amylose and amylopectin should be continued.
4. Further work should be carried out on "grist" determination, particularly with a view to developing a method which minimizes conglomerate formation during washing and drying.

Subject 28: Bone charcoal and other adsorbents

Referee: C. C. CHOU (USA)

1. In the method for the determination of bulk density of bone char, Officially adopted at the 13th Session, the exit aperture size of the funnel should be Officially enlarged to 12.7 mm.
2. An attrition hardness test, independent of particle size, shape and density, should be developed.
3. Methods for the determination of the capacity of ion exchange resins (for example those described in Appendices 4 a(b) and 4 b(b) to the Referee's Report to the 14th Session) should be further studied.
4. Representatives of different interests in the use of ion exchange resins should continue to define the critical properties of such resins and develop procedures for their determination.

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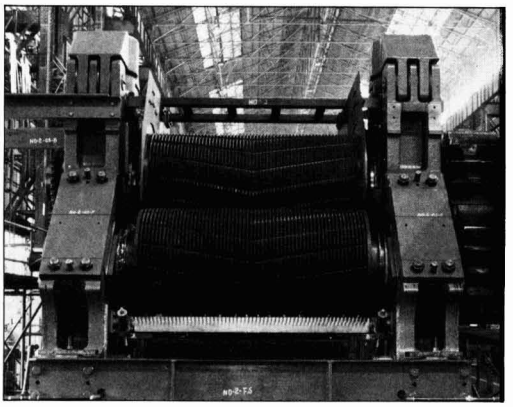

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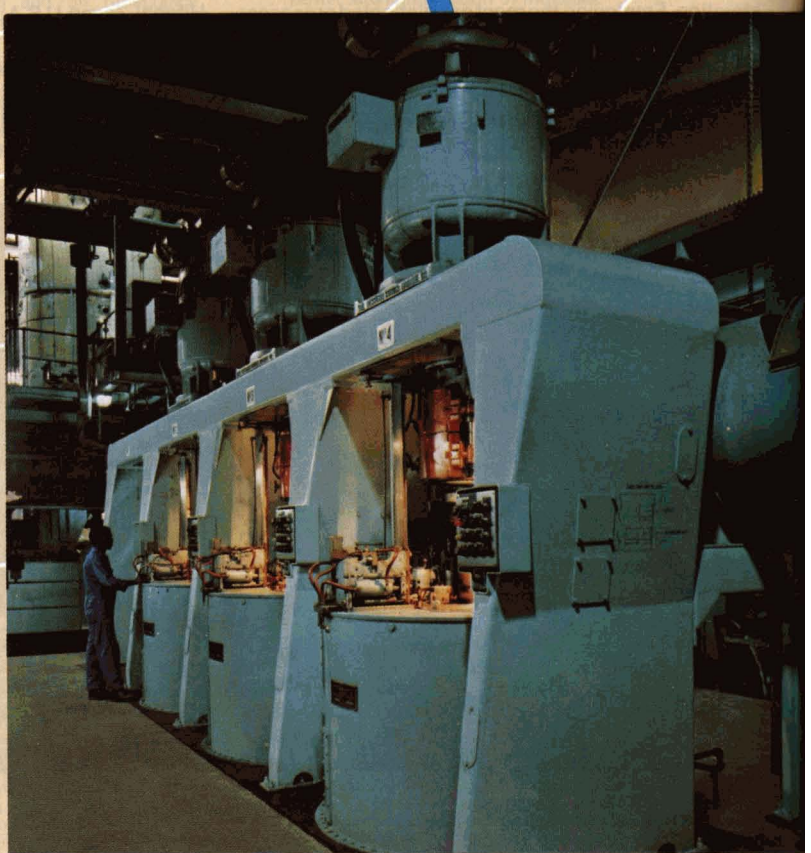

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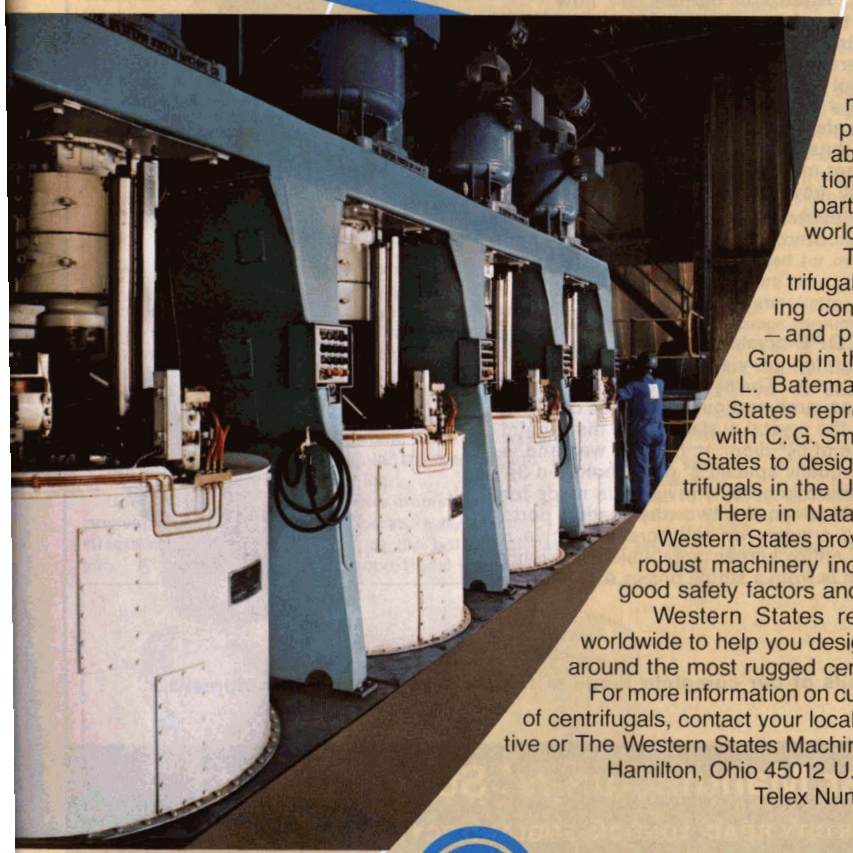

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The conditioning of refined sugar in South Africa *

By JAAP BRUIJN, BRIAN S. PURCHASE and A. BERNARD RAVNÖ
(Sugar Milling Research Institute, Durban, South Africa)

Introduction

The phenomenon of caking or stickiness of raw and refined sugars has long been known to sugar technologists all over the world. However it was not really until the introduction of bulk handling and distribution systems for refined sugar, that this became a serious problem for the producer. During the fifties and sixties, many investigations were conducted into the cause, prevention and measurement of caking in refined sugar. Much of this work is covered in a comprehensive review of the subject by Bagster[1].

It has now been widely accepted that the cause and mechanism of caking are related to the movement of the residual moisture content in the bulk sugar[2]. It has also been established that this phenomenon can be minimized or virtually eliminated by subjecting the bulk sugar to a "curing", "conditioning" or "aging" period, under certain prescribed conditions[3].

Sugar conditioning silos are large and costly installations. Consequently, before the design of the first bulk handling system in South Africa was finalized, it seemed prudent to undertake a few simple and practical tests to establish whether refined sugar from Huletts Refinery in Durban conformed with the established behaviour patterns for conditioning. In particular, it was necessary to determine whether the somewhat larger grain size, the relatively wider variations in grain size and the high conglomerate count of this sugar would have any substantial influence on curing behaviour. This paper gives details of the tests performed and the results obtained.

EXPERIMENTAL PROCEDURE

Experimental conditioning silos

Two pilot scale silos were constructed of stainless steel as shown in Figure 1. Each silo was 250 mm in diameter, 1000 mm high and had a capacity to hold 40 kg of sugar, supported on a fine wire mesh screen. The contents of each silo were maintained at a constant and uniform temperature by controlled heating of the vessel walls, which were wrapped externally with silicone rubber heating tapes. A voltage of 40-60V was required to maintain temperature equilibrium. Each silo was also provided with a thermometer in the centre and an opening at the bottom for sampling.

Compressed air at 20% relative humidity (RH) and preheated to the required temperature by means of a tungsten bulb, was introduced at the bottom of each silo. A thermocouple and proportional temperature controller were used to maintain the correct air temperature. The air was pre-dried to below 20% RH with silica gel. Humidity was measured by means of a calibrated hair hygrometer and controlled at the desired value by bleeding a small amount of moist air into the pre-dried stream. Air flow rates were regulated with small rotameters.

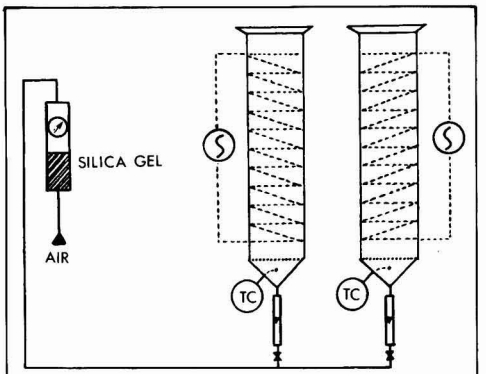

Fig. 1. Schematic diagram of the pilot conditioning silos

The air flow rate was controlled at 2 $l.min^{-1}$ per silo (equivalent to 50 $l.min^{-1}$ per 1000 kg sugar), which is a typical figure used for many commercial installations. However, it should be noted that, as a result of scaling-down, this produces a superficial air velocity in the silo of only 4 $cm.min^{-1}$, which is considerably lower than for industrial scale installations.

Miniature silos consisting of glass test-tubes (23 mm x 200 mm) were used for certain small scale experiments. Their temperature was controlled by immersion in a thermostatic water bath. Air entering these silos was warmed by passage through 3 m of coiled copper tubing immersed in the same water bath. The air flow rate to each miniature silo was not individually controlled, but the overall flow to the distributor manifold was regulated. Silica gel was used, as previously described, for humidity control.

* *Paper presented to 1982 Conference on Sugar Processing Research.*

[1] *I.S.J.* 1970, **72**, 263-267, 298-302.
[2] Rodgers & Lewis: *ibid.*, 1962, **64**, 359-362; 1963, **65**, 12-16, 43-45, 80-83.
[3] Stachenko, Allen & Swan: *Proc. Sugar Ind. Tech.*, 1966, **25**, 75-122.

J. Bruijn

B. S. Purchase

A. B. Ravnö

Caking tests

With the proposed bulk handling system, conditioned sugar would be transported to Johannesburg (600 km inland from Durban) by rail. The specially designed tankcars have a diameter of some 3 m and a nominal capacity of 50 tonnes. It was suspected that caking would be most likely to occur during transit, because of the considerable variations between day and night temperatures, especially in the inland areas (sometimes greater than 30°C).

To establish the potential caking characteristics in transit, it was decided to construct a suitable small-scale simulator of a rail tankcar, as shown in Figure 2.

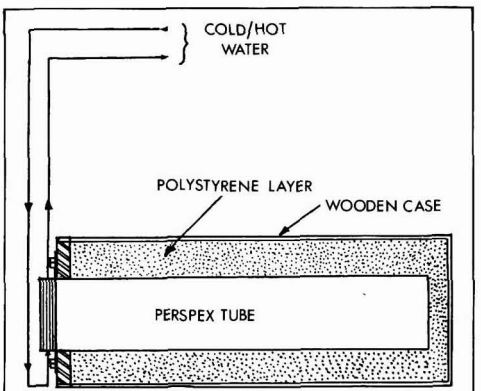

Fig. 2. Schematic sketch of the railcar caking simulator

This comprised a 200 mm diameter perspex tube sealed at one end. All sides, except the open end, were well insulated by a 50 mm polystyrene layer and the whole assembly mounted in a wooden box. The open end was fitted with an airtight metal lid through which water could be circulated. Thermocouples were mounted near to each end of the tube.

This simulator, which held about 40 kg of sugar, was 1400 mm in length, which corresponds to half the diameter of the proposed rail tankcars. The intention was that the sugar at the closed end of the tube would represent the material in the centre of the railcar, whilst that in contact with the metal lid would be the sugar at the outer wall of the tanker. By adjusting the temperature of the water circulating through the hollow lid, it was possible to subject the sugar in the simulator to a set of severe temperature gradients.

Details of the test procedure are as follows:—

(a) Before filling the simulator, the air in the tube was dried for 24 hours under tightly sealed conditions using silica gel.
(b) The silica gel was removed and the hot, conditioned sugar was transferred quickly from the conditioning silos to the simulator.
(c) The sugar was packed as tightly as possible and the metal lid sealed in position.
(d) Cold water at 2-5°C was circulated through the hollow lid for 16-20 hours, followed immediately by water at 60°C for 6 hours.
(e) The sugar temperatures near each end of the tube were recorded.
(f) After approximately 24 hours, the simulator was carefully opened and the sugar inspected for caking.

In later tests, this large scale simulator was found to be somewhat cumbersome and a simplified, small scale procedure was developed. Glass test-tubes (28 mm x 200 mm) were filled with sugar, sealed with a rubber bung and immersed to depth of about 5 mm in cold (3°C) water for 20 hours, then hot (65°C) water for 6 hours. The results from these "test-tube caking testers" correlated fairly well with the large scale simulator.

Moisture determination

The theory of the distribution of moisture in white sugar crystals is well established[2]. Most authors differentiate between three categories of moisture:

(i) *Free moisture.* All the individual crystals coming from the centrifugals are surrounded by a more or less dilute sugar solution. A very large proportion of the moisture present in this film is relatively easy to remove in convential dryers.

(ii) *Bound moisture.* This is moisture which is on the surface of the crystal but which is comparatively difficult to remove in that it takes time. Rodgers & Lewis[2] are of the opinion that this bound moisture is the greatest enemy to bulk handling.

(iii) *Inherent moisture.* This is moisture which is actually trapped within the crystal and is only determined analytically by grinding or dissolving the crystal. Although there is no direct evidence of the migration or release of this inherent moisture in troublesome amounts, even over prolonged periods of storage[2], Powers[4] has noted that there is more included water with larger crystals.

In view of the large grain size and high conglomerate counts for local refined sugar it was decided to adopt an analytical method for moisture which would determine the total water content of the sugar. The moisture content of the sugar samples was determined by an automatic Karl Fischer titrator (Metrohm) using the formamide method. The Karl Fischer reagent was standardized against oxalic acid dihydrate which was stored over saturated potassium bromide in a desiccator. Details of the analytical procedure are as follows:

(a) 60 ml of formamide was added in the titration vessel and automatically titrated to dryness. Manually the read-out was brought to 95 which took about 1 hour.
(b) About 20 g of sugar was weighed in a test-tube to exclude atmospheric moisture and quickly emptied into the titration vessel. The test-tube was then reweighed and the mass difference taken as the amount of sample being titrated.
(c) The mixture was stirred for 30 minutes after which the sugar was titrated manually, keeping the indicator at 95.
(d) A blank titration was carried out with only 60 ml of formamide to measure the uptake of atmospheric moisture during the 30-minute stirring period. The actual titration was then corrected for this small amount.

Conglomerate testing and sieve analysis

Sieve analysis was carried out according to the standard method used in South African sugar factories[5]. From these analysis data the specific grain size (SGS), mean aperture (MA) and coefficient of variation (CV) were calculated.

Conglomerate counts were based upon the following

[4] *I.S.J.*, 1954, **56**, 314-315.
[5] Anon. "Laboratory Manual for South African Sugar Factories." (S.A. Sugar Technologists' Association, Durban) 1977.

procedure:

(a) 100 g of sample were sieved through 850 micron and 425 micron sieves.
(b) The major fraction on 425 microns, which is about 70% of the sample, was retained.
(c) This fraction was passed through a 600 micron sieve and collected on a 5 cm wide piece of transparent sticky tape.
(d) The crystals were covered with a similar piece of tape. In this way a slide is produced holding about 1000 crystals.
(e) This was put on a photographic enlarger and a print made.
(f) A section of 100 crystals was marked out for conglomerate counting. All twinned crystals, clusters or star shaped crystals, and occluded, protruding or adhering crystals were classed as conglomerates.

RESULTS AND DISCUSSION

Influence of conditioning temperature

At Huletts Refinery, sugar leaves the granulators at 42-47°C under normal conditions. A number of conditioning tests were therefore undertaken at 40°C and 50°C in order to establish whether temperature had any marked influence over this range.

The table below summarizes all our results for the comparison of conditioning at these two temperatures.

	40°C	50°C
Number of trials	10	4
Mean moisture loss after 48 hr	0.029%	0.034%
Mean moisture content after 96 hr	0.051%	0.040%

During the initial 48 hours the mean rate of drying was greater at 50°C than at 40°C, but the difference is not statistically significant. This difference would probably become significant if more trials at 50°C were included.

Even with the limited number of trials, the moisture level after 4 days was significantly lower at the higher temperature, indicating that lower moisture contents are achieved more rapidly at higher temperatures.

Stachenko *et al.*[3] have shown distinct temperature effects with higher temperatures giving both increased rates of drying and lower final moisture contents. This is supported by the data shown in Figure 3 where conditioning temperatures were raised to 70°C for about 10 hours and then dropped again. This produced an immediate increase in the subsequent rate of moisture loss, particularly for the larger grain sizes.

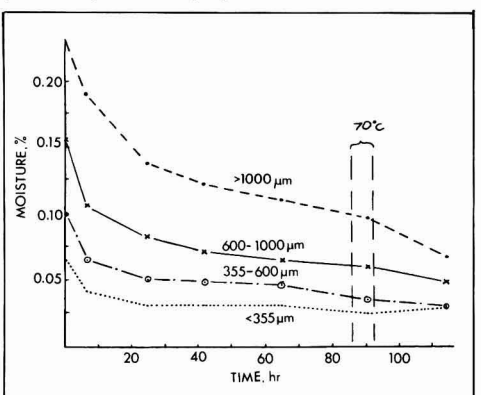

Fig. 3. Effect of grain size on conditioning

Bagster[1] mentions, however, that the rates of drying at different temperatures became equal after the first day and he suggests there is no advantage in using heat for longer than this period.

Effect of sugar dust on conditioning and caking

To investigate the effect of sugar dust on conditioning and caking it was necessary to de-dust 40 kg of sugar without cooling or drying it. In an attempt to do this, the sugar was shaken manually on a 100-mesh (150 micron aperture) screen in the hot room (38°C) at the refinery. Dust equivalent to 0.3% of the total sample was collected below the screen, whilst some finer dust escaped to the atmosphere. Unexpectedly, this de-dusted sugar absorbed moisture during the screening process, so a meaningful comparison of the conditioning rate of this material with its (unscreened) control sample was not possible. However, there were no obvious differences between the caking characteristics or final moisture contents of these two sugars.

For further investigations of particle size effects, the test-tube conditioning silos were developed. These required only 55 g of sugar so it was possible to experiment with small samples collected in a sieve-analysis apparatus. Particles collected in the bottom pan (less than 355 microns) were considered as dust and it was then possible to compare the rates of conditioning of dust alone, de-dusted sugar and the original sample (unscreened). The results are given in Figure 4 and show that dust carried less moisture per unit mass than either the de-dusted or the original sugar samples. Furthermore the dust attained a stable moisture content more rapidly than did the larger particles. Thus there are no indications that dust interferes with sugar conditioning. A test-tube caking test on partially conditioned sugar showed that de-dusted sugar caked at least as extensively as normal sugar.

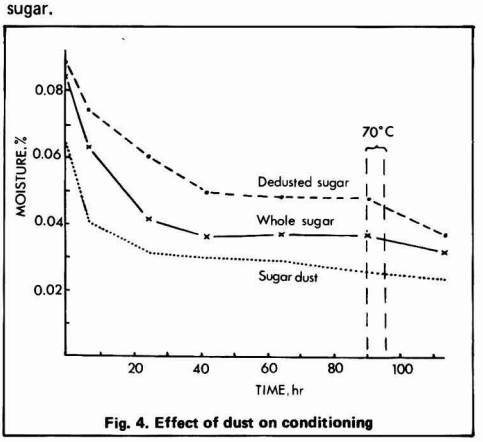

Fig. 4. Effect of dust on conditioning

These results suggest that there is no need to de-dust sugar prior to conditioning and bulk transport. Farag[6] also indicated that dust does not contribute to caking. He found that sugar dried at 145°C formed more dust but less cake than sugar dried at 100°C.

Effect of various grain sizes on conditioning

One batch of sugar caked in all caking tests, even after 168 hours of conditioning. Sieve analysis revealed that

[6] *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 207-216.

this sugar had an unusually high percentage of large (greater than 1700 micron) grains and a high coefficient of variation. This is illustrated in Table I.

Table I. Sieve analyses for various sugars used

Aperture (microns)	Mass percent retained				
	A	B	C	D*	E
1700	0.05	0.1	0	0.5	0.2
1180	0.2	0.3	0.3	0.8	0.6
1000	0.6	0.8	1.3	0.7	1.9
600	39.0	33.1	36.1	31.2	42.3
355	42.9	48.8	42.4	53.9	43.8
<355	17.2	16.9	19.7	13.0	11.2
MA mm	0.469	0.500	0.525	0.456	0.565
CV	43	51	46	67	45

* Sample caked even after 168 hr of conditioning.

The conglomerate count for sample D was not, in fact, very high. This suggested that the larger grains might prevent or delay successful conditioning and so the test-tube silos were used to study the rates of drying for various grain sizes at 40°C. The results presented in Figure 3 show that the two largest particle fractions contained considerably more moisture than any other cut and that they continued to release moisture long after the smaller fractions had stabilized. It is noteworthy that the sugar which could not be successfully conditioned was still releasing appreciable moisture after 7 days of conditioning.

The results of conglomerate counts on the various fractions of sample D are shown below:

Fraction	*% Conglomerates*
355-600 micron	86
600-1000 micron	100
>1000 micron	100

These results emphasise that the larger particles (mainly conglomerates) are important determinants of drying rates during sugar conditioning. Rodgers & Lewis[2] showed similar results and according to Chapman[7] it takes about 12 hours longer to condition coarse sugar (MA 0.5-0.6 mm) than fine sugar (0.3 mm). This is also confirmed by McGimpsey[8] who found that the time to reach equilibrium was shorter for finer sugars.

In the standard method for conglomerate counting (described earlier), the counts are done on sugar which has passed through a 600-micron screen. The results presented have shown that, for sugar conditioning, it is the particles larger than 600 microns which cause the problems and hence the standard conglomerate counts may be meaningless because they reflect a measurement made on a size fraction which is not problematic. Perhaps, for relevance to sugar conditioning specifically, the method for conglomerate counting should be modified. It is suggested that only the genuine, large, star-shaped conglomerates should be included in the count. These predominate in particles above 600 microns.

Influence of air flow rate

Air was purposely leaked from the base of one silo so that the air flow to that silo was reduced almost to zero. An 80 kg sample of sugar was divided equally between the two silos and rates of conditioning were then compared. The results indicated that, in fact, very little air is required for conditioning. The reduction in air flow rate did, however, decrease the initial rate of drying at the top of the silo. After the first 48 hours, air flow apparently had no effect on drying rate and even sugar stored in an insulated polystyrene box with a loosely fitting lid, dried as rapidly as that in the silo with 2 l/minute of air passing through it.

Stachenko *et al.*[3], Chapman[7] and theoretical calculations support the conclusion that air flow rate can be considerably less than the commonly accepted figure of 50 $l.min^{-1}$ per tonne of sugar. However, the lower the air rate, the greater the possibility of an uneven flow distribution across the silo.

Optimum conditioning time

In practical terms, sugar conditioning should aim to reduce the residual moisture content of a refined sugar to the point where no serious caking will occur when the sugar is subjected to temperature gradients slightly in excess of those expected in the real situation.

Rodgers & Lewis[2], in summarizing US practice, quoted residence times of 24 hours, which they suggest is too short a time. Many commercial installations aim at 36-48 hours.

In the present study, drying curves indicated that moisture removal was still substantial after 48 hours. In most cases it required in the region of 72 hours before the drying curves levelled off at residual moisture contents of 0.045-0.050%. Subsequent caking tests, in which these sugars were subjected to fairly severe thermal gradients (as previously described), indicated that in most cases a 72-hour conditioning period would be adequate. It is suggested that the relatively large grain size, coupled with the high conglomerate levels, are the cause of this longer curing period.

Potential changes in residual moisture

If the residual moisture in conditioned sugar (largely inherent moisture) was slowly released under prolonged storage, it could cause caking by migrating to the coolest areas. To test this danger, conditioned sugar from the 40 kg silos was stored for six weeks in tightly sealed plastic buckets and then returned to the caking simulator. In no case (4 tests) did sugar cake after storage if it had not caked before storage. The one sample which had caked prior to storage, did so to a lesser extent after the six weeks storage.

Another potential problem is that of moisture regain after conditioning. A series of simple tests was undertaken to establish whether conditioned sugar could absorb appreciable moisture when briefly exposed to ambient air during loading operations.

Conditioned sugar was spread in a petri dish which was closed in a balance chamber together with wet filter paper to create a moist atmosphere. The sugar was weighed periodically to determine changes in moisture content. It was found that stationary sugar exposed to humid air increases its moisture content to 0.01% in 10 minutes (1 mm layer) or 0.0076% in 10 minutes (10 mm layer).

To simulate the situation where sugar is moving in a screw conveyor, humidified air was passed through conditioned sugar in a test-tube. The rate of absorption was then as high as 0.03% in 10 minutes.

In each case, however, the absorbed moisture evapor-

[7] *Paper presented at 20th Tech. Conf. British Sugar Corporation Ltd.*, 1970.

[8] *Proc. Sugar Ind. Tech.*, 1960, **19**, 167-177.

ated rapidly when the humidity of the surrounding air was decreased and the sugar formed a hard cake. Thus, if moisture is re-absorbed during loading it is potentially very mobile and could cause caking. Moisture will not, however, be absorbed unless the RH of the surrounding air exceeds the so-called equilibrium relative humidity (ERH) of the sugar.

Rodgers & Lewis[2] state that it is dangerous to allow an RH greater than 65% in the air surrounding the sugar. McGimpsey[8] quotes ERH values between 68 and 75% for granulated refined sugar.

Conditioned sugar is normally warm (approx. 35°C) when loaded. This would heat the surrounding air in contact with the sugar, thereby decreasing its RH. It was noted that for air to exceed an RH of 70% at 37°C (i.e. to pose a potential danger for re-absorption), the initial air would need to be saturated (RH = 100%) at 30°C. Thus it seems unnecessary to take special precautions to protect warm sugar against moisture re-absorption from ambient air during loading.

Design of full scale installation

Based upon the data from the present study, together with the considerable body of published information, a full scale installation was erected and commissioned at Huletts Refinery in Durban during 1981.

The silo is constructed of steel and has a nominal working capacity of 750 tonnes. It is 8 m in diameter and 30 m high. Conditioning air (35 $m^3.min^{-1}$) is supplied at 42°C and 20% RH. Initial operating results have indicated that the residual moisture contents of conditioned sugar from the full scale installation are slightly lower than was obtained in the pilot scale tests. No serious caking problems have as yet been encountered during the warm summer period. However the system is not yet operating at design throughput rates nor has the conditioned material been subjected to the more severe temperature gradients encountered during winter. These results are awaited with great interest.

Conclusions

Results from this investigation indicate that, despite the high conglomerate count and coarse grain size of Huletts refined sugar, it can generally be conditioned adequately in 72 hours. Problems may be encountered with sugars containing a high CV and an exceptionally high percentage of crystals larger than 1700 microns. These parameters may prove useful indicators of sugars which would be difficult to condition. The standard conglomerate counting procedure is of dubious value in this regard.

The conditioned sugars generally contained 0.04 to 0.05% moisture as determined by the Karl Fischer analysis using formamide to dissolve the sugar. Conditioned sugars from other countries are reported to contain as little as 0.01% moisture but this is misleading because different methods for moisture determination are often used and these are known to give different results. Moroz *et al.*[9] found that sugar conditioned for 72 hours contained 0.036% moisture by the Karl Fischer-formamide method but only 0.012% when determined by standard oven drying at 105°C for 3 hours.

The alternative Karl Fischer method using anhydrous methanol to extract the moisture is expected to give lower results than formamide because methanol does not dissolve the sugar, thereby releasing the inherent (trapped) moisture. Stachenko *et al.*[3] present results which indicate that the Karl Fischer-methanol method gives results very similar to oven drying.

Sugar dust conditions more rapidly than whole sugar, whilst the influence of grain size on the rate of moisture release has been demonstrated clearly. Moisture re-absorption by conditioned sugars is potentially a rapid process, but is unlikely to occur during the loading of warm sugar because the RH of air in contact with the sugar will seldom exceed the ERH of the sugar.

The development of test-tube scale conditioning silos and caking testers is an advance which can facilitate future studies. These test-tube silos gave results which were similar to the 40 kg pilot silos and have the advantage that moisture changes can be monitored by simple weighing instead of the time-consuming Karl Fischer analyses. Because they require only small quantities of sugar, a large number of conditioning tests can be run simultaneously in the same water bath.

The test-tube caking test proved a more reliable indicator than the large railcar simulator, which proved difficult to seal. It is simple to use and could prove suitable for routine checking of the caking potential of sugars.

Acknowledgements

The authors are indebted to Huletts Refinery Limited, the S.A. Sugar Association and to Bosch & Associates for permission to publish these data and for their assistance in the preparation of this paper.

Summary

An account is given of tests made to determine the effect of conditioning on the large-grain refined sugar produced in South Africa. Simple devices are described which gave results comparable to those of larger test units and which permit rapid and simple measurement of moisture loss and caking potential. The tests showed that conditioning over a period of 72 hours gave satisfactory results and they have formed the basis for design of the conditioning plant built at the Durban refinery.

Le conditionnement du sucre raffiné en Afrique du Sud

On rapporte les essais effectués en vue de déterminer l'influence du conditionnement sur du sucre raffiné gros grain produit en Afrique du Sud. On décrit des systèmes simples donnant des résultats comparables à ceux obtenus dans des unités d'essais plus grands et qui permettent une mesure rapide et simple de la perte en humidité et du potentiel de prise en bloc. Les essais montraient qu'un conditionnement pendant 72 heures donnait des résultats satisfaisants. Les essais ont servi de base á la conception de l'usine de conditionnement construit à la raffinerie de Durban.

Die Konditionierung von raffiniertem Zucker in Südafrika

Berichtet wird von Untersuchungen über den Einfluß der Konditionierung auf grob-kristallinen Zucker, der in Südafrika hergestellt wurde. Einfache Geräte werden beschrieben, die vergleichbare Resultate zu komplizierteren Apparaten ergaben, und die einfache Messungen des Feuchtigkeitsverlustes und der Neigung zum Zusammenbacken erlauben. Die Untersuchungen zeigten, daß die Konditionierung über 72 Stunden zufriedenstellende Ergebnisse ergab, und diese bildeten die Basis für die Konstruktion einer Konditionierungsanlage, die in der Raffinerie Durban gebaut wurde.

[9] *Proc. Tech. Session. Cane Sugar Refining Research*, 1966, 102-112.

Condicionamiento de azúcar refinado en Sud-Africa

Se presenta una cuenta de ensayos hecho para determinar el efecto de condicionamiento sobre azúcar refinado de grande tamaño producido en Sud-Africa. Dispositivos sencillos se describen que han dado resultados comparables con ellos de equipos más grande y que permiten la medida rápida y sencilla de la perdida de agua y potencial para endurecimiento, Los ensayos demuestran que condicionamiento sobre un período de 72 horas producen resultados saisfactorios y han formado el base del diseño de la planta para condicionamiento construido a la refinería de Durban.

Swedish Sugar Company celebrates 75th year of operations

By SVANTE WRAMSTEDT

Following the initial stage of development which began about 1850, the Swedish beet sugar industry experienced a period of growth during the 1880's and 90's. A large number of sugar factories were built during these years, most of them in Scania, although some were established in other parts of southern Sweden. Refining companies that had been in existence for some time participated in many of the new sugar companies as financial partners and as purchasers of raw sugar.

Development generated a degree of over-capacity, with accompanying competition for customers as well as for growers. The idea of some type of amalgamation therefore arose around the turn of the century and resulted in the establishment of the Swedish Sugar Company (Svenska Sockerfabriks AB) in August, 1907.

At the time of its establishment, SSA was the largest industrial firm in Sweden, with a share capital of SEK 135 million. The company owned 10 refineries, 21 beet sugar factories and 4 juice stations. Only three of the Swedish sugar factories were not included in the new company, and these were in fact acquired later, in 1936.

A programme of structural rationalization was initiated immediately following the formation of the company in 1907.

By 1920, five of the ten refineries had been shut down. The pace of rationalization slowed during the next two decades, but increased again around 1940. Comprehensive changes in the organization of the sugar factories occurred between 1940 and 1967. Since the latter year, the Swedish Sugar Company has operated six white sugar factories, one raw sugar factory and one refinery. This mix of production facilities enables the company to meet the total Swedish demand for sugar of about 340,000 tons. Of this amount, slightly over 90% is made from sugar beet, while the rest is imported as raw sugar. By-products such as molasses and beet pulp are used to make animal feeds.

From the very start in 1907, the Sugar Company's activities covered more than simply production and sale of sugar. The farms owned by several of the companies which participated in the amalgamation were included in the new company and operated as a special agricultural section.

There was a great deal of interest in production of good beet seed, which in 1912 resulted in the formation of a special seed section. This section was established at the small farm of Hilleshög and developed vigorously into the present Hilleshög AB, an extensive international operation for production and sale of sugar beet seed. In recent years, Hilleshög has gone in for breeding of forest trees and other types of plants.

Manufacture and sale of other products was started in the 1940's. Dextran had been discovered, and the company began production of raw dextran. Intensified research in organic chemistry and biotechnology generated new processes and products, of which several have been exploited successfully.

In the early 1960's, the company entered other sectors of the food industry. A centralized potato-growing operation was started with the aim of delivering quality potatoes to households on the basis of rationalized growing methods, transport and storage. The Felix canning company was acquired, and developed during the 1960's into one of the industry leaders. These operations have since been sold.

The Stockholm refinery was discontinued in 1956. On the centrally located site of the refinery, the company erected a number of office buildings and blocks of flats and thus entered a new field of operations, i.e. real-estate management. These buildings were sold some years ago, but the real-estate management section still operates as a separate company with holdings acquired in recent years.

In 1968, it was decided that the time had come to reorganize the sugar company and its various branches of operations. The investment company AB Cardo was established, and the branches of operations which did not have a direct connexion with sugar production were organized as separate companies. Cardo, the parent company, thus became the owner of several subsidiaries:

- Sockerbolaget (the Swedish Sugar Company): production and sale of sugar
- Hilleshög AB: seed production and plant breeding
- AB Sorigona: production of dextran, tryptophane, etc., engineering of water purification plants, biotechnology processes, etc.
- Säbyholms Jordbruks AB (Säbyholm Farms): agricultural operations
- AB Tanto: real-estate management
- AB Felix (subsequently sold).

Cardo is also extremely active in the field of financial management and has a comprehensive portfolio of listed shares.

In recent years, the company has acquired the plant breeding company W. Weibull AB, as well as a 60% holding in Finans AB Cartos, a finance company. Both of these companies have been integrated in the Cardo Group.

AB Cardo has a share capital of SEK 415 million. The company's shares are listed on the Swedish Stock Exchange and are distributed among approximately 26,000 shareholders. The Cardo Group had a turnover of SEK 2,419 million in 1981. Group personnel total 5,051, of whom 770 are employed outside of Sweden.

The history of the Swedish Sugar Company and the Cardo Group is described in a book commemorating the 75th anniversary of the company. An English version of the book is scheduled for publication early in 1983 and may be ordered from AB Cardo, Information Department, Box 17050, S-200 10 Malmö, Sweden. Tel. Int + 46 40 736 40.

SUGAR CANE AGRONOMY

Growth behaviour and quality of unharvested mature sugar cane. S. N. Pandit and A. K. Sinha. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.81-Ag.90. Two-year investigations on the growth behaviour and calculated sugar recovery pattern of unharvested mature cane left standing in the field until the next crushing season showed that the mother shoots and their late suckers continued to gain in height and weight. After an initial fall, the juice quality of the mother shoots recovered while that of the late suckers continued to improve. By the start of the next season, the juice was comparable in quality to that in normal ratoons.

Studies on crop logging of sugar cane in north India. C. V. Raghavaiah, P. P. Singh and N. S. Murthy. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.91-Ag.101. — Three cane varieties were logged for foliar N and leaf sheath moisture at 1-month intervals from 90 days after planting. Results showed a decrease in both parameters with age of crop, a significant positive correlation between foliar N and yield during the major growth period and a significant negative correlation between the two parameters during the ripening period. Sheath moisture was negatively correlated with yield at the ripening stage but was positively correlated with foliar N.

Further studies on improving productivity of a stubble crop in low-temperature areas of north India. R. S. Kanwar and H. Kaur. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.103-Ag.109. — Field experiments are reported in which the effects of various mulches, fungicides and ripeners on ratoon yield were studied. Best results were given by use of a polyethylene mulch, spraying with 0.25% Emisan fungicide and treatment with 500 ppm Ethrel. A significant increase in yield also followed application of 225:75:200 kg.ha^{-1} N:P:K.

Yield and quality components associated with early maturity in sugar cane. G. S. C. Rao and A. T. Yaragattikar. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.111-Ag.122. — Investigations of yield and quality parameters in an early maturing and a late maturing cane variety indicated that early ripening is a result of early fall in moisture content and non-sugars rather than increased sugar accumulation or sucrose synthesis.

Recent advances in sugar cane research in Andhra Pradesh (a review). K. K. P. Rao. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Ag.123-Ag.144. — A survey is presented of the more important results of cane research conducted in Andhra Pradesh during 1968-78.

Growth rates of Florida sugar cane during seven growing seasons. G. Kidder and E. R. Rice. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 8-11. — Cane heights were measured at weekly intervals from April to October, inclusive, at Canal Point, Florida, during each of seven years in the period 1968-75, omitting 1972. Results showed that the plants grew most rapidly from mid-June to early July, averaging a maximum of 15 cm per week. The rates then fell almost linearly from July to October, when measurements were discontinued; the value for late October averaged 8 cm/week. Average height in October was 2.8 m, representing an average growth rate of 9 cm/week during the grand growth period. The five varieties tested showed different growth rates, but all had the same general pattern of growth.

The relationship between the nitrogen content of medium-coarse to medium-fine textured soils and yield response of stubble sugar cane to fertilizer nitrogen. L. E. Golden. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 12-15. — Increases in yield of ratoon cane due to fertilizer N were determined by comparing the results with those for untreated controls at 38 locations; the tests were conducted at various years extending from 1958 to 1971 and involved a number of cane varieties grown on various types of soil ranging from medium-coarse to medium-fine in texture. The mean yield from control plots was 21.49 tons.acre^{-1}, and the mean increase in yield due to fertilizer N 6.95 tons.acre^{-1}; the mean N content of topsoil was 0.092%. Relatively low N contents were found in the coarser soils by comparison with the fine soils. A statistically significant positive correlation was obtained between topsoil N and yield response to fertilizer N, while correlations between topsoil N and cane yield in the control plots and in the treated plots were non-significant. The relatively low yields from control plots on the finer soils were apparently due, in part, to low oxygen contents and poor root development in the subsoil.

The effect of planting date on yield and its components of sugar cane in the Lower Rio Grande Valley of Texas. S. A. Reeves. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 20-24. — Comparison was made of yields of cane planted in November, December, February and March in 1975-76 and in October, February, March and April in 1976-77. Five varieties were involved. Results showed that, generally, the yields from cane planted in the earliest month in each experiment were higher than those of cane planted in the later months, indicating the advantage of autumn planting; substantial falls in yield followed planting later than February.

The comparative effects of pre-emergence herbicides used in plant cane in Louisiana. E. R. Stamper. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 25-26. — The effect of herbicide treatment on cane and sugar yield was determined during 1974-78 at various locations and with different cane varieties. Results showed that all five herbicides increased yield by comparison with the untreated control, there being no essential difference between the values given by Sinbar at 2/3 lb.acre^{-1}, Fenac at 1 pt.acre^{-1} + Silvex at 1 lb.acre^{-1}, Spike at ¾ lb.acre^{-1}, Sencor at 1½ lb.acre^{-1}, Velpar at ½ lb.acre^{-1} and Sinbar at ½ lb.acre^{-1} + Fenac at ½ pt.acre^{-1}.

A brief introduction to the Linbian-Lili river bed development project. L. M. Sing. *Taiwan Sugar,* 1981, **28,** 198-201. — An account is presented of the title land reclamation project which took some 5½ years to complete and which has made available 1132 ha of cultivable land for cane growing. The land is divided into blocks of 16-24 ha, with farm roads around each block; irrigation and drainage ditches have been dug, irrigation water being supplied by deep wells. Photographs illustrate the construction work and some of the results.

SUGAR BEET AGRONOMY

New approaches to location-specific nitrogen fertilization of sugar beet. II. Mineral nitrogen content (N_{min}) of the soil – results of a survey combined with nitrogen trials. A. von Müller and D. Merkel. *Zuckerind.*, 1981, **106,** 1084-1093 *(German).* – Trials are reported in which increasing dosages of N were applied to soil in the beet-growing area of Lower Saxony (North Germany); the 120 trials were associated with a survey of some 1000 beet fields carried out in the region during 1976-80, and were aimed at establishing how much mineral N in the spring (soil N + fertilizer N) would bring the highest gross return, allowing for costs of the fertilizer. Results of the experiments are discussed.

Herbicides in sugar beet agriculture. J. Kositorna. *Gaz. Cukr.*, 1981, **89,** 129-130 *(Polish).* – Advice is given on best herbicides for control of various specific dicotyledons and grasses in beet fields.

Results of trials in Belgium, 1980, on destruction of weed beets using an electric charge. A. Vigoureux, T. Vreven and P. Engles. *Publ. Trimest. Inst. Belge Amél. Betterave,* 1981, **49,** 45-56 *(French, Dutch).* – Trials are reported in which a Lasco electric discharge system for weed control was applied to bolted beet. Results, although promising, were inconclusive, so that trials were to be repeated in 1981. The experiments were carried out in mid-July, when the soil was too wet and the forward speed of the tractor too high. Where the population of bolters was very high (more than 18,000 per ha) complete destruction was low at 29%; where the number was 3000, 80% and 92% of the bolters were completely destroyed in two fields. The need to destroy all the side stems, so at to prevent production of viable seed, is stressed. A voltage of about 10,000 and a current of 5 amp is considered necessary. The electrode should precede the tractor, and 12 rows should be treated at a time under Belgian conditions (6 rows where there is heavy infestation). There should be modifications to the electrode, to allow sufficient time of contact with the bolter, and to the discs acting as weights, so that they can penetrate the top 7-10 cm of soil.

Quality beet – an economic necessity for growers and the sugar industry. W. C. von Kessel. *Zuckerind.*, 1982, **107,** 29-31 *(German).* – The desirable properties of a high-quality beet in regard to processing are listed, and indications given of the increased costs resulting from negative factors, including falls in quality parameters and practices that are necessary to counter adverse factors.

Beet storage on the farm under UK conditions. J. F. T. Oldfield, M. Shore, J. V. Dutton and B. J. Houghton. *Sucr. Belge,* 1981, **100,** 423-431. – After a brief description of the climatic conditions and their effect on beet harvesting and clamping in the UK, the authors discuss types of clamp used, length of beet storage, frost protection and storage losses. The extreme effects of temperature on beet losses (through over-heating of the clamped beets in mild weather and through frosting in cold weather) are stressed.

Soil treatment and structure. R. Vanstallen. *Le Betteravier,* 1982, **16,** (160), 15-16 *(French).* – The adverse effect on growth of the beet taproot of soil compaction and how to avoid it are discussed. Advice is given on seedbed preparation according to type of soil.

The optimum nitrogen dose for beet. R. Vanstallen. *Le Betteravier,* 1982, **16,** (160), 16-17 *(French).* – How to determine the optimum N dosage rate, the role played by liquid and farmyard manure, and results of nitrogen trials in Belgium are discussed.

N_{min} in beet fields and N fertilizer requirement. Results of a 1976-80 survey. A. von Müller. *Die Zuckerrübe,* 1982, **31,** 20-22 *(German).* – The mineral N content in soil layers of 0-30, 30-60 and 60-90 cm depth was determined in 1000 beet fields in West Germany during 1976-80. The values and their bearing on the N fertilizer requirement are discussed. Eight types of soil were involved.

Bolting of sugar beet. K. Lexander. *Die Zuckerrübe,* 1982, **31,** 24-26 *(German).* – A representative of the Swedish beet breeding firm, Hilleshög AB, describes the conditions of temperature and light that favour bolting of both annual and biennial beets, and the interaction of these environmental factors and genetic factors. The processes occurring in the bolting beet are explained, although it is stressed that little is known about which processes are affected by the environmental factors so as to cause a change in the growth pattern. Means of reducing the incidence of bolting through the activities of the beet breeder and the seed producer are described.

Recent knowledge on the value of liquid manure. Anon. *Die Zuckerrübe,* 1982, **31,** 26 *(German).* – Aspects of the value of liquid manure are briefly discussed. While only 50% of the N content is available to the plant (essentially in ammonium form), the use of an anti-nitrification additive will help to improve this. The source of the manure will determine the inorganic and organic P contents; inorganic phosphate is comparable to mineral phosphate as a fertilizer, while organic phosphate is only sparingly soluble and hence not readily available. On the other hand, K in liquid manure is highly soluble in water and is comparable to mineral fertilizer. Excessive application of liquid manure adversely affects the earthworm population.

Economical weed control in sugar beet. J. M. Belien and J. F. Salembier. *Le Betteravier,* 1982, **16,** (161), 18-19 *(French).* – Pre-sowing and pre- and post-emergence herbicide efficiencies and costs are indicated, and examples given of economical weed control programs.

Results from low-dose herbicide trials. T. Breay. *British Sugar Beet Rev.,* 1982, **50,** (1), 7-9. – Trials, in which 60 or 80 litres. ha^{-1} Betanal E or Goltix post-emergence herbicides were applied instead of the normal 240 litres.ha^{-1} dosage rate, showed that the level of weed control was lower than with the full dose, but two 80 litres.ha^{-1} treatments gave a higher level of control with better crop vigour than did a single application of 240 litres.ha^{-1}. Best results were obtained by spraying when

the weeds were small. Spraying at 72 psi gave reliable results; this pressure compares with one of 30 psi for normal doses.

New post-emergence herbicides to control grass weeds in sugar beet. T. Breay. *British Sugar Beet Rev.,* 1982, **50,** (1), 9, 11. — A brief account is given of trials on grass weed control with Hoegrass, Clout and Fusilade herbicides. The first has proved effective against wild oats and black grass, the second against wild oats and couch grass, and the third against a number of annual and perennial grasses, including couch grass. Results with Clout have been variable, sometimes because of too early an application.

Low-volume applications in Northern Region. A. Kennedy. *British Sugar Beet Rev.,* 1982, **50,** (1), 11-12. The author confirms the benefits of applying post-emergence herbicides at lower-than-normal dosage rates. He considers a pressure in the range 50-75 psi to be suitable.

The Southern Region experience. K. Matthews. *British Sugar Beet Rev.,* 1982, **50,** (1), 12-13. — High-pressure application of herbicides at low dosage rates (using smaller nozzles) has proved to be safer as regards the beet crop than application of standard doses at lower pressures. Mention is made of a pressure of 90 psi used to spray 4 ha per hour.

Weed-free crops — a continuous battle. R. Dunicliff. *British Sugar Beet Rev.,* 1982, **50,** (1), 13, 17. — High-pressure, low-volume spraying has the advantage over band spraying of allowing the farmer to cover all of his beet area quicker, while the cost of using one-third of the normal dosage rate is approximately equal to that of band spraying. Disadvantages include the need to fit new nozzles, the difficulties of achieving the required pressures with some sprayer pumps and inability of pipework on some sprayers to withstand the high pressures.

ADAS experience. R. Madge. *British Sugar Beet Rev.,* 1982, **50,** (1), 17, 21-23. — Trials at sites operated by the Agricultural Development & Advisory Service (ADAS) showed that repeated low-volume spraying of herbicides at normal pressure (30 psi) is as reliable a method of weed control as any other method, but timing is the decisive factor, since the weeds must be sprayed when small. The economics are discussed.

A grower's experience. M. Boydell. *British Sugar Beet Rev.,* 1982, **50,** (1), 23. — Results obtained with low-dose application of Betanal E post-emergence herbicide at 100 psi are reported; three applications gave excellent weed control, and the method is cost-effective. However, timing, accuracy and speed are decisive factors.

Some conclusions from the 1981 WRO experiments on high-pressure applications and repeated low doses of Betanal E and Goltix. M. May. *British Sugar Beet Rev.,* 1982, **50,** (1), 24, 26, 28. — Trials conducted by the Weed Research Organization showed that repeated low doses of the title post-emergence herbicides generally performed as well as or better than herbicides applied in full doses. Use of high pressures sometimes gave better control than low-pressure application, but may involve a risk of reducing selectivity between crop and weeds, and some yield reductions were observed when high pressures were used in a stress-affected crop. Studies showed that sugar beet can retain more herbicides per g dry weight of foliage than most annual weeds, particularly with high-pressure spraying.

Sugar beet weed control. W. Bray. *British Sugar Beet Rev.,* 1982, **50,** (1), 29, 32-34. — Chemical weed control recommendations are given, with tabulated details of herbicides available for use in the UK.

Weighing up transplanted sugar beet. R. Wickens. *British Sugar Beet Rev.,* 1982, **50,** (1), 59-63. — Field experiments are reported in which an increase of 1.5-2.0 tonnes.ha^{-1} in beet yield resulted from transplanting of seedlings by comparison with sowing of seed. However, the economics have yet to be evaluated, and the practical aspects of transplanting examined.

Weed beet survey. G. Maughan. *British Sugar Beet Rev.,* 1982, **50,** (1), 68-69. — In a brief survey of the incidence of misplaced seedlings and/or bolters in UK fields, the author finds it disappointing that insufficient attention is being focused on the problem by farmers; in 42% of fields affected, no attempt was made to control weed beet.

Time and method of nitrogen application: a review of recent trials. P. Draycott, P. Last, J. Webb and M. Palmer. *British Sugar Beet Rev.,* 1982, **50,** (1), 73-76. — Trials at various locations are reported, which showed that no more than 125 kg.ha^{-1} N should be applied. Application should be made in one dose (using a special applicator) immediately after drilling if possible, or 40 kg.ha^{-1} broadcast immediately after drilling and the rest broadcast when establishment is complete, normally no later than the end of May.

Soil erosion — a timebomb for our beet operations? W. C. von Kessel. *Die Zuckerrübe,* 1982, **31,** 56-59, 62 *(German).* — The harmful effects of water erosion, wind erosion and "technical" erosion (soil loss caused by excessive removal with the beet) on beet field operations, particularly harvesting, and hence on yield losses are discussed and means of reducing it described. The economic effects are also estimated.

Weed control in Schleswig-Holstein sugar beet. B. Holm. *Die Zuckerrübe,* 1982, **31,** 64-65 *(German).* — Problem weeds occurring in beet fields in the title area of North Germany are discussed and means used for their control described.

Sugar beet agriculture and problems of field perimeter fertilization. U. Schünke. *Die Zuckerrübe,* 1982, **31,** 66-68 *(German).* — The effect of lack of precision in fertilizer distribution, whereby some of the fertilizer will be scattered over soil outside the beet crop area (at the edges of fields or plots), on beet yield is discussed. The causes of the non-uniformity and ways of preventing it are indicated.

Soil preparation and tillage in areas liable to erosion. A. van der Beek and A. Stroppel. *Die Zuckerrübe,* 1982, **31,** 100-102 *(German).* — It is emphasized that soil erosion caused by wind and rain are often a result of intensive agriculture, particularly where crops, such as beet and corn, provide shade only late in the season. Where there is high risk of erosion, the practices used for soil preparation must involve a certain amount of conservation work, even if this results in reduced yields and higher costs. The subject is discussed, and some results of comparative tests are reported.

BEET PESTS AND DISEASES

Laboratory evaluation of some modern insecticides against the hairy caterpillar, *Diacrisia obliqua* Walker infesting sugar beet *(Beta vulgaris).* R. K. Tewari, O. Prakash and O. P. Singh. *Indian Sugar Crops J.*, 1980, **7**, 88-89. — The title pest has been discovered causing maximum damage to beet foliage in early December and between late February and April at the Indian Institute of Sugarcane Research, Lucknow. Ultimately, the entire leaf is skeletonized by the larvae, the later stages of which migrate from plant to plant. Eleven insecticides were tested in their action on 2nd instar larvae in petri dishes, and four of them (Volaton, Quinalphos, Phosalone and Monocrotophos) found to cause 100% mortality within 24 hours, and another two (Endosulfan and Dipterex) 100% mortality within 48 hours; the 0.3% concentrations were sprayed in 1-ml doses each.

New methods of protecting monogerm sugar beet. M. Kubacka-Szmidtgal. *Gaz. Cukr.*, 1981, **89**, 35-38 *(Polish).* — Results are given of trials conducted at six locations during 1975-79 involving granular systemic and contact insecticides added to the soil at beet sowing.

Scanning electron microscope examination of sugar beet flowers and fruits infected with *Phoma betae*. H. El-Nashaar and W. M. Bugbee. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 11-22. — *P. betae* is the only important seedborne fungal pathogen of sugar beet; it can survive in the soil for at least 26 months after planting of the beet crop, and a high percentage of seed may become infected in regions of adequate rainfall. Seedlings from infected seed may fail to emerge or die after emergence, while those that survive are stunted and show retardation of growth until warm weather permits recovery. The fungus attacks almost every part of the beet and is spread over great distances by seed dissemination. The present work, which includes a number of electron photomicrographs, was aimed at gaining more knowledge on the process by which both the flower and the fruit become infected. The results showed that the fungus was associated with the inner fruit wall to a far greater extent than other fungi, and little was recovered from the seed coat, indicating that either it invades first or has a competitive advantage over other saprophytes. The significance of the findings for possible control of the disease is indicated.

Relative effectiveness of soil-applied granular insecticides on spinach carrion beetle. Y. M. Yun and M. B. Spaur. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 23-26. The title pest, *Silpha bituberosa,* causes sporadic damage to beets in one area of northern Wyoming, and experiments were carried out to evaluate three insecticides extensively used by local beet growers, since there is currently no chemical registered for control of the beetle. Results showed that Carbofuran was highly effective against the pest, while Temik and Terbufos had virtually no effect whatsoever.

Control of Cercospora leaf spot and Rhizoctonia crown rot diseases of sugar beet with fungicides applied by sprinkler irrigation. H. S. Potter and C. L. Schneider. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 50-55. Tests are reported on application of fungicides through a sprinkler system as a means of controlling leaf spot (caused by *Cercospora beticola)* and crown rot (caused by *Rhizoctonia solani).* Each of eight fungicides applied for control of leaf spot significantly reduced disease severity to below that of the untreated control; the degree of control was as good as or better than that obtained in concurrent tests with conventional spray equipment. Crown rot incidence was significantly reduced by separate sprinkler application of two of the fungicides, Chlorothalonil and triphenyltin hydroxide, a result which was comparable to that obtained with conventional spray equipment. Advantages of sprinkler application are given as: more uniform coverage, particularly on the lower plant canopy and on the undersides of leaves; lower costs; and lower energy consumption.

Directed spraying of the beet crop. T. Strouthopoulos. *Hellenic Sugar Ind. Quarterly Bull.*, 1981, (46), 503-510 *(Greek).* — *Cercospora beticola* (leaf spot) is the major beet disease in Greece, although spraying with a fungicide such as Benomyl has proved effective in its control. Advice is given on spraying to achieve maximum economical effect without risk to livestock and humans.

Rhizomania — a new disease of sugar beet. M. Kubacka-Szmidtgal. *Gaz. Cukr.*, 1981, **89**, 93-94 *(Polish).* — Brief mention is made of a disease caused by soil-borne spores of the fungus *Polymyxa betae,* which manifests itself in the form of a tangled mass of lateral rootlets growing over the entire surface of the root. Control means are described.

Productivity of sugar beet with varying degree of resistance to virus infection. V. Rimsa, J. Polak, J. Chod and M. Jilkova. *Listy Cukr.*, 1981, **97**, 247-249 *(Czech).* Field trials were conducted with multigerm selective material and a monogerm x multigerm hybrid to determine their tolerance of a mixture of beet yellows virus, beet mosaic virus and beet western yellows virus; the variety Dobrovicka A was used as standard. Results showed that the multigerm material suffered a 41-47% loss in root and sugar yield and the hybrid 39-43% loss when infection occurred in the early growth stages (1st and 2nd pairs of true leaves); the standard suffered a loss of 60%. The high tolerance of the hybrid was attributed to inheritance of this property from its multigerm parent.

Fusarium stalk blight resistance in sugar beet. J. S. McFarlane. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 175-183. — Crops of seed beet grown in the Willamette Valley in Oregon are frequently found to be severely damaged by stalk blight caused by *Fusarium oxysporum* f. sp. *betae,* although a wide span of reactions occurs among breeding lines, ranging from absence of injury to death of all plants. The partially inbred lines 562 and 563, extensively used as parents in commercial hybrid varieties, are susceptible to the disease; however, a resistant selection is reported that resulted from the 563 line. Resistance was found to be dominant. No close correlation was found between susceptibility to stalk blight and monogermity. Resistance is controlled by more than one gene.

CANE SUGAR MANUFACTURE

A case study of hard scales and remedies. V. K. Verma, B. M. Kapoor and N. K. Sharma. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.1-Mg.9. — Steps taken to combat considerable evaporator scale formation at the authors' factory are described, including modifications to the clarification process and the use of softened water for imbibition, etc. The procedures used in scale removal are also described.

Buckau-Wolf SC-1100N continuous centrifugal with melting ring. R. L. Gupta and V. M. Tiwari. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.11-Mg.15. — A description is given of the title machine which is provided with a perforated coil for spraying hot water onto the low-grade sugar in the space between the basket and the outer casing; a pipe transfers the melt to a storage tank. The performance of the machine at the authors' factory, where it was installed during the 1977-78 season, is discussed.

A new design of continuous pan (Teevra). K. N. Agarwal. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.17-Mg. 37. — Details are given of a horizontal continuous pan designed by the author and tested at his factory on low-grade boiling. Tabulated performance data are discussed. Frequent fluctuations in vacuum prevented regular achievement of expected results.

Treatment of final massecuite — the technique of returning pre-spun molasses to reduce compaction on cooling. B. Chakravarty. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.39-Mg.54. — Tests are reported in which pre-spinning of massecuite taken from and the molasses returned to No. 4 in a continuous battery of six crystallizers helped to improve exhaustion through increased fluidity without the need for dilution with water before normal purging in the centrifugals. Comparison is made with reheating of massecuite as a means of reducing viscosity.

Current monitored control of a resistance heater. A new concept. K. S. G. Doss *et al. Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.55-Mg.59. — Resistance heater control based on increase in massecuite conductivity with temperature and hence increase in the heating current is described. When the heating current exceeds a given pre-set limit, it is automatically switched off so as to prevent overheating of the massecuite. Tests at a number of factories have shown that the system is successful in controlling the temperature of the massecuite on discharge within ± 0.3°C.

Studies on the use of flocculating agents during sugar cane juice clarification. XII. Settling studies with Magnafloc LT 26 and Magnafloc LT 27. S. Bose and L. Singh. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.61-Mg.69. — Comparison was made between the two title flocculants and Separan AP-30, showing that 4 ppm Magnafloc LT 26 gave greater mud volume with time up to 60 min, while Separan AP-30 gave the best overall performance.

Effect of lime and phosphate on the removal of iron in the clarification process. I. B. Adarakatti, G. Chakrapani, G. S. C. Rao and R. V. Vatnal. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.71-Mg.78. — Laboratory and factory tests were conducted on the use of lime and phosphate to remove iron from juice. Best results under factory conditions were obtained by liming to pH 9.5 and adding 300 ppm phosphate. No significant relationship was found between iron content and the colour of the clear juice.

S.M. separator. B. Lakshmanaswamy and K. Venkataratnam. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.79-Mg.82. — Tests conducted on continuous filtration of A massecuite, such as described by Thirel[1], are briefly reported, details being given of the resultant sugar appearance and purity and the total power consumption for a throughput of 2500 tcd. No information is given on the composition of the unfiltered massecuite.

The semi-Kestner — a study on its working and performance. R. K. Shukla. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.83-Mg.88. — The design and operation of a semi-Kestner evaporator are described and some results obtained with one of 9000 ft² h.s. installed at the author's factory are reported. The evaporator provides sufficient process steam by comparison with a shortage before its installation, permitting an increase in the crushing rate. There was no increase in inversion or caramelization, and entrainment did not occur.

Instant heating — the incredible aid for continuous centrifugal machines. K. S. R. Rao, K. Venkataratnam and O. B. Reddy. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.89-Mg.96. — Experience in the operation of Walkonti-6 and -8 continuous centrifugals (manufactured under licence from Hein, Lehmann AG) and KCP machines for low-grade massecuite is recounted, with particular mention of the benefits of the steam jacket incorporated.

Behaviour of major inorganic cations during cane juice clarification. G. Chakrapani, I. B. Adarakatti and R. V. Vatnal. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.97-Mg.112. — Investigations were conducted on the effects of clarification on K_2O, Na_2O, CaO and MgO in mixed juice. Results showed that only 6.4% of the 3515 mg.litre^{-1} of K_2O in the 15°Bx juice was removed, and only 3.5% of the 307.5 mg.litre^{-1} Na_2O, while MgO and CaO increased by 19.5% and 65.6%, respectively.

Economical use of aluminium-tube evaporator bodies to bring down the cleaning time. M. G. Joshi, H. R. Apte and P. B. Londhe. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.113-Mg.122. — The number of hours lost through the need for frequent removal of evaporator scale at Walchandnagar factory was considerably reduced by installing two extra effects provided with aluminium tubes. Details are given of the operation of the new effects, and costs are compared of (i) installation of a new single effect as standby for the 3rd or 4th effect, (ii) two new effects as standby for the existing 3rd and 4th effects, and (iii) a complete quadruple-effect evaporator as standby for the existing evaporator, with aluminium or brass tubes.

[1] *I.S.J.,* 1979, **81**, 293-296.

Correction for quality of cane in reduced mill extraction formula. N. G. Joshi and N. V. Thete. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.1-C.5. — Since one formula used to calculate the reduced mill extraction does not allow for variation in cane pol, a correction has been calculated on the basis of sugar factory observations. The resultant formula is:

$$\text{Corrected RME} = \text{actual RME} \left(\frac{93.125}{0.57 \text{ pol \% cane} + 86} \right).$$

Reduced mill extraction. New concepts. P. K. More. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.8-C.17. See *I.S.J.,* 1980, **82,** 253.

Performances. P. K. More. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.33-C.54. — Formulae are presented for evaluation of cane mill, clarifier and boiling house performances.

Advances in mill machinery in the 70's. J. R. Allen. *Australian Sugar J.,* 1981, **73,** (7), 391, 395. — Advances in the design and size of equipment used in Australian sugar factories are described. They include: larger locomotives used to haul cane trains, with a second, radio-controlled locomotive installed near the rear of the train to permit longer trains (an idea introduced by two sugar factories); modifications to chopped cane discharge from bins, with weighbridges incorporated in the tipping systems at some factories, and installations for simultaneous tipping of two cane trucks at several factories; more powerful shredders driven by turbines of up to 4500 kW installed power, knife sets being removed in many cases because all the cane handled is chopped; new mill feeding devices such as the CSR toothed feeder, with up-rating of existing feeders by provision of auxiliary under-feed rollers and larger feed chutes; higher crushing speeds and replacement of reciprocating engines as mill drives with more powerful turbines, the introduction of larger mills and the provision of roller bearings to reduce power requirements; installation of suspension fired type of boilers of higher steam capacity, with provision for cane of varying fibre content; increase in the size of power generating equipment, with greater emphasis on electrical load control; the highly efficient SRI clarifier; the direct vapour contact juice heater; larger multiple-effect evaporators, some of 4200 m^2 h.s. and provided with stainless steel tubes and internal water condensers; larger vacuum pans, of up to 164 m^3 capacity, automatic control of boiling house operations and introduction of continuous boiling; continuous centrifugals, and pre-treatment of highly viscous massecuites; automatic control of raw sugar conditioning for shipment; and use of dextranase to reduce cane deterioration.

Corrosion in the sugar factory. S. J. Clarke and D. F. Day. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 88-92. — Types of corrosion, means of its prevention and sites in the factory where it is most likely to occur are discussed, and evaporator and cane wash table corrosion considered in greater detail.

Observations on the Louisiana core samplers. H. S. Birkett. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 93-95. Questionnaires were sent together with core samplers to seven sugar factories. The answers to the questions are summarized, generally indicating advantages of the system over previous sampling methods.

Maintenance standards for sugar mills. L. Mann. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 96-99. — The benefits of maintenance standards and how they are implemented are discussed.

Development of an effective chemical cleaning procedure for steam/vapour side fouling in heat transfer equipment. P. R. Arellano, J. C. P. Chen and J. S. Rauh. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 107 *(abstract only).* Scale deposition on heat transfer surfaces, especially evaporator tubes, can directly affect operating efficiencies and thus have a direct impact on operating costs in sugar production. Field studies and evaluations of chemical inhibitors and chemical cleaning procedures for controlling or removing scale deposits have been the subject of many technical articles and presentations. The bulk of this information has been involved solely with scale deposition on the juice side. This paper discusses the importance of scale deposition and steam/vapour side fouling in relation to the overall efficiency of evaporators and other heat transfer equipment. Steam/vapour side fouling is detailed in information covering its causes, sources of contaminants in deposits, and a review of prior methods tested in attempts to remove such deposits. Also covered is the development of a chemical cleaning procedure from laboratory evaluations to an actual Florida factory application.

A computer simulation study of multiple-effect evaporator control systems. C. Wang and A. E. Johnson. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 108 *(abstract only).* A digital computer model was developed for simulation of multiple-effect evaporators and their control systems. A primary interest in the development of the model was to provide for study of systems in which vapour bleeds are removed from one or more evaporator bodies to supply low-cost heat for other factory equipment. In addition, the computer model was to be flexible and easily modifiable for studying a variety of evaporator configurations and control system arrangements. After verification of the computer model by comparing its output with steady-state evaporator design results and with expected dynamic behaviour of commercial evaporator systems, a series of case studies were performed to study the effectiveness of conventional control systems in the face of varying vapour bleed demands and other system disturbances. The objective of these studies was to try to identify those situations and configurations which do not provide satisfactory performances. This paper presents in graphical form the results of the studies carried out to date, which consist of six different commercial designs, involving various combinations of total number of bodies, number and quantity of vapour bleed streams, and conventional control system arrangements. Some of the conclusions discussed are: (1) systems with pre-evaporators control the pressure of the vapour bleed stream best; (2) whenever too large a vapour bleed stream is removed from the pre-evaporator, the system cannot respond well to large feed rate changes; (3) whenever vapour bleed demands vary (such as the demand from vacuum pans), substantial make-up exhaust steam control action is required even with a pre-evaporator. These and other conclusions and observations are presented. Future studies are planned to test modifications and innovations to conventional control systems designed to improve the control system performance of evaporator systems providing vapour bleed streams.

Possibilities of Indian sugar factories co-generating electric power as in Hawaii. P. J. M. Rao. *Indian Sugar,* 1981, **31,** 163-170. — See *I.S.J.,* 1982, **84,** 343.

BEET SUGAR MANUFACTURE

Mechanical and technological possibilities of improving pulp pressing. J. Ehrenberg. *Zuckerind.*, 1981, **106**, 968-971, 980-981 *(German).* – The influence of cossette quality and diffusion conditions on pulp pressability is discussed, and mention made of experiments to study the effects of applied pressure and time on the performance of a laboratory press. Results showed that increase in pressure above 2 bar at a constant time of 20 min (the usual maximum in sugar factories) gave no further increase in dry solids content, whereas increase in time at constant pressure did have a positive effect. Application of these findings to design of a new press is indicated. Since low pressure applied over a very short period removes large quantities of water and squeezes out the air, pulp feed shafts are used for so-called "predewatering"; thus, advantage is taken of the natural prepressing that takes place between pulp entry into the shaft and entry into the press. The reduction in specific volume benefits the receiving capacity of the press, and the separately driven feed device (rotating faster than the press scrolls) forms an integral unit with the press. Other possible means of improving pulp pressing are outlined.

The new generation of Salzgitter pulp presses. G. Lampe. *Zuckerind.*, 1981, **106**, 971-975, 980-981 *(German).* The fundamentals of pulp pressing are briefly examined, and the question of high *vs.* low pressure application discussed. The HP 1800 vertical press is described and details given of its performance since its introduction as a prototype at Wevelinghoven factory. A horizontal version of the press has also been manufactured and was installed at Farsum factory for operation in the 1981/82 campaign. Advantages of both presses are listed. Subjection of pulp to a first pressing, followed by addition of $CaCl_2$ and 3.4% molasses (on beet) and then a second pressing, increased the dry solids content considerably by comparison with only one pressing without additive. At a scroll shaft speed of 0.85 rpm (equivalent to a daily throughput of 1600 tonnes of beet), the average final dry solids was 36.3%; at 1.14 rpm shaft speed it was 33.2%. These values compare with 24% after the first pressing.

Use of chemical aids for pressing. D. Bollmann. *Zuckerind.*, 1981, **106**, 978-981 *(German).* – Advantages and disadvantages of calcium chloride, aluminium sulphate and calcium bisulphite as additives for beet pulp pressing are listed, and experiments with them are reported. While aluminium sulphate gave good results, was simple to use (although vessels and pipelines carrying it must be acid-proof) and cheap (the amount needed was less than that of $CaCl_2$ to achieve the same results), its use is forbidden under West German laws governing animal fodder. Calcium bisulphite gave good results and had such good properties as a disinfectant that no formalin was required in diffusion; however, it is not cheap, requires elaborate preparation and gives risk of incrustation. Calcium chloride gave good results, was easy to handle and cheap, but the large quantity of Cl^- ions passing into the raw juice increases molasses formation while also causing corrosion of high-grade steel. Further tests were to be carried out with calcium bisulphite.

Mathematical formulation and digital simulation of an evaporator in the beet sugar industry. M. Mäkelä. *Zuckerind.*, 1981, **106**, 989-993 *(German).* – After a brief description of a typical multiple-effect evaporator and control of juice level, input, Brix and condensate level and quality, a mathematical model is presented for calculation of enthalpy, Brix and mass balances as a means of evaluating the dynamic behaviour of an evaporator. A simulation program applied to the evaporator at Turenki sugar factory in Finland was based on pressure in the calandria and vapour space, juice Brix after each effect, juice temperature after the preheaters and beet throughput (weekly averages). While the program pertained to stationary conditions, it gave values in close agreement with practical results provided there was only slight deviation from the static conditions; with greater divergency, there was considerable difference between the two sets of results. Brief mention is made of use of LiCl tracer to establish the juice residence time in the last three effects.

Use of sodium sulphite for treatment of yellow sugar remelt liquors. A. P. Kozyavkin, N. I. Odorod'ko and L. D. Bobrovnik. *Sakhar. Prom.*, 1981, (11), 21-25 *(Russian).* – Investigations were carried out to determine the optimum quantity of sodium sulphite required for treatment of 65°Bx remelt liquors from sugar of 94-99 purity after filtration with kieselguhr. The liquors were heated to 80°C and held at this temperature for a period that was governed by the amount of sulphite added in the range 0.01-0.10%; in turn, this was dependent on the composition of non-sugars, including colouring matter, and had maximum effect at pH_{80} 7.40-7.85. An empirical formula was obtained on the basis of the results. Confirmation of the effectiveness of sodium sulphite was given by the reduction in colour, ash and turbidity of white sugar solutions (of purity > 99) when up to 0.003% Na_2SO_3 on weight of beet was added to remelt liquor.

Modernization of trough-type beet washers in sugar factories. A. D. Baglyuk. *Sakhar. Prom.*, 1981, (11), 37-38 *(Russian).* – Modifications to beet washers briefly described include the application of vibratory means, heightening of the walls and installation of screens. They are intended to prevent blockage of the transfer weir grids with impurities as they accumulate in quiescent water and overflow. The use of treated flume-wash water instead of fresh water is also recommended.

Theory and practice of beet juice purification. V. Tibensky, M. Konecna and V. Slama. *Listy Cukr.*, 1981, **97**, 243-246 *(Czech).* – In a discussion of the theory of raw juice treatment, the authors first examine the behaviour of colloids in an electric field, particularly their electrophoretic mobility under the effect of pH. The action of lime in inducing coagulation is described; while coagulation requires alkaline conditions, de-esterification of pectin requires neutral or even slightly acid conditions. The benefits of progressive preliming are discussed and ways of achieving optimum mud structure indicated, including recycling of carbonatation mud as one form of coagulation nucleus. The question of optimum 1st carbonatation pH, especially under conditions of the

simultaneous process, and the effect of preliming performance on carbonatation mud particle flocculation are examined.

Renovation of worn-out centrifugal baskets. Z. Tubl. *Listy Cukr.*, 1981, **97**, 253-256 *(Czech)*. – Metal fatigue, under the effects of corrosion and erosion, ultimately leads to formation of hairline cracks at the edges of the perforations in centrifugal baskets; eventually they could extend to form one large crack and result in complete destruction of the basket. The author describes how such worn-out baskets can be repaired and given a completely new life.

An analysis of root damage during piling. C. L. Peterson, E. R. Muller, M. C. Hall and J. C. Thompson. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 136-149. – Studies are reported which showed a significant increase in root damage as beets were piled with conventional equipment, particularly as a result of long drops. Modifications to the sampling procedures for tare determination would, it is suggested, reduce the extent of damage as well as increase piling efficiency.

Effects of lime on the chemistry of sugar beet tissue. W. M. Camirand, J. M. Randall, E. M. Zaragosa and H. Heuman. *J. Amer. Soc. Sugar Beet Tech.*, 1981, **21**, 159-174. – Pre-treatment of beet with lime could reduce energy consumption in the beet sugar factory as a result of better pulp pressing properties and lower diffusion temperatures required (since the beet cells will already be denatured and the high pH prevents fermentation at reduced temperatures). Studies showed that addition of $Ca(OH)_2$ at 40°C or lower caused demethylation and deacetylation of the pectin in the cell walls, allowing Ca^{++} to cross-link the pectin as a stable insoluble matrix. Pectin retention in the pulp was increased by liming, as indicated by a 10-30% increase in pulp solids. Although extraction rates were substantially reduced by liming, total sugar yield from cossettes should be greater than with conventional diffusion because of the increase in press water yield under the same conditions of pressing. Since the hydrodynamic resistance is lower than for normal cossettes, thinner cossettes could be used.

The expansion of Groningen sugar factory from 7800 to 11,800 tonnes/day beet slice. H. Wunsch. *Zuckerind.*, 1981, **106**, 1071-1075 *(German)*. – Details are given of the stages of expansion of the title Dutch sugar factory over the four years 1977, 1978, 1979 and 1980, and information is given on the equipment of the more important process stations.

Official opening of Groningen sugar factory of Suiker Unie in Holland. G. Bruhns. *Zuckerind.*, 1981, **106**, 1078-1081 *(German)*. – A report is presented on the official opening of the expanded Groningen sugar factory (see preceding abstract), with information on the factory's history and some of the new plant installed.

The relative ebulliometric number and its application to massecuite boiling control. S. M. Petrov, V. I. Tuzhilkin and A. R. Sapronov. *Sakhar. Prom.*, 1981, (11), 43-45 *(Russian)*. – The relative ebulliometric number (REN) is defined as the ratio between the boiling point elevation of a sugar solution and of a saturated sugar solution of identical purity and at the same pressure. At a purity in the range 60-100, pressure of 0.02-0.1 MPa and a crystal content of 0-50%, linearity was established between REN and supersaturation in the range 0.6-1.5 within ± 5%. Application of this finding to boiling control is described.

Investigation of the quality and intensity of self-purification of general sugar factory waste water occurring with combined hydro-conveying of flume and carbonatation muds. B. Polec and E. Glabski. *Gaz. Cukr.*, 1981, **89**, 133 *(Polish)*. – Investigations showed that the title waste can be held in a quiescent tank for a long period and the solids allowed to settle out without need for any additive apart from possible dilution water. During 8 months at Krasnystaw factory, the BOD_5 and COD fell by 99.6% and 98.4%, respectively, while the pH rose by 1.5 units (from 5.9 to 7.4).

The sub-sampling reception centre at Pithiviers-le-Vieil. Anon. *Sucr. Franç.*, 1982, **123**, 25-26 *(French)*. – Details are given of the beet reception and sampling system used at the title sugar factory which has a daily slice of 8000 tonnes of beet, representing 600 truckloads. The system is designed to handle 60 trucks per hr, and provision is made for installation of a parallel system.

Experience with fuel economy in the operation of Tbilisi sugar factory. Yu. S. Kuz'minskii, Yu. A. Granovskii and V. K. Chernetskii. *Sakhar. Prom.*, 1981, (12), 19-23 *(Russian)*. – Details are given of a number of modifications to factory processing, to evaporator operation and to the overall heat economy as well as introduction of worker incentive schemes which resulted in a reduction in fuel consumption at the title factory.

An auxiliary electrode for pH measuring systems. Z. S. Voloshin, Yu. N. Kiyanitsa and A. G. Nikulin. *Sakhar. Prom.*, 1981, (12), 24-25 *(Russian)*. – A description is given of a silver chloride electrode, designed for high-temperature application (up to 120°C), which has been tested over two campaigns in 2nd carbonatation pH measurement and control.

A discharge valve for FiLS filters. V. I. Zablotskii and A. F. Kravchuk. *Sakhar. Prom.*, 1981, (12), 25-26 *(Russian)*. – Details are given of a specially designed valve intended for use with FiLS filter-thickeners on 1st carbonatation juice. It is located in the mud discharge pipe so that an acute angle is formed between the inclined inner wall of the pipe and the valve seat. Opening and closing of the valve is made possible by movement of a pivoting spindle fixed to the valve disc.

Device for trapping leaves and other light impurities. V. E. Ryzhikov. *Sakhar. Prom.*, 1981, (12), 27 *(Russian)*. A simple means of preventing impurities accompanying beets to the slicer consists of a fan placed at right-angles to the freely falling beets as they leave the belt conveyor on their way to the weigher hopper. The jet of air emanating from the fan blows the light impurities away from the beets, and the deflected debris then falls onto another belt conveyor for removal. The system has removed an extra 0.6% of impurities (on weight of beet), or 3.5 tonnes per 8-hour shift.

The A2-PKB-3 combined mixing barometric condenser. S. A. Zozulya *et al. Sakhar. Prom.*, 1981, (12), 28-31 *(Russian)*. – Details are given of the performance of a combined condenser system (comprising a co-current condenser linked to a cooler) applied to vacuum pan vapours.

STARCH BASED SWEETENERS

Production of high fructose corn syrup by *Streptomyces* sp. M. Bhatia and K. A. Prabhu. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, G.123-G.129. – Details are given of tests on production of glucose isomerase from a strain of *Streptomyces* sp. (using xylose as carbon source) obtained from the soil. Experiments were conducted on glucose conversion to fructose using corn hydrolysate, bagasse hydrolysate and an aqueous magnesium sulphate-glucose mixture, respectively, as substrates. A maximum conversion of 40% was obtained from the glucose mixture at pH 7.2, 90°C and 48 hr at an enzyme concentration of 60 $\mu g.ml^{-1}$. Approximately the same results were obtained with corn hydrolysate but after 72 hr, while the bagasse hydrolysate yielded a maximum of 29% after 58 hours.

Biotechnical problems of isoglucose production. IV. Production and characterization of immobilized glucoamylase. J. Hollo, E. Laszlo and A. Hoschke. *Starch/Stärke,* 1981, **33,** 52-55. – Although several methods have been developed for immobilization of enzymes applicable to glucose conversion, so far no process has been introduced on an industrial scale, probably because of the lack of appropriate carrier; carriers investigated hitherto have either been too costly or unsuitable for industrial application. Studies are reported in which cellulose amine and DEAE-cellulose were tested as carriers for immobilization of industrial *Aspergillus niger* glucoamylase (Miles L-100); glutaraldehyde and *p*-benzoquinone were used as bonding agents, respectively. The effects of carrier particle size and bonding agent concentration on immobilization were determined, as were the parameters of the immobilized enzyme. With cellulose amine, best results were obtained at the smallest of three particle sizes tested, while immobilization was greater with benzoquinone than with glutaraldehyde as bonding agent. In the case of DEAE-cellulose, the amount of enzyme immobilized was governed by the degree of swelling, immobilization even occurring in the pores of the carrier.

Process for fructose enrichment from fructose-bearing solutions. H. W. Keller, A. C. Reents and J. W. Laraway. *Starch/Stärke,* 1981, **33,** 55-57. – Details are given of the Techni-Sweet molecular exclusion process (differing from normal ion exclusion in that the materials separated are non-ionic) for manufacture of Enriched Fructose Corn Syrup ("second-generation" HFCS) from "first-generation" HFCS. The process uses ion exchange resin in a salt form, preferably Ca^{++}, which selectively holds the fructose to a greater degree than the glucose. Elution is carried out with deionized water; glucose appears first in the column effluent, followed by a mixture of the two sugars, and then a fraction of relatively pure fructose. The degree of separation is raised by operation at elevated temperature. The amount of water to be evaporated is minimized by use of a recycling technique. Comparison is made with a normal flow-through procedure, showing the considerable reduction in rinsing volume where a 55% HFCS is produced from a feed of 42% fructose, 53% glucose and 5% oligosaccharides, and the economics are indicated.

Immobilized glucose isomerase on DEAE cellulose beads. L. F. Chen, C. S. Gong and G. T. Tsao. *Starch/Stärke,* 1981, **33,** 58-63. – Purified glucose isomerase from *Actinoplanes missouriensis* was immobilized on porous DEAE-cellulose beads by simple adsorption; the immobilized enzyme retained over 70% of its original activity, pore diffusion and film diffusion having an insignificant effect on activity with a bead size of 35-mesh or smaller. It was possible to maintain substrate flow at 0.04 $cm.sec^{-1}$ or higher. While the optimum pH of the immobilized enzyme remained unchanged, the optimum range widened; a broadening of the pH profile indicated that immobilized enzymes are less sensitive to pH change in the substrate. The half-life of the immobilized enzyme was about 1000 hours at 60°C; Co ions are not required for enzyme stability. The cost of immobilization of cell-free enzyme on DEAE-cellulose beads should be lower than that of whole-cell isomerase immobilization on cellulose particles or regenerated powders, since the beads are re-usable for immobilization and purification and show potential for high fructose syrup production.

Filtration is the key to quality control at ADM corn sweeteners. L. Langhauser. *Sugar y Azúcar,* 1980, **75,** (1), 248-250. – With addition of 55% and 90% fructose syrups to the production range of the ADM Corn Sweeteners factory in Cedar Rapids, Iowa, there has been considerable emphasis on the importance of the quality of kieselguhr used as precoat in the vacuum and pressure filters. The raw syrup is first subjected to vacuum filtration for the removal of suspended solids; this is followed by active carbon decolorization and then pressure filtration to remove the carbon fines. Subsequent processing includes ion exchange, enzymatic isomerization, further decolorization and pressure filtration. The vacuum and pressure filtration operations are described in greater detail, and a typical analysis is given of the 55% fructose syrup produced.

The purification of glucose isomerase from *Streptomyces* sp. by affinity chromatography. S. L. Cheng. *Rpt. Taiwan Sugar Research Inst.,* 1980, (87), 39-47 *(Chinese).* The application of the newly developed affinity chromatography technique in the purification of glucose isomerase is described whereby a highly active and purified enzyme can be prepared for immobilization and use in making HFCS from starch. The affinity adsorbent, xylitol-Sepharose 4B, was bio-specific for glucose isomerase from *Streptomyces* sp. The enzyme protein bound to the affinity column was flushed off with 0.05M succinate buffer at pH 7.5, and elution performed with 0.4M NaCl. Similar results in raising the enzyme purity more than four-fold were obtained with flow rates of 0.14 and 0.29 $ml.min^{-1}$, with recovery around 83%.

Energy investigations of the competition between sucrose and isoglucose. J. Fenner. *Zuckerind.,* 1980, **105,** 979-985 *(German).* – From a comparison of the energy balances for agriculture, transport and processing of sugar beet, potatoes, wheat and maize, it is concluded that HFCS has a slight advantage over sucrose as regards energy consumption. However, many factors that play a significant role in the relative competitiveness of the two sweeteners cannot be evaluated in energy terms.

Immobilization of glucose isomerase on radiation-modifed gelatine gel. S. Bachman, L. Gebicka and Z. Gasyna. *Starch/Stärke,* 1981, **33,** 63-66. – Whole-cell glucose isomerase immobilization on gelatine gel that had been irradiated with gamma-rays from ^{60}Co was tested. The enzyme was stabilized within the cells by heating to 70°C, and the cells then mixed with the gelatine gel and cross-linked by glutaraldehyde. The immobilized enzyme had 70-75% of the activity of the free cells. Continuous isomerization of glucose to fructose was performed using a column packed with cell granules. The immobilized enzyme had a half-life of 650 hours at 60°C. A number of properties of the immobilized enzyme under varying reaction conditions are discussed.

Studies on glucose isomerase. II. Nitrogen sources of the medium for large-scale production of glucose isomerase from *Streptomyces* sp. C. L. Lai. *Rpt. Taiwan Sugar Research Inst.,* 1981, (91), 67-73 *(Chinese).* – The possible use of de-fatted soybean and fodder yeast extracts as nitrogen sources for large-scale production of glucose isomerase from *Streptomyces* sp. S41-10 was investigated. The effect of the soybean extract varied with method of extraction, that obtained with water at room temperature being more effective than those extracted with water at higher temperatures or with alkaline liquor, although high-temperature extraction (95°C) was preferable for yeast extract. The activity of the cells produced from a mixture of the two extracts of suitable ratio was higher than that of cells produced from the basal medium. Acid hydrolysates obtained from a high concentration of bagasse pith was found to inhibit the growth of *Streptomyces* cells, but this was overcome by pretreating the hydrolysate with lime.

Diffusion hindrance in isoglucose production with immobilized enzymes. J. Hollo, E. Laszlo and A. Hoschke. *Starch/Stärke,* 1981, **33,** 361-366. – It is stated that the design and operation of "bioreactors" for glucose isomerization to fructose using immobilized enzymes involves a number of problems, the greatest of which is determination of the degree of external and internal diffusion that affects mass transfer. Industrial-scale investigations are reported which were carried out in packed bed reactors using glucose isomerase of three different origins that had been immobilized by different methods: (1) Maxazyme, of spherical form, produced from *Actinoplanes missouriensis* and mycelium-immobilized, after gelatine gel entrapment, by glutaraldehyde; (2) Takasweet, an amorphous enzyme from *Streptomyces olivaceus,* cell-immobilized by glutaraldehyde and extruded; and (3) Sweetzyme, cylindrical in form, produced from *Bacillus coagulans* and cell-immobilized by glutaraldehyde followed by extrusion. From the reaction kinetic constants and parameters, it was established that more than 95% of the rate decrease was due to internal porous diffusion hindrance, while external diffusion limitation had practically no effect. The rate decrease for enzyme (1) was about half that of (2) and (3). The results demonstrate the suitability of the evaluation method for determining the degree of diffusional limitation for any form of glucose isomerase in a packed bed reactor.

Some properties of whole-cell glucose isomerase immobilized in polyacrylamide gel by radiation. S. Bachman, L. Gebicka and Z. Gasyna. *Starch/Stärke,* 1981, **33,** 366-369. – Whole-cell glucose isomerase from *Actinoplanes missouriensis* was immobilized by mixing a suspension of the enzyme with acrylamide and dextran solutions and exposing the mixture to gamma-rays emitted by ^{60}Co. Irradiation at up to 6kGy at −196°C caused no decrease in enzyme activity. Optimum temperature at which maximum activity was observed remained unchanged as a result of immobilization, while the optimum pH shifted from 8 to 7. The Co^{++} ions did not increase stability of the immobilized enzyme at pH values above 8 in continuous isomerization. The half-life of the immobilized enzyme was 24 days at 60°C.

Production and physico-chemical properties of isomerized glucose syrups. I. Sweetness. S. Z. Dziedzic. *Starch/Stärke,* 1981, **33,** 369-372. – Sweetzyme glucose isomerase was used to isomerize glucose syrups of 21, 45, 65 and 100% D. E. Conversion of glucose to fructose was determined by high-pressure liquid chromatography and found to be in the range 49-52%. Isomerization resulted in a marked increase in sweetness of both high and low D.E. syrups.

Enzymatic hydrolysis of inulin – an alternative way to fructose production. L. Zittan. *Starch/Stärke,* 1981, **33,** 373-377. – For fructose production from inulin, present in a number of different plants, hydrolysis is an essential step. Investigations were carried out on the use of an *Aspergillus* inulinase which permitted more than 99% hydrolysis after 72 hours at an inulin concentration of 20% w/w, a pH of 4.5 and an inulinase dosage of 2-3 units/g inulin.

The evaluation of activated carbon in purification of starch-based sweeteners. T. M. W. van Asbeck, M. Gouwerok and E. Polman. *Starch/Stärke,* 1981, **33,** 378-383. – After a brief description of processes used in the activation of carbon, explanations are given of two parameters characterizing the adsorptive properties of activated carbon, viz. the molasses number (the amount of carbon in mg required to give the same decolorization ratio as a fixed quantity of standard carbon in the case of a molasses solution) and benzene adsorption at 20°C and relative vapour pressures between 0.001 and 0.900, related to pore size distribution. The role played by active carbon in the purification of starch-based sweeteners (removal of colouring matter and of colour precursors such as hydroxymethyl furfural) is discussed. The performances of steam- and chemically-activated carbon were assessed in laboratory experiments on glucose syrup treatment, and results are given in graph form; these indicate that, in a two-stage counter-current system, the chemically-activated carbon was generally better.

A sequential chromatographic process for the separation of glucose-fructose mixtures. P. E. Barker and C. H. Chuah. *Chem. Eng.,* 1981, (371-2), 389-393; through *S.I.A.,* 1981, **43,** Abs. 81-1720. – A process has been developed on a laboratory scale for the separation of glucose-fructose mixtures (e.g. those produced by isomerization of starch-based syrups by immobilized enzymes) into fructose-rich and glucose-rich fractions. It uses a semi-continuous chromatographic refiner (SCCR4) operating in counter-current and having a moving-port design. The equipment and its operating principles are described, and a theoretical basis for prediction of run parameters is shown. Results of experimental runs under various operating conditions are tabulated and discussed. From feed containing a 50:50 fructose:glucose mixture, it was possible to obtain fructose-rich and glucose-rich products of 90% purity by weight at a throughput of 75 g.hr^{-1}.


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LABORATORY STUDIES

A simple method for determination of colour of white sugar in solid form. R. D. Athavale. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), A.131-A.134. — Details are given of a reflectance spectrophotometer developed by the author (the Laserphot) for measurement of sugar whiteness.

Dextran in Marhowrah factory (north Bihar) cane juices. Laboratory observations on its removal with dextranase Novo 25L. S. C. Sharma and P. C. Johary. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, Mg.123-Mg.143. — Laboratory investigations on removal of dextran, present in the range 7190-12,635 ppm/100°Bx, from cane juice are reported. Optimum dextranase dosage rate was 25 ppm, at which the IEV (initial enzyme velocity), i.e. mg of dextran hydrolysed per min per unit enzyme in 100 ml of juice, was maximum; a hydrolysis time of 20-25 min and a temperature of 60-65°C gave 38-46% removal. The dextran contents were determined in ten cane varieties and found to be in the range 6500-41,250 ppm/100°Bx. The concentration was higher in the lower half of the stalk than in the upper section.

Spectrophotometric determination of sugars in traces. M. Prasad, J. K. Srivastava and R. Chandra. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.19-C.23. For determination of trace quantitities of sugar, a method was tested in which 0.2 ml of 1.5% (w/v) cysteine hydrochloride, 0.2 ml of 0.12% (w/v) alcoholic carbazole solution and 4.6 ml of conc. sulphuric acid were added to 5.0 ml of the test solution (e.g. condensate and other waters), and the resultant violet coloration measured at 560 nm. Beer's law proved to be valid up to 160 ppm sugar.

Polarimetric estimation of dextran in sugar house products. II. Studies with sugar cane juice. S. Bose and L. Singh. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.25-C.31. — Two 50-ml aliquots of mixed juice were poured into 100-ml flasks; 5 ml of lead acetate solution of 30°Bé was added to one, while modified Herles' solution[1] was added to the other (used as control). The contents of both flasks were made up to volume with distilled water, filtered and the filtrates used for pol measurement, dextran then being found by the difference between the two readings. Mean deviation was ± 3.35% for dextran concentrations in the range 250-8000 ppm. Statistical evaluation of the results gave a formula for calculation of dextran X from pol reading Y for mixed juice: $Y = 0.0010X - 0.1597$.

A method for estimation of cationic colloids using a surfactant. A. P. Gupta, S. P. Shukla, K. M. Tewari and S. Bhatt. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.55-C.62. — A method is described which is based on the use of sodium lauryl sulphate to precipitate colloids in 20 ml of juice, completion of precipitation being established colorimetrically. The quantity of colloids removed has been found to be linearly related to the amount of surfactant (of 2.5 g.litre^{-1} concentration) added.

Study on the use of various preservatives for cane juice samples in analytical control of a sugar factory. A. P. Gupta, S. P. Shukla, S. Bhatt and K. M. Tewari. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, C.63-C.73. — Various chemicals were tested for their performance in preserving cane samples for later analysis; they included mercuric chloride (the best for prevention of deterioration but not suitable where reducing sugars, pH and acidity are to be determined), sodium metasilicate (also suitable if pH and/or acidity are not to be measured), sodium benzoate and cetyl pyridinium chloride (which did not prevent changes in purity and reducing sugars and were only of value in preventing biodegradation) and sodium hypochlorite (which failed completely to prevent deterioration). The various parameters were determined 4 and 24 hours after addition of the preservative.

Rationalization of laboratory work at Vrdy factory. S. Hajkova, V. Moravcova, M. Buckova and H. Svobodova. *Listy Cukr.,* 1981, **97,** 261-264 *(Czech).* — Details are given of the equipment installed at the central laboratory at Vrdy and of a new rapid procedure used to determine massecuite and syrup purities as a means of monitoring boiling house operations, particularly low-grade working.

Habit modifications of sucrose crystals. A. Van Hook. *J. Amer. Soc. Sugar Beet Tech.,* 1981, **21,** 130-135. Various aspects of the effects of raffinose and dextran on sucrose crystal habit are discussed. Tests on the use of raffinose as a possible heterogeneous nucleating agent for sucrose crystallization (because of chemical and structural similarities of the two sugars) were unsuccessful, as were attempts to establish a distortion caused by raffinose in the basic sucrose lattice structure and to find evidence of the pentahydrate form in which raffinose is thought (on the basis of the phase rules pertaining to sucrose-raffinose-water systems) to co-crystallize with sucrose — answers will only be found when more sensitive apparatus is available. Crystal habit modifiers such as raffinose have been found to cause a considerable reduction in the size of crystal slurries when gently agitated. The effect of dextran on sucrose crystallization is only briefly mentioned, as are other causes of sucrose crystal habit modification. The use of varnish to prevent growth of different crystal faces and so permit clear evidence of habit modification is suggested.

Effects of sugar beet sample preparation and handling on sucrose, non-sucroses and purity analyses. R. J. Hecker and S. S. Martin. *J. Amer. Soc. Sugar Beet Tech.,* 1981, **21,** 184-187. — Experiments were carried out to compare methods of beet sample preparation and preservation for analysis. Phenylmercuric acetate used as preservative did not affect the sucrose content, refractometric dry solids, raw juice purity or thin juice purity, although amino-N and conductivity ash were lower than in the controls. The sucrose content of brei samples taken from beets grown at low, optimum and excess N fertilization was unaffected by freezing of the brei before analysis. A 1:1 brei:distilled water blend analysed immediately after filtration gave the same thin juice purity as a 1:1

[1] Brown & Zerban: "Sugar analysis" 3rd Edn. (Wiley, New York) 1955, p.327.

extract which was stored at −30°C and a 1:1 extract taken from brei stored at −30°C, although in two out of three experiments the extracts had a significantly lower thin juice purity than standard limed pressed juice stored at −30°C. Differences between seven non-sucrose components in the extracts were significant in some cases but of no practical importance. While each of the extracts should provide a reliable sample for purity determination, the data from the different extracts should not be compared numerically. The 1:1 frozen brei extract is considered a suitable alternative to the conventional sample. Comparison was made between the Na, K and amino-N contents of lead-clarified filtrate (1) freshly analysed, (2) after 24 hours at 4°C, (3) frozen and then thawed for 18 hours at 4°C, (4) frozen and then thawed in water at 37°C, and (5) frozen and then thawed by micro-wave heating. The results were significantly affected by some of the treatments, although high correlations between the treatments indicated that they might be immaterial provided the same procedure were used consistently. Three methods of storing brei or limed juice samples gave lower thin juice purities than found for juices analysed straight away. While glucose in 10 varieties ranged from 0.14% to 0.43% on fresh weight, there were no differences between the mean pol measurement and sucrose value obtained by gas chromatography.

Determination of the invert content in beets correctly stored in piles as well as in deteriorated and thawed beets. H. Gruszecka. *Gaz. Cukr.*, 1981, **89**, 131-132 *(Polish)*. – The invert sugar content was determined in stored, healthy beet during October-February and found to be sufficiently insignificant as to have little effect on polarimetric measurement of sugar. Even with increase in invert in April-May, the maximum (0.327% on beet) was still only equivalent to a pol reading of −0.07°S. On the other hand, the invert content in deteriorated beet was much greater, rising to 4.10% on beet, equivalent to −0.81°S. However, it was found by gas chromatography that, during hot digestion, some of the fructose in the sample underwent degradation, so that the invert was basically in the form of glucose, which is dextrorotatory; in this case, 4.10% invert as glucose would be equivalent to +2.16°S.

The laboratory, chemical control organ of the sugar factory. N. Mwirawabangi. *Sukari* (Zaire), 1981, **1**, (1), 29 *(French)*. – The role of the laboratory in the running of the sugar factory is examined and the task of the chemist in determining known and unknown losses explained. The two types of losses are described.

The potential of liquid chromatography for the analysis of sugar cane. J. Wong-Chong and F. A. Martin. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 78-82. – Results of polarimetry were compared with sucrose values given by HPLC for fresh, moderately deteriorated and badly deteriorated juice. Correlation coefficients between the two methods ranged from 0.989 for fresh juice to only 0.460 for the poorest quality juice, from which it is concluded that HPLC is better than polarimetry during periods when false pol values may occur, e.g. after a severe stalk-damaging frost. Comparison was also made between the two methods during the last 27 days of the 1978 cane harvest in Louisiana. Correlation coefficients ranged from 0.97 on the day of best agreement to 0.76 on the day of poorest agreement, the overall coefficient for the entire period being 0.9094, which was to be expected in view of the ideal harvesting conditions. Comparison of values at sampling points in the factory showed greatest difference for products of lowest purity, e.g. molasses.

Concentration of clarified cane sugar juice by reverse osmosis. R. Chang and J. P. Merle. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 83-87. – A 20-ft^2 polyamide spiral-wound membrane was used in a study to determine the feasibility of concentrating clarified juice after passage through a polypropylene cartridge filter. Tests were also conducted on water and pure sugar solutions at various temperatures, pressures and concentrations. Despite pre-treatment, fouling of the membrane was a major obstacle, since the flux decreased by 50% over a 2-day period of continuous operation. However, cleaning with a 2% sodium borate solution restored most of the flux, which averaged 5 gal.ft^{-2}.day^{-1} at 10-25°Bx, 110°F and 450 psig. However, in spite of considerable savings in energy, use of reverse osmosis for juice concentration is not economically justifiable at the present stage of membrane technology because of the large surface area required and the replacement and maintenance costs of the membrane.

Trace metals in sugar cane juice – a new atomic absorption method. L. E. Vidauretta and C. J. Feigel. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 107 *(abstract only)*. A method has been developed for the analysis of trace metals in the various stages of raw sugar refining. The method includes ashing and filtration, followed by an analysis of the metals by atomic absorption. The newly developed method is used primarily for very viscous sugar samples.

Improved sugar separation by high-performance liquid chromatography using porous-microparticle carbohydrate columns. M. T. Yang, L. P. Milligan and G. W. Mathison. *J. Chromatogr.*, 1981, **209**, (2), 316-322; through *Anal. Abs.*, 1981, **41**, Abs. 6C14. – Monosaccharides and some oligosaccharides were separated (without derivatization) on a column (30 cm x 4 mm) of MicroPak NH_2-10 (preceded by a 4-cm x 4-mm guard column of Vydac SC) or on the MicroPak column in series with an ensuing column (30 cm x 3.9 mm) of Bondapak Carbohydrate. The mobile phase was water:acetonitrile (1:4, or 3:7 if increased polarity was required to reduce retention time). Spectrophotometry at 192 nm and refractive index measurement were used for detection, with simultaneous recording of peaks. Identities of component sugars in the collected fractions were confirmed by paper chromatography and gas-liquid chromatography. Resolution was comparable to that attainable by GLC methods. The technique was applied to a hemicellulose hydrolysate from hay.

Thermophilous fungi of decomposing sugar cane bagasse. D. K. Sandhu, S. Singh and M. K. Waraich. *Can. J. Botany*, 1980, **58**, (18), 2015-2016; through *S.I.A.*, 1981, **43**, Abs. 81-1760. – Twenty species of thermophilous fungi were isolated from 100 samples of bagasse from an Indian factory. All the samples contained one or more species. *Aspergillus fumigatus* was found in 80% of the samples and *Mucor pusillus* in 70%. The other species were each found in less than 30% of the samples.

Isolation of thermophilic actinomycetes from Punjab soils, compost and bagasse. V. K. Sharma and D. S. Chahal. *Sci. and Culture*, 1978, **44**, (3), 132-133; through *S.I.A.*, 1981, **43**, Abs. 81-1761. – Five samples of rotting bagasse in India contained on average 150 actinomycetes/g, mainly *Nocardia* spp. and *Streptomyces* spp.

BY-PRODUCTS

A new bleached bagasse pulp machine and its operation and maintenance. H. Y. Tao. *Taiwan Sugar,* 1981, **29,** 116-130. — Details are given of a wet pulp machine and its operation and maintenance from its trial run in 1977 to 1979; after the machine had failed to meet the requirements of a daily capacity of 330 tonnes, a supplementary machine of 100 tonnes.day^{-1} rated capacity was supplied by the manufacturers by way of compensation. A brief description is given of this machine.

Automatic control of oil-to-air ratio in the combustion chamber of a drum dryer for beet pulp. S. Naidenov. *Khranit. Prom.,* 1980, **29,** (1), 35; through *S.I.A.,* 1981, **43,** Abs. 81-1448. — The automatic controls of an East German dryer at Gorna Oryakhovitsa factory were defective and the air supply to the burner was temporarily controlled manually. An experimental circuit which has successfully controlled combustion is shown; the basis is constant temperature and pressure of oil sprayed in, for constant oil:air ratio.

Ethanol production from sugar cane segments in a high-solids drum fermenter. Z. Er-el, E. Battat, U. Shechter and I. Goldberg. *Biotechnology Letters,* 1981, **3,** (7), 385-390; through *S.I.A.,* 1981, **43,** Abs. 81-1480. — The EX-FERM process[1] was carried out in a rotating-drum fermenter, in which a high cane:water ratio could be used, with the aim of obtaining a high ethanol concentration. Cane was cut into segments about 1 cm wide and fermented with *Saccharomyces oviformis* at acid pH. When the sugar was exhausted, the cane segments were replaced by a fresh batch; three such fermentation cycles were carried out. Final concentrations of ethanol were only slightly lower than those predicted from theory, reaching 89 g.litre^{-1} at the highest cane:water ratio tested, 1:1.04. Ethanol yield was about 49% on sucrose in each cycle.

Effect of temperature on sucrose-to-ethanol conversion by *Zymomonas mobilis* strains. E. Lyness and H. W. Doelle. *Biotechnology Letters,* 1980, **2,** (12), 549-554; through *S.I.A.,* 1981, **43,** Abs. 81-1481. — For the two strains tested, the optimum temperature was 35°C, at which conversion efficiency was 75% in 22-27 hours' fermentation time.

Storage and feeding of fresh sugar beet pulp. Anon. *Current Topics* (Min. Agric., Fisheries and Food), 1981, (Nov. 16), 2 pp. — Because of rising fuel costs, the quantity of dried beet pulp produced in the UK has been reduced but more fresh pulp made available as animal fodder. Pressed pulp (with or without molasses addition) and unpressed pulp have a short shelf life and should be eaten by cattle within 10-14 days of production; for storage beyond this period, air-tight containers with adequate drainage must be provided. Fresh pulp is often stored under poor conditions. Trials showed that simply tipping the pulp into the silo for ensilage caused dry matter losses greater than 15% and considerable spoilage by moulds, including *Aspergillus fumigatus,* a pathogen responsible for mycotic abortion. Good ensilage techniques included manual consolidation, immediate covering with polyethylene sheeting and uniform weighting with straw vales to exclude air; this treatment reduced dry matter losses to 3% and there was no mould development. The feeding values of the three types of pulp mentioned are reported. While, on a dry matter basis, the feeding value of pulp is 5-6% lower than that of barley grain, it contains more digestible fibre; through stimulation of an acetate type of fermentation this encourages production of butter fat in milk.

Ethanol production from cane juice by *Zymomonas mobilis.* E. Lyness and H. W. Doelle. *Biotechnology Letters,* 1981, **3,** (5), 257-260; through *S.I.A.,* 1981, **43,** Abs. 81-1483. — Clarified or mixed juice containing 100-200 g of sucrose/litre was fermented by *Z. mobilis* strain Z 7 in 1-litre pilot-plant fermenters, without supplementation. Ethanol yields were 59-88% with fermentation times of 20-29 hours at 35°C.

Effect of mineral acid treatments in vinasse on the growth of *Candida utilis.* S. M. Tauk. *Ciencia a Cultura* (Brazil), 1978, **30,** (3), 350-353; through *S.I.A.,* 1981, **43,** Abs. 81-1487. — Mixtures of vinasses and 3% molasses, both from Santa Lina factory, in the ratios 1:3, 1:1, 3:1 or 1:0, were sterilized and adjusted to pH 4.6 with NaOH or HCl, and *C. utilis* grown for 30 hr at 30°C; the vinasses were either raw or pretreated with 5% by volume conc. H_2SO_4, HCl or HNO_3 and filtered after several hours. The biomass was consistently highest with HNO_3 treatment, maximum yield being 1.6 g/100 ml for the medium containing 75% vinasse; total N and total P in biomass were also highest with HNO_3, respective maxima being 7.5% and 1.9% for the medium containing 50% vinasse + 1.5% molasses. Such media are more economical than molasses for single-cell protein production, and alleviate the pollution problem with vinasse.

The effect of gibberellic acid on ethanol fermentation using cane juice. R. L. Samaniego, J. D. Layoso and T. V. Rola. *Crystallizer,* 1981, **4,** (4), 12 *(abstract only).* In a study of the stimulative effect of gibberellic acid (GA_3) on cane juice fermentation, juice samples were treated with the acid at various concentrations in the range 0.001-3.75 ppm. Addition of 1.0 and 3.75 ppm increased fermentation efficiency to 95.08 and 99.72%, respectively, by contrast with 90% where no GA was added. Microbiological production of the acid was also investigated and found to be satisfactory. However, the cost of GA makes its use uneconomical.

The development of a micro-distillery for fuel alcohol in Brazil. D. J. L. Hulett. *Sugar J.,* 1981, **44,** (5), 7-9. See *I.S.J.,* 1982, **84,** 313.

Sugar beet pulp drying control. H. P. Gildersleeve. *Sugar J.,* 1981, **44,** (5), 15-18. — A system developed and patented by Holly Sugar Corporation is described in which control of the beet pulp dryer load is based on the differential pressure between the furnace and the drum discharge chamber; the differential pressure is used for automatic control of the induced draft to the drum — a decrease in the former causes an increase in the latter.

[1] Rolz: *I.S.J.,* 1980, **82,** 47-51.

Advantages obtained with the system at company sugar factories include reduced fuel costs, increased capacity, more uniform moisture content in the dried pulp and reduction of particulate emission. Investment costs of the system are low, and installation requires only minor modifications to existing equipment.

Potential use of high-molassed dry pulp in cattle and pig fodder. H. Meyer. *Die Zuckerrübe,* 1981, **30,** 220-221 *(German).* — Trials carried out in recent years on the feeding of molassed beet pulp (containing up to 25.4% sugar) to cattle and pigs are reported. Results demonstrated the versatility of the pulp and its contribution to a reduction in feed costs. Of importance is storage (so that no mould forms), a properly balanced ration (particularly for dairy cows) and a suitable feeding technique.

A scheme for rum production by khandsari units. R. S. Dubey. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), B.1-B.10. — The equipment required for production of rum at converted khandsari plants is listed and the costs of this and of manufacturing rum and alcohol from 16,000 tonnes of cane per season are calculated

Sugar cane and its by-products — source of fodder for ruminants. A. P. Deshmukh and I. G. Chavan. *Proc. 31st Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1981, (1), B.11-B.18. — The values of bagasse as animal fodder is discussed, and processes to increase its digestibility and crude protein content are indicated. Rations containing bagasse, molasses and cane tops are described and goat feeding trials involving protein-enriched bagasse reported.

A scheme for rum production by khandsari units. R. S. Dubey. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, G.1-G.12. — See abstract above.

Screening of yeasts for fermentation of sugar cane juice and sugar cane (preliminary report). B. S. Yadav, D. S. Dahiya and P. Tauro. *Proc. 45th Ann. Conv. Sugar Tech. Assoc. India,* 1981, G.13-G.20. — Preliminary investigations showed that *Saccharomyces cerevisiae* Strain 39 was the most effective yeast for alcohol fermentation of cane juice, giving 8.4% alcohol (v/v) after 36 hours at 30°C; direct fermentation of cane was also possible, but yields were lower. The fermentation rate and alcohol yield were slightly improved by addition of 0.2 kg + 0.2 kg urea and phosphoric acid per 100 kg fermentable sugars.

Profitability of ethanol manufacture from sugar beet under present and changed economic conditions. R. Wolffram and H. Hantelmann. *Zuckerind.,* 1981, **106,** 1094-1102 *(German).* — From analysis of alcohol manufacture from sugar beet under four different distillery operational schemes, it is shown that production would not be profitable at current costs and prices. Farmers would obtain only a fraction of the price guaranteed by the EEC under sugar marketing regulations, while ethanol manufacture from crude oil costs so little that no significant improvement could be expected in the economics in the medium term, even where alcohol manufacture was intended to reduce excess sugar.

The use of residues from sugar cane factory and distillery for fertilizers. G. Samuels. *Proc. Amer. Soc. Sugar Cane Tech.,* 1981, 72-77. — The fertilizer potential of filter cake and vinasse is discussed. The chemical composition of both materials is given, and the economics of handling them are examined. The amounts to apply in cane fields are considered, and the need for experiments in order to establish optimum quantities is stressed.

The effect of medium composition on the production of ethanol by *Saccharomyces cerevisiae.* S. J. Devine and J. C. Slaughter. *FEMS Microbiol. Letters,* 1980, **9,** (1), 19-21; through *S.I.A.,* 1981, **43,** Abs. 81-1800. — Ethanol production by *S. cerevisiae* strain NCYC 1108 grown on minimal media supplemented with 250, 750, 1000 or 2000 mg.litre^{-1} N as $(NH_4)_2SO_4$ was investigated. The optimum salt concentration for ethanol production was up to 1000 mg.litre^{-1}. The type of salt used altered ethanol production: K_2SO_4 and Na_2SO_4 did not stimulate it, but NH_4Cl and $(NH_4)_2SO_4$ did, indicating that ethanol production depends on the NH_4^+ ion specifically. Using a complex N source with and without NH_4^+ addition, the ethanol yield was 3.82 and 3.56%, respectively. These effects were observed only with glucose as C source, and not if maltose, fructose or sucrose was used.

Lysine production with *Brevibacterium* **sp. 22 Ld using sugar cane molasses. I. Study of optimization.** A. M. Khalaf-A., B. Janzso and J. Hollo. *Acta Aliment.,* 1980, **9,** (2), 107-116. **II. Effect of carbon source concentration, pH and rate of aeration.** *Idem ibid.,* 117-128; through *S.I.A.,* 1981, **43,** Abs. 81-1818. — Experiments were carried out in a Kutesz fermenter containing 5 litres of medium. The optimum medium for lysine production contained 15% cane molasses and 3.5% corn steep liquor, together with salts, at pH 7.0-7.5. Fermentation at 30°C for 40-50 hr with agitation at 650 rpm and aeration at 1.0-1.2 vol/min yielded 35 g of lysine/litre. Further experiments confirmed that lysine yields were higher with 15% than with 20% molasses, and showed that pH 6.8-7.3 and an aeration rate of about 0.8 vol/min gave best results.

L-Lysine production by mutants of *Bacillus licheniformis.* H. Hagino, S. Kobayashi, K. Araki and K. Nakayama. *Biotech. Letters,* 1981, **3,** (8), 425-430; through *S.I.A.,* 1981, **43,** Abs. 81-1819. — A bacterium able to grow at 46°C was isolated from soil and identified as *B. licheniformis.* Mutants producing L-lysine were derived from it. One mutant produced up to 30 mg L-lysine/ml in a medium based on cane molasses and containing 10% reducing sugars.

Bagasse utilization in Cuba. Anon. *Sugar y Azúcar,* 1981, **76,** (11), 26, 28, 35-36. — The utilization of bagasse for manufacture of newsprint, dissolving pulp and particle board in Cuba is described.

Drying and the urea nitrogen content in fodder. M. Piasecki, M. Polak, W. Grajek and K. Szebiotko. *Gaz. Cukr.,* 1981, **89,** 110-112 *(Polish).* — While the temperature at which beet pulp was dried had no effect on molasses and/or filter cake added as supplements, temperature rise from 105°C was accompanied by degradation of added urea N, which reached 50% at 160°C. The total N in the non-supplemented pulp remained unchanged with drying.

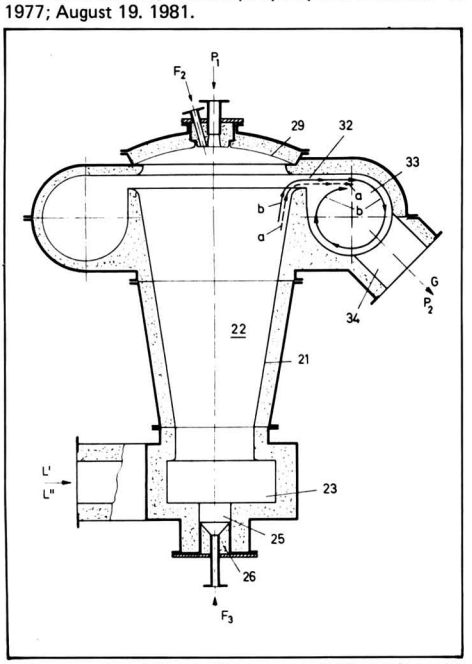
Methods of alcohol production available to the cane sugar refiner. M. C. Bennett. *Sugar J.,* 1981, **44,** (6), 19-21. — See *I.S.J.,* 1982, **84,** 254.

PATENTS

UNITED KINGDOM

Beet harvester. Wilhelm Stoll Maschinenfabrik GmbH, of Lengede-Broistedt, Germany. **1,591,867.** May 31, 1978; June 24, 1981.

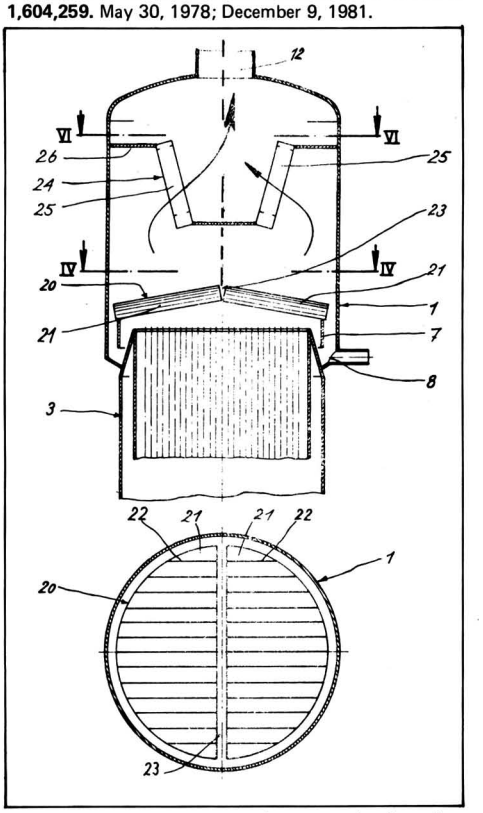
Production of calcined materials. F. Schoppe, of Ebenhausen/Isartal, Germany. **1,595,956.** December 6, 1977; August 19. 1981.



Because of variation in the amount of filter-cake to be handled at different stages in a campaign, the possibility of interruptions of supply because of breakdowns, etc., a kiln for calcination to produce lime from the cake must be able to handle material at rates varying widely from the equilibrium throughput. This is achieved in the design shown whereby a stream of hot gas is fed into the inlet L'/L'' and directed tangentially (preferably at an angle between 8° and 11°) so that it starts to follow a spiral along the inner surface 21 of the body 22, then recirculating down the centre of the body. Feed material enters through port P_1 while fuel is injected through inlets F_2 and F_3. Calcined material follows the path of the broken line and is carried by gas stream b into the toroidal chamber 33 through ring 32, leaving as a calcined product P_2 through duct 34. The dimensions are, for example, inlet guide height 950 mm, height of chamber 22 5700 mm, lower diameter 1600 mm, upper diameter 3200 mm.

Glucose isomerase compositions comprising iron salts. Novo Industri A/S, of Bagsvaerd, Denmark. **1,596,662.** August 23, 1977; August 26, 1981. — The glucose isomerase, in cell mass form, is activated by the presence of at least 0.05% w/w dry basis (preferably 0.2 – 2.0%) of a non-toxic, water-soluble iron salt [e.g. $Fe_2(SO_4)_3$, $FeCl_3$, $FeSO_4$, etc.]. The enzyme may, after incorporation of the salt, be converted into particulate form and dried.

Entrainment separator. U. Regehr, of Aachen, Germany. **1,604,259.** May 30, 1978; December 9, 1981.



The separator is in two sections operating in series. Vapour from the evaporator 3 rises almost vertically through a first-stage separator 20 which comprises fins 22 forming semi-circular sections 21 mounted on guide ring 7 similarly to a roof with the highest points along the parting line 23. Separated liquid drains into the bottom of housing 1 and leaves through outlet 8. The vapour then passes almost horizontally through the second stage of separation which comprises the drop separators 24 and 25 carried by intermediate bases 26 before leaving through the outlet 12.

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

BREVITIES

Cane breeding for alcohol manufacture in India[1]. — The Indian Council of Agricultural Research has initiated a program in which the Sugarcane Breeding Institute, Coimbatore, the National Sugar Institute, Kanpur, and Sakthi Sugars Ltd., Appakudal, Tamil Nadu, are collaborating in the development of cane varieties of high carbohydrate, but not necessarily sucrose, content which can be fermented for the production of fuel alcohol. From early research it was found that CoC 671 variety, planted in June and harvested at 480 days, yielded 21,008 kg of alcohol per hectare.

New corn sweetener plant in Yugoslavia[2]. — A new factory which will process maize into instant starch, glucose, high fructose corn syrup, gluten and other products is to be built at Jabuka in Vojvodina, and will go into operation in 1983. The investment involved is estimated at 1700 million dinars ($35 million).

Indonesia diversification projects[3]. — The State-owned PTP XXIV-XXV sugar plantation enterprise is seeking a foreign partner for an integrated alcohol plant at Takalar, South Sulawesi. The plant, estimated to cost $3.6 million, will produce monosodium glutamate, yeast, liquid carbon dioxide, citric acid and other related products as well as alcohol. The project will obtain its basic feedstock, molasses, from three nearby sugar factories, scheduled to start operations in 1984, which will produce a total of 66,000 tonnes of molasses per season. Another project planned by the same PTP is a liquid sugar plant to be located at Pasuruan in East Java. Estimated to cost about $2.8 million, this will have a design capacity of 50 tonnes per day and will obtain its feedstock from the company's sugar cane estates in East Java.

USSR refined sugar imports and exports 1981[4]. — Of the approximately 5.2 million tonnes of sugar, raw value, imported by the USSR in 1981, 936,240 tonnes was in the form of refined sugar, according to official sources. This was some 120,000 tonnes or 11% less than in 1980. Refined sugar exports in 1981 amounted to 169,218 tonnes, up by some 12% from the 151,706 tonnes of 1980.

Distillery waste fermentation to methane[5]. — Vinasse from the Distillerie Coopérative Agricole de la Région d'Auvernaux, which produces alcohol direct from beets, is now subjected to an anaerobic fermentation after mixing with pulp press water. The plant, which has a working volume of 1000 m^3 and treats 15 $m^3.hr^{-1}$ of the mixture, is maintained at 35-40°C and provides an energy equivalent of 22% of that consumed by the distillery or 5-6 kg of fuel per hectolitre of alcohol produced. However, at current prices, the investment will not be amortized before 10 years. The plant is principally seen as an anti-pollution measure rather than an energy economy measure, since the vinasse had previously to be disposed of on the fields and, while it provided free nutrients, even over a 4-year cycle of application it slowly caused a deterioration in soil structure.

US beet sugar factory closure[6]. — Amstar Corporation has suspended indefinitely beet processing operations at its plant in Chandler, Arizona, from July 1982. Low-capacity utilization of the 4000-ton plant has made operations unprofitable and it is to be restricted to packaging and warehousing. The company had previously announced its intention to close its Salinas, California, beet sugar factory which leaves it with only three in operation.

Poor Barbados sugar crop forecast[7]. — The 1982 sugar crop in Barbados is expected to be the worst for 34 years, according to the Director of the Sugar Producers Federation which administers the substantially privately-owned industry. Output is now expected to fall to 88,700 tonnes of sugar, the lowest since 1948. The pre-crop estimate was 100,000 tonnes and this had since been revised downward to 96,000 tonnes. Last year's output was 96,000 tonnes, compared with 135,000 tonnes in 1980.

Liberia sugar industry restoration plans[8]. — China has signed a $13 million agreement to revitalize the Liberian Sugar Corporation and Chinese technicians are to inspect the factory in southeastern Maryland county and draw up a recovery plan. The factory closed after the April 1980 coup. The factory construction was completed by the Chinese after a break in diplomatic ties between Taiwan and Liberia halted work by Taiwan.

Ivory Coast sugar production, 1981/82[9]. — The sugar cane crop in 1981/82 amounted to 1,750,000 tonnes from the 32,500 hectares planted in the Ivory Coast. Raw sugar production was about 166,000 tonnes, 23% up on the 135,000 tonnes of the previous year. Production should reach 180,000 tonnes in 1982/83 and climb to 280,000 tonnes by 1985/86 when Sodesucre's six northern industrial plantations, covering 32,500 hectares, are in full production. Sodesucre hopes to export some 80,000 tonnes of raw sugar during the current financial year, leaving a surplus of about 7000 tonnes after domestic consumption estimated at just under 80,000 tonnes. The Ivory Coast has requested a quota for export to the EEC and has been given a quota of 70,000 tonnes a year under the International Sugar Agreement, while it has also signed a long-term contract with Portugal. Partly for financial reasons, it is not to proceed with a planned sugar terminal at the port but will institute packing systems at the various factories.

El Salvador sugar production[10]. — Sugar production in 1981/82 reached 3.8 million quintals (174,000 tonnes) of which 2.6 million quintals (119,600 tonnes) was consumed at home, but an output of 5 million quintals (230,000 tonnes) is expected by the Instituto Nacional del Azúcar from the 1982/83 crop.

Indian bagasse paper project[11]. — A plant which will convert bagasse into newsprint is to be established in the Indian state of Karnataka. The factory, which will use Japanese technology, will have an annual capacity of 9000 tonnes a year and will produce 2½ metres wide newsprint. It is expected to be operational by the middle of 1984.

Cane payment in Thailand[12]. — The Thai Cabinet approved a recommendation that sugar cane be purchased by factories according to its sugar content and not by weight alone as in the past. Trading of cane under the Cane Commercial Sugar (CCS) system will start in 1983 and will be implemented in all parts of the country in 1986, giving a fair deal to both planters and factories and bringing additional income to the government in the form of tax.

Mexico sugar production 1981/82[13]. — The Mexican National Sugar Industry Commission has officially confirmed that actual 1981/82 sugar production was 2,680,000 tonnes, tel quel, which is 20,000 tonnes less than the original production target but 308,000 tonnes more than was produced in the previous season. The production was obtained from 32 million tonnes of cane. The Commission report claims that a peak 3 million tonnes of sugar could have been produced had there been greater efficiency in delivery of cane to the sugar factories and a reduction of lost time in crushing the cane. Imports have been reduced to only 400,000 tonnes in 1982 against 563,000 tonnes in 1981 and 739,000 tonnes in 1980. Consumption is estimated at 3,120,000 tonnes as compared with 3,019,000 tonnes in 1981. Because of progress achieved in 1981/82 there is hope for self-sufficiency in the 1983/84 season, even though consumption will continue to rise. Further modernization of the factories is to continue and the use of fertilizers has raised the average cane yield from 65 to 70 tonnes per hectare.

New Sri Lanka sugar factory[14]. — An agreement was signed in Colombo recently between the authorities of India and Sri Lanka for the establishment of a new sugar factory in the latter country. The project is scheduled to have an annual production capacity of 44,000 tonnes of sugar.

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1 *Sugarcane Breeding Inst. Newsletter,* 1982, **1**, (2), 1-2.
2 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 380.
3 *Indonesia Development News,* 1982, **5**, (11), 6.
4 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 380.
5 *Biomasse Actualités,* 1982, (5), 3.
6 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 383.
7 *Reuter Sugar Newsletter,* July 15, 1982.
8 *Westway Newsletter,* 1982, (105), 16.
9 *Reuter Sugar Newsletter,* July 6, 1982.
10 *Bank of London & S. America Rev.,* 1982, **16**, 125.
11 *Public Ledger,* July 22, 1982.
12 *Reuter Sugar Newsletter,* July 27, 1982.
13 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 442.
14 C. Czarnikow Ltd., *Sugar Review,* 1982, (1620), 181.

C.I.T.S. 17th General Assembly, 1983

The 17th General Assembly of the Commission Internationale Technique de Sucrerie (C.I.T.S.) will be held in Copenhagen during May 30 – June 3, 1983. The main subjects of the technical program, arranged by A/S De Danske Sukkerfabrikker, will be "Reduction of energy requirements in sugar processing" and "Crystallization". The program will end with a full day excursion to look at DDS sugar production and beet seed breeding activities. The social program will include a welcome reception, an excursion to North Sealand and an official dinner. The Ladies' Program will include a visit to the Royal Copenhagen Porcelain factory, the Royal Reception Rooms, etc. The official languages will be English, French and German, with simultaneous translation. Registration forms will be sent out from Denmark in December 1982 and practical arrangements, including hotel reservations, will be handled by DIS Congress Service, Linde Allé 48, DK-2720 Vanlose, Copenhagen, Denmark.

New Yugoslavian sugar factory[1]. – A new sugar factory is expected to be completed next year at Zavak in Serbia. The plant will have an annual capacity of 56,000 tonnes of sugar and will cost $61 million. The equipment will come from Yugoslavia and Czechoslovakia.

Malawi alcohol project[2]. – The International Finance Corporation has approved allocation of $550,000 which will cover a quarter of the cost of a project in Malawi for expansion of alcohol production. Use of a greater amount of molasses from the Dwangwa sugar factory will raise annual alcohol production to 7.5 million litres from an original projected 4.9 million litres.

Cameroun sugar industry[3]. – The Cameroun Sugar Company produced its first sugar in 1976/77; annual output now exceeds 40,000 tonnes and is approaching the full 48,000 tonnes capacity based on its 4000 t.c.d. milling capacity. The newer Lago sugar complex, of similar capacity, is scheduled to reach full throughput in 1985/86. The factory at M'Bandjock, owned by Société Sucrière du Cameroun, is undergoing a $6.3 million rehabilitation due for completion in June 1984. Output will be 27,500 tonnes so that by 1985/86 the total capacity of the industry will be some 125,000 tonnes, against domestic consumption, currently about 70,000 tonnes, which is expected to have risen to near 90,000 tonnes. This fast rate of growth will enable Cameroun to become a net exporter instead of a net importer as at present.

Brazil plans for giving private sector control over sugar exports[4]. Government officials have confirmed as basically correct a report in a São Paulo newspaper that it was planned to transfer to private hands the sugar export sector, including sales, warehousing, transport and port terminals. The report said that the changes would take place gradually over five years beginning with the June 1983/May 1984 crop year; at present the government's Sugar and Alcohol Institute has complete control over sugar exports. Changes would be preceded by wide-ranging discussions to avoid affecting the external market adversely, the report said, quoting government sources. One proposal would be for the government to subsidize exports when the international price is below the domestic level and to levy a contribution quota when it is above. When international prices are below local ones, the exporters would submit subsidy requests at a tender and the one asking the lowest would win, according to the proposal.

Japan beet sugar production 1981/82[5]. – The 1981 sugar beet crop in Japan was damaged by low temperatures and a lack of sunshine. Sugar production amounted to 494,415 tonnes, white value, compared with 535,000 tonnes in 1980/81. The crop was grown on 73,811 hectares against 64,820 ha in 1980, and, reflecting a switch to other crops by Japanese farmers, the 1982 area has been reduced by 5.6% to 69,683 ha. Conditions for sugar beet have been favourable, with good weather and high temperatures prevailing in Hokkaido this year.

Kenya white sugar manufacture[6]. – Miwani sugar factory, near Kisumu, will start producing refined sugar in January. Kenya is currently importing some 30,000 tonnes of refined sugar a year and is otherwise self-sufficient in sugar production.

Chile sugar imports 1981[7]

	1981	1980	1979
	tonnes, raw value		
Argentina	47,649	129,230	70,070
Bolivia	0	62,672	46,681
Brazil	8,120	48,376	22,067
Colombia	5,163	107,309	98,994
EEC	5,989	2,250	26,632
Peru	0	13,522	28,863
USA	19,081	69,149	0
	86,002	432,508	293,307

Pakistan cane area 1982/83[8]. – The Ministry of Agriculture has announced that the cane area for the next crop will be 905,000 ha, a 2.88% increase over the 879,700 ha of 1981/82. The cane yield is expected to increase from 39.3 to 39.45 tonnes per hectare to give a total crop of 35,702,000 tonnes against 34,568,000 tonnes in 1981/82. Cane used for seed is expected to rise to 7,095,000 tonnes against 5,520,000 tonnes; of the balance in 1981/82 slightly more than half was used for white sugar manufacture and slightly less for gur.

Zambia sugar cane growers scheme[9]. – Contracts have been awarded to pave the way for establishing the K 17 million (£1,042,000) small growers' sugar cane scheme at Mazabuka. The Commonwealth Development Corporation executive in Zambia is quoted as saying that the initial contracts worth K 3.5 million had been placed for land clearing and field irrigation and that approximately 800 hectares of cane would be planted this year. The scheme is managed by Kaleya Small Holdings Co. Ltd. and will eventually cover some 2000 hectares. It is hoped that, when fully operational by 1986, at least 300 smallholders will be involved.

Bagasse-fired power station for Mauritius[10]. – A 110 million-rupee ($9.8 million) bagasse-fired power station is to be built with equipment supplied by Fives-Cail Babcock at Flacq United Estates Ltd. by June 1984. The project will be financed by French economic cooperation funds and government-guaranteed supplier's credits. Annual power output will be some 35 million kWh, doubling electricity production from bagasse on the island and saving 30 million rupees a year in oil imports. The Mauritius Central Electricity Board plans to build more bagasse-fired stations but its immediate priority is for a pelleting plant to enable the use of bagasse the whole year round.

Yugoslavia beet crop reduction[11]. – Although the government had planned an expansion of the Yugoslavian beet area to 179,000 ha, the 1982 area in fact reached only 142,000 ha, about 5000 ha less than in 1981, owing to the planting of other, more profitable crops by private farmers. Spring weather gave the crop a poor start and the beet crop is now estimated at 5.4 million tonnes against 6,212,000 tonnes in 1981 and sugar production in the 1982/83 is expected to reach 780,000 tonnes.

Pakistan sugar surplus problem[12]. – Only three years ago, Pakistan had to import 200,000 tonnes of white sugar to meet domestic requirements. In 1982, thanks to a bumper crop, production reached a record 1.3 million tonnes, white value, and the surplus is reported to be more than 400,000 tonnes. The government-controlled price applies to rationed sugar for domestic and commercial use; free market sugar is available for commercial customers and its price has fallen below the government-controlled price. Nevertheless, stores are full of sugar which is lying around at the factories and even in the open. This will result in losses when the monsoon rains come and further problems will arise when new crop sugar comes into production in late 1982. There is little likelihood of being able to export any sugar because the cost of production, equivalent to $388 per tonne, is substantially higher than the world market price.

1 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 455.
2 *Westway Newsletter*, 1982, (106), 10.
3 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 460.
4 *Reuter Sugar Newsletter*, August 11,1982.
5 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 461.
6 *Standard Chartered Review*, September 1982, 14.
7 *I.S.O. Stat. Bull.*, 1982, **41**, (8), iv.
8 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 491.
9 *Standard Chartered Review*, September 1982, 13.
10 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 491.
11 *World Sugar J.*, 1982, **5**, (3), 36.
12 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 476.

China sugar imports 1981[1]

	1981	1980	1979
	tonnes, raw value		
Australia	367,239	300,590	119,274
Brazil	12,883	0	41,788
Colombia	0	0	24,000
Cuba	573,246	512,095	485,625
EEC	26,422	0	99,760
Fiji	0	32,630	0
Hong Kong	67	0	0
India	0	0	22,149
Japan	0	216	0
Malaysia	1	0	0
Philippines	92,719	44,443	119,251
Thailand	112,956	56,153	73,565
	1,185,533	946,127	985,412

Thai sugar factories for sale[2]. — The Thai Rung Ruang Group has announced that it wishes to sell its eleven sugar factories and to switch to other business. The reasons are the current slump in the sugar industry and differences with the Thailand Government over sugar policy. The government plans to sell up to 600,000 tonnes of sugar a year up to five years in advance with payment from overseas buyers as loans to be used to finance the purchase of cane. The Group's statement said that this policy was risky and could mean local sugar companies facing bankruptcy.

Syria sugar production increase[3]. — Although 505,000 tonnes of beet were grown in Syria in 1979/80 on an area of 22,000 ha, only 387,000 tonnes were processed to sugar because a new factory did not start on time; sugar production amounted to 25,286 tonnes, raw value. In 1980/81 the harvest from the same area amounted to 557,000 tonnes and sugar production rose to 47,188 tonnes. In 1981/82 the planted area was increased to 27,500 ha and beet and sugar production are estimated by government officials at 698,000 and 60,000 tonnes, respectively. The beet area is expected to rise to more than 30,000 ha in 1982/83 and sugar production to more than 70,000 tonnes.

Mexico beet sugar pilot plant[4]. — The Mexican National Sugar Industry Commission plans the construction of a beet sugar pilot plant in the Mexicali valley of northern Baja California. It will be of 52,000 tonnes annual production capacity and will cost around $40 million. It will supply sugar to the local area with any surplus going to the northern border areas, saving considerably on transport costs. The near and medium term projection is for expansion of the beet sugar industry in favourable areas, according to the Commission, since plant costs are much lower than for factories to produce the same amount of cane sugar, while the by-products can be used for cattle feed. The Mexicali valley was chosen as the site for the plant because of the region's Cierro Prieto thermo-electric plant which can provide the steam needed. In addition, the soil is similar to that of the Imperial Valley in the US where very good beet yields are achieved. A total of 10,000 hectares are to be sown to beet with an expected crop of around 400,000 tonnes. However, neither Commission nor government officials have clarified whether the plans, which require substantial investment, can be carried out in view of the present economic crisis, reduction of imports and bank nationalizations.

Thailand cane crop reduction[5]. — Sugar cane production for the 1982/83 season is expected to fall to about 22 million tonnes from the 28 million tonnes recorded in the 1981/82 season. This is largely due to growers switching to other crops as a result of the low cane prices realized last season. Sugar factories have been instructed to purchase cane only from planters who have registered with the local agricultural offices in line with the cane plantation zoning policy of the Ministry of Agriculture and Cooperatives. About two-thirds of the country's 95,000 sugar cane planters are believed to have complied with this regulation.

Indonesian sugar project[6]. — C. Itoh. & Co. Ltd. and Kawasaki Heavy Industries Ltd. of Japan, teaming up with an Indonesian heavy machinery maker, are reported to have made the lowest bid in a recent international tender for the construction of a state-run sugar factory in Baturadja, in southern Sumatra. The price offered by the group is said to be about $28 million for a projected plant capable of processing 4000 tonnes of cane per day and the contract is expected to be awarded to them provided that a satisfactory conclusion is reached in talks with the government. Under Djakarta's counter-purchase policy, foreign companies are required to buy Indonesian primary products in exchange for their exports to Indonesia.

Egypt sugar imports 1981[7]

	1981	1980	1979
	tonnes, raw value		
Argentina	0	0	25,543
Brazil	198,838	146,523	84,950
Cameroun	4,093	0	0
Cuba	162,415	138,088	111,320
Cyprus	2	1	1
Czechoslovakia	11,880	5,800	0
EEC	216,101	141,979	11,010
Germany,East	45,109	0	11,957
India	0	12,479	87,407
Ivory Coast	6,000	0	0
USA	23,043	23,687	3
	667,481	468,557	332,191

EEC sugar as animal fodder[8]. — The EEC plans to sell 500,000 tonnes of sugar to the animal feed industry this year in a bid to cope with its mammoth sugar surplus resulting from yet another bumper crop. Animal feed traders say that, while the availability of denatured sugar this year will have some appeal to the compound feed industry, the scope for incorporation of sugar in feed rations is limited. Small amounts of sugar could be incorporated into sheep and chicken feeds but the main outlet would be in pig rations.

Fructose manufacture project abandoned[9]. — The California-based genetic engineering company Cetus Corporation has blamed the unfavourable world price of sugar for its decision to scrap a $8,000,000 project for the biotechnical manufacture of fructose. Earlier in the year, Cetus had announced that it would press ahead with the work, provided that a new sponsor could be found to replace Standard Oil of California, which withdrew its support in May for "technical and commercial reasons".

Bulgarian electronic beet thinner[10]. — Bulgaria is hoping to modernize its sugar beet cultivation by the use of a new electronically-controlled field-work system for thinning. The new system, designed in Bulgaria, is claimed by the press to be able to differentiate between beets, stones and weeds and thus to be able to produce "thousands of extra tonnes of beet" from the same quantity of seed and with the same amount of effort.

South African drought[11]. — Cane in Natal is in very poor condition as a result of drought. The South African Cane Growers Association has said that rain is very badly needed to save the wilting cane, with the outlook becoming more critical. The situation is reported to be not beyond hope and the cane could recover to achieve record output if rains came quickly. The 1982/83 crop is likely to be below the 2,170,000 tonnes, tel quel, estimated in mid-September. Production in 1981/82 reached 2,060,000 tonnes.

Japan tax on HFCS[12]. — The Japanese Ministry of Agriculture has introduced a surcharge on high fructose corn syrup production in order to support manufacture of domestic sugar, as expected earlier[13]. The surcharge is determined by raw sugar import prices and is expected to discourage any further expansion in HFCS manufacture but to be low enough to maintain current production levels. HFCS production in Japan increased from 162,000 tonnes, dry basis, of 42% product in 1977/78 to just over 500,000 tonnes, dry basis, in 1980/81, of which about two-thirds was the 55% product.

PERSONAL NOTES

We regret to report the death, earlier this year, of **Dr. Ramon Samaniego**, Professor of Agricultural Chemistry in the University of the Philippines at Los Baños. After graduating in 1940 he studied in the USA and Germany. He was appointed Director of the Sugar Technology Program at UPLB and contributed many papers on agricultural and sugar processing technology to the Philippines Sugar Technologists, ISSCT and to the *Crystallizer*, of which he was Editor.

1 *I.S.O. Stat. Bull.*, 1982, **41**, (8), v.
2 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 475.
3 *World Sugar J.*, 1982, **5**, (3), 35.
4 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 490.
5 *Standard Chartered Review*, September 1982, 41.
6 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 527.
7 *I.S.O. Stat. Bull.*, 1982, **41**, (8), vii.
8 *Public Ledger's Commodity Week*, Oct. 23, 1982.
9 *Chemistry & Industry*, Oct. 2, 1982.
10 *East Europe Agriculture*, Sept. 1, 1982.
11 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 524.
12 *World Sugar J.*, 1982, **5**, (4), 25.
13 *I.S.J.*, 1982, **84**, 129.

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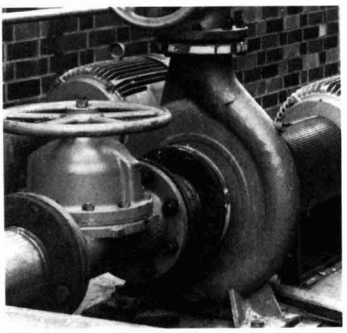
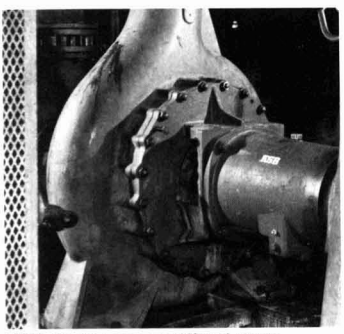


CPK-U pump handling hydrochlorid acid



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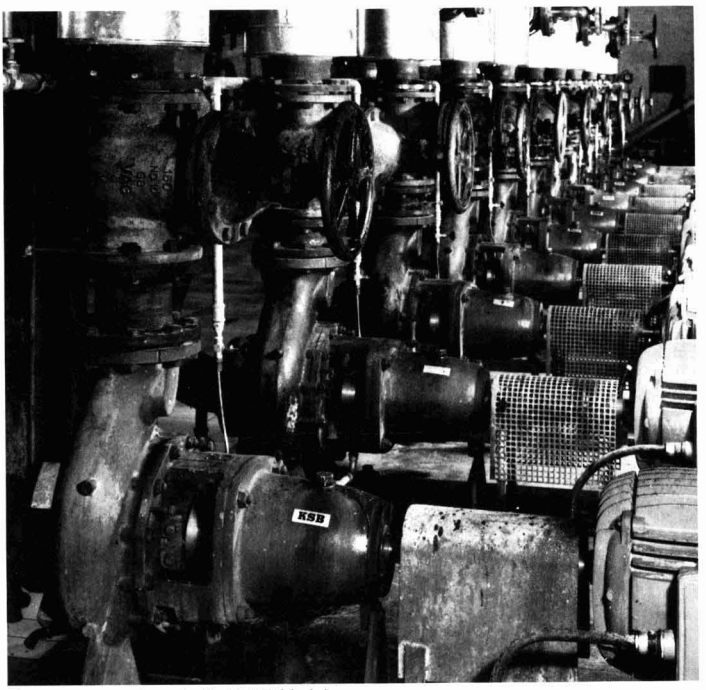
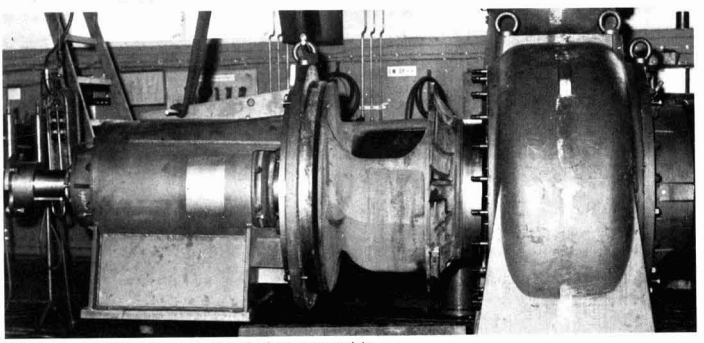


Evaporators equipped with KWP thin juice pumps



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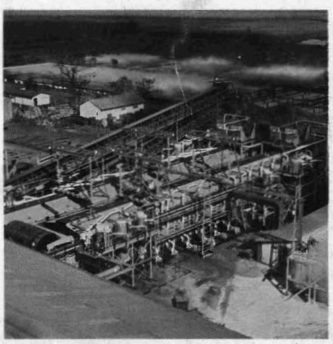

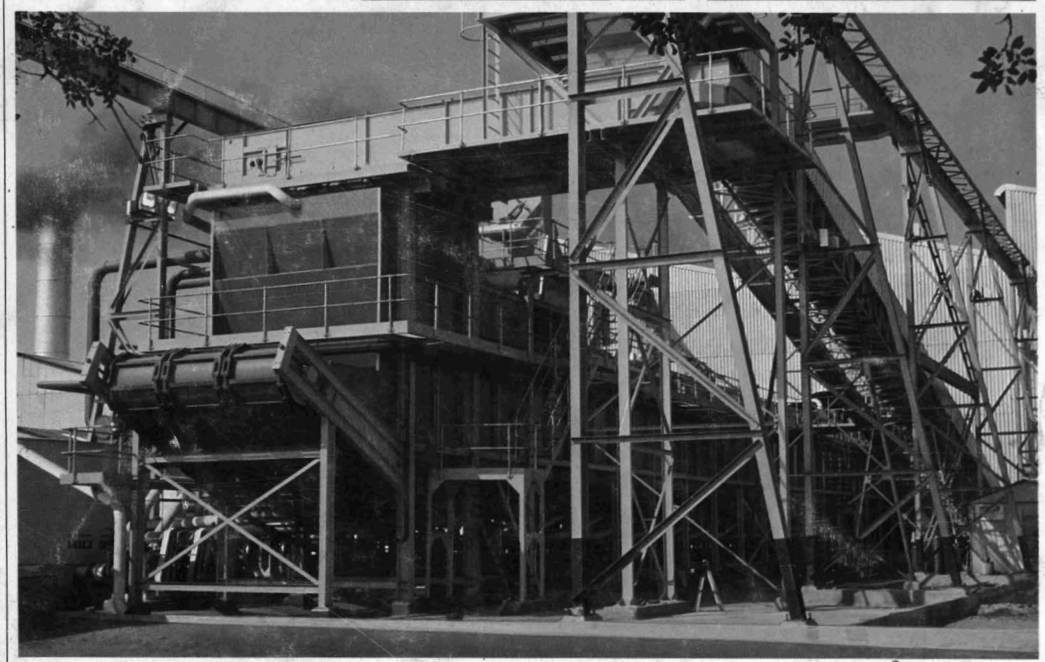

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