International Sugar Journal

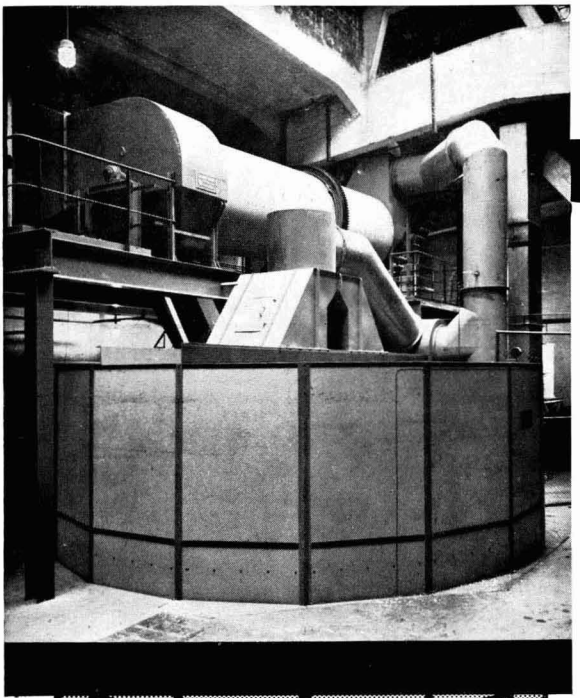
VOL. 66 *December 1964* No. 792

* * *

Published by
The International Sugar Journal Ltd.
Central Chambers, The Broadway,
London, W.5.
Telephone: EALing 1535
Cable: Sugaphilos, London, W.5.

* * *

Annual Subscription: 32s 0d or $5.00 post free
Single Copies: 2s 6d or 45 cents plus postage



BÜTTNER

Equipment and Machinery for the Sugar Industry

Rotary Dryers and Coolers
for Diffusion and Sugar Beet Pulp
Beet Tops and Fodder

Turbo Tray Dryers and Coolers
with and without Predryers for all Sugar Qualities

Screens and Bins

Dryers for Defecation Slurry

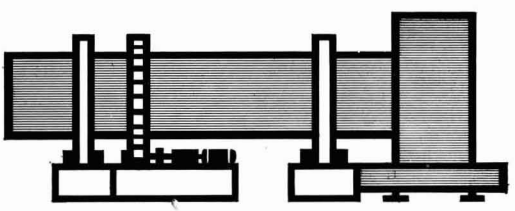
Conveyers for Defecation Slurry

Travelling Grates, Oil Furnaces for Drying Plants

Beet Top Preparation Plant
(Washing, Pressing, Shredding)

Fans, design Dr. Eck

Dust Collecting Plants, design van Tongeren



BÜTTNER-WERKE
AKTIENGESELLSCHAFT
415 KREFELD-UERDINGEN

802

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXVI DECEMBER 1964 No. 792

NOTES AND COMMENTS

International Sugar Council.

The Eighteenth Session of the International Sugar Council was held at the Seat of the Council in London on 4th and 5th November 1964. The Session was presided over by Señor FEDERICO PATIÑO (Mexico), the Chairman of the Council for 1964. It was attended by representatives of forty-three countries and an observer from the E.E.C.

The Council noted that, since its last Session, the Malagasy Republic had become a member of the Council, bringing total membership to 46 countries.

The Council appointed Mr. ERNEST JONES-PARRY as its new Executive Director in place of the late Dr. R. E. STEDMAN. Mr. JONES-PARRY is at present an Under-Secretary in the Ministry of Agriculture, Fisheries and Food for the United Kingdom.

The Council adopted the first estimate made by its Statistical Committee of the minimum net import requirements of the world market in 1965 (reproduced elsewhere in this issue). As in the past, the Committee had at its disposal many official figures; where these were not forthcoming, the Committee had to make its own assumptions based on the best information available. On that basis, minimum net import requirements of the free market for 1965 were estimated to amount to 11,689,400 metric tons; import requirements of the United States of America from foreign sources were noted at 3,075,000 metric tons raw value, making a total for the net import requirements of the world market of 14,764,400 (rounded 14,765,000) metric tons, raw value, for next year. The Council considered this estimate against the first forecast of total supplies likely to be available for the export to world destinations in 1965 and noted that, taking the year as a whole, supplies now appeared to be in excess of estimated requirements. This, in the opinion of the Council, will allow for a return to more normal stock levels.

The Council resumed its discussion of the bases and framework of a new International Sugar Agreement and provided for the continuation of this work at its next Session.

The Council unanimously elected Mr. J. O'MAHONY, of the Republic of Ireland, as its Chairman and Mr. N. C. SEN GUPTA, of India, as its Vice-Chairman, for 1965. It also approved the composition of its Committees for 1965.

The next Session of the Council will be held at the Seat of the Council in London in the second half of April, 1965.

* * *

U.S. 1965 supply quota.

Proposed sugar quotas for 1965 were announced on the 19th October by the U.S. Secretary of Agriculture and are tabulated below:

	short tons
Domestic beet	2,650,000
Mainland cane	895,000
Hawaii	1,110,000
Puerto Rico	1,140,000
Virgin Islands	15,232
Total Domestic Areas	5,810,232
Philippines	1,050,000
Argentina	59,383
Australia	172,317
Belgium	1,748
Brazil	204,535
British Honduras	3,853
British West Indies	112,954
China (Taiwan)	63,174
Colombia	27,101
Costa Rica	32,219
Dominican Republic	358,405
Ecuador	45,759
El Salvador	15,857
Fiji	42,053
France	5,328
French West Indies	39,799
Guatemala	36,914
Haiti	20,216
India	89,433
Ireland	8,002
Madagascar	6,739
Mauritius	13,898
Mexico	359,459
Nicaragua	37,483
Panama	13,330
Peru	223,214
Réunion	2,043
South Africa	98,277
Southern Rhodesia	8,423
Turkey	1,411
Venezuela	2,464
Held in Reserve*	233,977
	9,200,000

* Quantity for proration to foreign suppliers when final charges for 1964 are known.

Although consumption is expected to amount to some 9·8/9·9 million short tons, the scheduled quotas amount only to 9·2 million tons[1]. It has been stated that this low level has been decided upon in order to encourage market values to improve; whether this measure will be accepted by Congress when it re-convenes in January next remains to be seen, but clearly at some stage it will be necessary to open the way for the marketing of a tonnage approximating to total needs. In the past it has frequently occurred that initial quotas have been set at a level below estimated requirements and then, when prices have responded to the supply position, entitlements have been increased. It might also be found possible, of course, to make special provisions which would enable stocks of domestically produced sugar to be sold without these counting against their respective quotas.

The Sugar Act provisions applying to sugar originating from domestic areas and the Republic of the Philippines remain in operation until 31st December 1966 and accordingly quotas in respect of these territories have been fixed on the basis of existing regulations. Of the balance 10% has been withheld until total charges for 1964 are known, whilst the remainder has been allocated on the basis of actual deliveries during 1963 and 1964, double weight being given to current year shipments.

The recognition of the efforts by foreign suppliers to meet the needs of the U.S.A. during the months of shortage in 1963 and 1964 by allocating 1965 quotas on a performance basis will undoubtedly make a favourable impression on world suppliers and should encourage greater understanding between the producers concerned and the U.S.A. For one of the world's largest importers to take so broad a view in organizing its import requirements augurs well for international sugar trade negotiations.

Under the Sugar Act no increase can be made in the quotas of domestic areas and the Philippines until the Supply Quota reaches 9·7 million short tons. Thereafter, however, domestic beet and mainland cane areas between them share 65% of all quota increases, with the balance of 35% being shared amongst foreign suppliers other than the Philippines.

No provision has been made for the application of import fees. The Secretary of Agriculture has stated, however, that the Administration intends to recommend that a system of import fees be incorporated within long-term legislative arrangements.

* * *

Commonwealth Sugar Agreement

The British Government announced on the 30th October that it had received applications from India and Southern Rhodesia to become exporting members of the Commonwealth Sugar Agreement and had proposed that these applications, which the British Government supports, should be discussed with the other parties to the Agreement during the current series of discussions.

The British Government have been guided by the following considerations:—

(i) India and Southern Rhodesia were not sugar exporters when the Commonwealth Sugar Agreement was signed in 1951 but have since become substantial exporters,

(ii) the British commitments to purchase sugar have been reduced as a result of the termination of the bilateral sugar agreement with South Africa at the end of 1964,

(iii) this provides an apportunity for these major Commonwealth exporters to participate in the benefits of the Commonwealth Sugar Agreement, and

(iv) the inclusion of these exporters would give further strength to the group as a whole.

In respect of Southern Rhodesia the British Government's attitude is based upon Southern Rhodesia's present position within the Commonwealth. Membership of the Commonwealth Sugar Agreement is confined to the industries of member countries of the Commonwealth. If Southern Rhodesia should cease to be a member of the Commonwealth for any reason, her sugar industry would of course forfeit membership of the Agreement.

* * *

Common Market sugar policy unresolved[2].

The Ministers of Agriculture of the six member countries of the European Economic Community met in Brussels on 20th October to discuss proposals for a common sugar policy and the adoption of a common grain price. The Council made little progress on sugar with most member states sticking to their original positions, conference sources said.

The E.E.C. Commission, supported by the Benelux countries, want to control sugar beet production entirely through a common price mechanism[3], whereas Italy and Germany have proposed the setting-up of production targets for individual countries or beet-producing regions, the sources said.

France, while not supporting the production targets proposals, would like to see some additional control of production through producers' agreements and a community stocking policy. Italy has also proposed that she should be allowed certain derogations from the Community's policy because of the natural and structural disadvantages under which her beet industry labours.

There is also no agreement yet on whether there should be a link between the common grain and sugar policies, the sources said.

* * *

Our Frontispiece.

The picture forming the 1964 Frontispiece has been provided by courtesy of the Link-Belt Company and shows a cut-flight screw conveyor serving as a mingler for raw sugar and syrup in a Canadian sugar refinery. The flighting is of 24 inches diameter and pitch.

[1] C. Czarnikow Ltd., *Sugar Review*, 1964, (684), 188.
[2] *Public Ledger*, 24th October 1964.
[3] See *I.S.J.*, 1964, **66**, 137–138.

THE USE OF HERBICIDES IN SUGAR CANE

Recent Developments in Natal

By J. M. GOSNELL

RELATIVELY few planters in Natal have, until recently, made use of herbicides to control the growth of weeds in sugar cane. There are several reasons for this, but most important is the low cost of hand weeding. A secondary, but very important factor, is the erratic rainfall distribution. This is responsible for the variable results which are obtained when soil-applied herbicides are used in rain fed areas and, as these form a large part of the cane belt, the general lack of confidence in the efficacy of herbicides. In consequence, the only herbicides used on an appreciable scale are 2,4-D and PCP.

The low cost of using mule- or tractor-drawn implements for inter-row cultivation of plant cane has often limited the use of herbicides to "row only" application. In the case of ratoon crops, trashing is widely practised, the trash layer suppressing the growth of weeds, making weeding unnecessary.

Fig. 1. Effect of "Paraquat" (4 pt/acre) on a mixed population of weeds in young cane. Left control, right treated.

At present, the sugar cane industry is expanding rapidly and large scale planting programmes are either in hand or envisaged. This, coupled with a shortage of labour which is aggravated by the fact that the main planting season, September–December, falls within the main harvesting season, has created a great deal of interest in the use of herbicides. Fortunately, this development has coincided with the introduction of a number of promising new herbicides, a declining trend in new herbicide prices, and an increase in the area of land under irrigation—the latter enabling soil-applied herbicides to be used successfully. It is anticipated therefore that herbicides are likely to be used in Natal on a much larger scale than in the past.

The more important herbicides which can be used are referred to in the following discussion. In all cases, the application rates quoted refer to quantities of commercial material applied per acre.

Pre-emergent herbicides

Many pre-emergent herbicides give only poor control of weeds if they are used in rain-fed areas in the spring, when rainfall is erratic. In these circumstances "Dacthal" and 2,3,6-trichlorobenzoic acid give some degree of weed control, but both the triazines and substituted ureas have proved ineffective. Under moist conditions or in irrigated areas, "Atrazine", "Simazine", "Diuron", 2,4-D and MCPA have all given commercially acceptable weed control, but only 2,4-D and MCPA are used to any extent. None of these herbicides has given adequate control of nutgrass (*Cyperus esculentis* and *C. rotundis*), which is the most important weed in the cane belt. Successful control of nutgrass has been achieved using EPTC, but to date its high cost and the difficulties encountered in application have precluded its general use. In addition it has, under certain conditions, caused severe damage to cane. Further studies of methods of applying EPTC are planned, in an attempt to overcome these problems.

Post-emergent Contact Herbicides

The recent introduction of "Paraquat" has provided the industry with a post-emergence contact weed-killer which is more effective than the PCP, which was used previously. When vigorously growing, 9–12 in tall *Cyperus* spp. are sprayed with "Paraquat" at a rate of 2–3 pints per acre, the above-ground vegetative parts are completely scorched and good control is achieved for periods of up to one month in spring, or 6 weeks in summer (Fig. 1). Thus an extremely

laborious hand weeding operation, estimated to cost 40s 0d to 70s 0d per acre, can be completed very conveniently for 20s 0d to 30s 0d. However, in both cases, re-growth of weeds is so rapid that another "in-row" weeding or spraying may be necessary before the canopy is sufficiently dense to provide control. The costs quoted are calculated on a basis of weeding or spraying in the row only. This comprises about one-third of the total area, the inter-row being cultivated using mule- or tractor-drawn implements.

Experiments carried out under glass have shown that the optimum time for spraying *Cyperus rotundus* is 3–4 weeks after germination, or when it is coming into flower. If "Paraquat" is applied at an earlier stage, then re-growth takes place fairly quickly; delayed beyond four weeks it allows severe competition with the crop to take place.

"Paraquat" causes quite spectacular damage to cane but, provided it is applied before the 6-leaf stage is reached, it recovers very quickly. The initial effect of treatment is a severe reduction in shoot population, but this is followed by an increase in tiller formation with the result that the stick population increases to a level higher than in the case of unsprayed cane. However, spraying after the 6-leaf stage has been reached does reduce the eventual height of the cane. Cane varieties appear to differ in their susceptibility to "Paraquat" and this is shown in their comparative growth measurements. Thus N50/211 and N51/168 appear to be less affected than N:Co 382 and N:Co 376. Recently, an experiment was harvested in which "Paraquat" was applied at various levels to N:Co 376 plant cane, when this was at about the 5-leaf stage. The following results, which are the mean of 8 replicates, were obtained:—

Treatment Rates/Acre (Full Cover)	*Yield Tons Cane/acre*
"Paraquat" 6 pt	42·4
Hand weeded	42.2
"Paraquat" 4 pt + 2,4-D amine 3 pt	40·4
"Paraquat" 4 pt	37·4
"Paraquat" 2 pt	34·6
No weeding	30·7

All treatments containing "Paraquat" showed a similar degree of cane scorch after spraying. However, the fact that the highest level of "Paraquat" produced the highest yields is evidence, not only of good recovery of the cane, but also of effective weed control. Since the weeds were also scorched uniformly, greater translocation may have taken place in the treatments containing higher levels of "Paraquat".

Preliminary work with ^{14}C-labelled "Paraquat" has shown that some translocation to the rhizomes and young shoots of *Cyperus rotundus* does in fact take place, although most of the translocation is towards the apex of the leaf to which application is made. Further indication of the translocation of "Paraquat" is given in results obtained from spraying young cane with 3 pt of this herbicide per acre, at various times of day. Five replicates were sprayed as follows:

Time of Spray	*Solar radiation for 12 hours following spraying (Cal/sq. cm.)*	*Visual Scoring Damage to Nutgrass after 1 week*
6 a.m.	548	7·2
10 a.m.	364	6·4
2 p.m.	57	8·4
6 p.m.	5	8·6

Solar radiation was measured with a Kipp solarimeter situated ¼ mile from the experiment. Scoring was carried out on a basis of 0 = no weed control, 9 = complete weed control. The results confirm the work of BALDWIN[1] who reported that more efficient translocation of dipyridilium compounds had been obtained when a period of darkness followed spraying.

The inclusion of a wetting agent ("Agral 90") is usually an advantage when using "Paraquat", but in the case of *Cyperus* spp. visual observation suggests that no such advantage is gained. This is probably due to the fact that nutgrass foliage retains aqueous sprays to a much greater extent than many other weeds[2]. It follows therefore that with mixed weed populations, the use of a wetting agent would still be recommended.

"Paraquat" is effective against a wide variety of broad-leafed and graminaceous weeds in cane. Good control of perennial grasses, especially *Panicum maximum*, has been achieved but the period of control is frequently inadequate.

Good control of weeds has been obtained using "Diquat", another contact herbicide, but it is less effective than "Paraquat", particularly for the control of grasses. The recovery of cane after spraying with "Diquat" was no quicker than that sprayed with "Paraquat"[3], although the cane was not so badly scorched in the first place[3].

Post-emergent Systemic Herbicides

"Dalapon" and TCA have both been in use for some years with rather variable results. When soil moisture is adequate, TCA effectively controls grass weeds and, to a certain extent, nutgrass. It is normally applied at 15–20 lb per acre but these rates are usually inadequate for control of perennial grasses and higher rates damage the cane. "Dalapon" has given similar results, although it is less dependent on soil moisture and is somewhat more toxic to cane, especially at levels higher than 7½ lb/acre. Furthermore, there appear to be varietal differences in susceptibility to "Dalapon", N:Co 339 being a great deal more susceptible to damage than Co 331. Thus effective control of perennial grasses, especially *Panicum maximum*, with systemic herbicides, has not yet been achieved. Pre-planting treatment with "Dalapon" is the best method available at present.

[1] *Nature*, 1963, **198**, 872.
[2] ENNIS *et al.*: *Weeds*, 1952, **1**, 274.
[3] THOMPSON & GOSNELL: *Proc. 37th Congr. S. African Sugar Tech.*, 1963, 143.

Fig. 2. Weed control achieved using 1½ lb "Bromacil" and ½ pt "Paraquat" per acre, row only. Rain-fed cane.

Fig. 3. Adjacent plot unweeded.

"Diuron" with a wetting agent (WK) applied as post-emergence treatment has been far more successful than when it is applied as a pre-emergent herbicide. Under irrigated conditions it can usually be recommended at a rate of about 4 lb per acre for mixed weed populations. "Linuron" has given quicker but shorter-lived weed control than "Diuron", and would not seem to be such a useful herbicide.

An encouraging recent development in the field of systemic herbicides has been the introduction of "Bromacil". In preliminary trials, this herbicide has given outstanding long-term control of mixed weed populations under both dry land and irrigated conditions which make it more useful than "Diuron".

"Bromacil" applied at rates of 4–6 lb/acre—the optimum rate perhaps depending on soil organic matter—causes fairly severe yellowing and stunting of cane, followed by reddish necrosis of the leaves—these symptoms remaining for about one to two months after spraying. Recovery thereafter is good, but yield data are not yet available. Lower rates of "Bromacil" (2–4 lb/acre) have given useful weed control without causing any apparent damage to the cane. Further work is planned on rates of application of "Bromacil" using several varieties of cane.

Mixtures

"Paraquat" has proved to be a particularly useful component of herbicide "cocktails" (Figs. 2 and 3). At a rate of 2 pints per acre on a full cover basis, it has given outstanding weed control, when used in conjunction with either "Bromacil" or "Diuron" at 2–4 lb/acre. "Paraquat" causes a severe initial scorch, especially of *Cyperus* spp., while the residuals suppress both these and other species until the cane canopy is sufficient to control weeds in the row. A "Paraquat" + TCA mixture has also proved effective, while "Paraquat" + 2,4-D is a valuable mixture, in which 2,4-D contributes mainly towards residual control of broad-leafed weeds.

Conclusions

Whilst in the past a number of factors have militated against widespread use of herbicides in the Natal cane belt, changing conditions, especially shortage of labour and an increase in its cost, an increase in the acreage irrigated and a decline in herbicide prices have brought about a marked increase in the use

of herbicides. Variability in soil moisture conditions is mainly responsible for the erratic responses achieved using soil-applied herbicides, especially pre-emergents. However, outstanding short-term post-emergence control of *Cyperus* spp. has been achieved using "Paraquat", provided spraying is carried out 3–4 weeks after emergence. In this case, damage to cane although it may be severe in appearance, is usually not important, provided the cane is fairly young at the time of spraying. A mixture of "Diuron" or "Bromacil", a wetting agent and "Paraquat" has been found to be very successful as a general purpose herbicide "cocktail". "Bromacil" appears to be a promising post-emergent systemic formulation for use in rain-fed areas, although its effect on cane yield has yet to be determined.

VARIETY POSITION OF THE SUGAR CANE INDUSTRY IN BRITISH GUIANA

ATTENTION has been drawn to the changing variety pattern in British Guiana in reports that have recently appeared[1]. There has been a further reduction in the percentage contribution of B 37161 to the total crop, this variety being second only to B 41227 in terms of acreage. The latter has increased in importance and now accounts for 50% of the crop. The acreages of B 47258, B 47225 and Pindar have continued to decline.

The most significant increase in acreage was that of D 141/46 which accounted for 1·9% of the 1962 acreage, as compared with 0·5% in 1961. This variety occupied at least 20% of the 1962 plantings and it was estimated its total contribution to the next crop would be 5·3%.

D 37/45 and D 158/41 have also shown considerable increases in acreage although still only very minor varieties, the former being almost entirely confined to the East Coast Estates and the latter to the county of Berbice (Rose Hall Estate). The variety B 5116 has rapidly increased, especially in the Berbice area, where the Sugar Experiment Station trials have shown it to be very useful.

In the detailed report on variety trials a table summarizes the performance of the most promising varieties under trial. This is intended to give only a very rough indication of the likely value of a variety, for no distinction has been made for performance on different soil types.

F.N.H.

Sugar cane irrigation. L. G. LOZADA. *La Ind. Azuc.*, 1964, **69**, 115–117.—This is information abstracted from an article on cane irrigation in Venezuela. Advantages and disadvantages of 5 different methods of irrigation are discussed.

* * *

Anhydrous ammonia for crop use. C. R. VON STIEGLITZ. *Producers' Rev.*, 1964, **54**, (4), 41.—With the use of this source of nitrogen now of interest to cane growers in Queensland in the form of "aqua ammonia" (anhydrous plus water) the writer gives an account of its history and development, also of its physical and chemical properties and effects on the soil.

* * *

New chemical gives cleaner cane. A. N. JOHNSTON. *Producers' Rev.*, 1964, **54**, (4), 47.—The advantages of "Fenatrol" in cane fields are stressed, this weedkiller having been well tried out in northern Queensland. It efficiently controls annual summer grasses when applied after the last cultivation, doing away with the "difficult-to-burn crop" which causes trouble in mechanical harvesting.

* * *

Plastic drainpipes success in salt removal. ANON. *Producers' Rev.*, 1964, **54**, (4), 65.—Experience in Australia is that plastic drainage pipes may be installed more cheaply (20–60%) than earthenware pipes and have many advantages, especially lightness and easy handling. One ton of salt every three days was removed from one 4½-acre site.

* * *

Aqua ammonia safety precautions. ANON. *Producers' Rev.*, 1964, **54**, (4), 69.—These notes are for Queensland cane growers using this form of nitrogenous fertilizer. As it is a 25% solution, as against 3–10% for household ammonia, it can cause severe burns and damage the tissue of eyes, throat and lungs if carelessly handled. It is corrosive to zinc, copper and aluminium alloys. Equipment for it may be of iron or steel.

* * *

Cane fire danger on power line easements. ANON. *Producers' Rev.*, 1964, **54**, (4), 73.—Damage to 132,000-volt transmission lines was caused when sugar cane was burned prior to harvesting. This caused blackouts in large areas of North Queensland and considerable inconvenience to consumers.

* * *

The fertilizing of sugar cane. G. S. DIMAS ORTEGA. *Bol. Esta. Exp. Cana de Azúcar de Occidente* (Venezuela), 1964, **69**, 34 pp.—An account is given of the analysis of various sugar cane soils in Venezuela and details of their response to N, P and K fertilizers, for both plant cane and ratoons.

[1] *Sugar Bulletin* (Department of Agriculture, British Guiana), 1963, (31), 53 pp.

Promising new herbicide. ANON. *Producers' Rev.*, 1964, **54**, (4), 85.—Information is given about the new hormone weedkiller "Tordon" [Dow Chemical (Australia) Pty. Ltd.] under trial with sugar cane in Queensland. In preliminary tests it proved successful with annual weeds at a rate of 1–4 oz per acre and with perennial weeds and bracken at 4 lb per acre.

* * *

Mosaic spread fast in 1964. L. L. LAUDEN. *Sugar Bull.*, 1964, **42**, 200.—In Louisiana mosaic disease has spread much more rapidly this year, in all major varieties of cane, than for many years in the past—since 1925 according to one estimate. Heavy infestation of sour thistle aphid is blamed, weather conditions being very favourable for both thistle and aphid. This aphid is considered to be the most effective transmitter of mosaic disease.

* * *

Researches on underground water in Mauritius. R. SENTENAC. *Mauritius Sugar Ind. Res. Inst., Occasional Papers*, 1963, (15, 16 & 17).—These three papers refer to the investigations in different districts of Mauritius. The work may well be of great benefit to the sugar industry.

* * *

Sugar gradients and translocation of sucrose in detached blades of sugar cane. C. E. HARTT and H. P. KORTSCHAK. *Plant Physiology*, 1964, **39**, 460–474.—This paper describes experiments in translocation in detached leaf blades of sugar cane over a long period using two varieties of cane. Velocity in detached blades was 0·4 cm per minute, as against 0·7 to 2 cm per minute with attached blades, sucrose being the principal compound moving. Rates are given for different light intensities.

* * *

Aphid infestations in sugar beet seed crops. W. J. S. KERSHAW. *Plant Pathology*, 1964, **13**, 90–91.—Results of a survey of aphids (*Myzus persicae*) on sugar beet seed crops, including the winter months, are recorded. Aphid populations varied considerably. The total population of these potential virus yellows vectors on the 3000 acres of sugar beet and mangold seed crops in Britain was estimated at 17,000 million.

* * *

Sugar beet seed production experiments. J. L. SNEDDON. *J. Nat. Inst. Agric. Bot.*, 1963, **9**, 333–345. In transplanted plots (at Cambridge) during the years 1955–60 yields were increased by closer spacing, autumn as opposed to spring planting, and nitrogen applications. Topping had no effect. Bolting appeared to be related to air temperature.

Growth of the sugar beet crop. D. J. WATSON. *Rothamsted Experiment Station, Report for* 1963 (*Botany Dept.*), 1964, 85–86.—Studies on the interaction of spacing and variety were carried out on different soils in three areas—Rothamsted, Broom's Barn and Ely. Closer spacing might also produce smaller, more uniform beet, more suitable for mechanical harvesting. The increased payment in 1963 for sugar contents above 16% and larger penalties for those below, revived interest in the Z strains of sugar beet, bred for high sugar content.

* * *

Filterpress cake as manure for tomatoes. H. AZZAM and G. SAMUELS. *J. Agric* (Univ. Puerto Rico), 1964, **48**, 55–59.—Various combinations of filter-press cake and starter solutions were used in experiments on a low-humus, sandy-clay soil of Río Pedras. Filter press cake increased marketable yield by 6·76 tons per acre. Filter press cake plus starter solutions are recommended for tomato production in Puerto Rico.

* * *

Transmission of beet yellows virus by alate and apterous aphids. G. D. HEATHCOTE and A. J. COCKBAIN. *Annals Appl. Biol.*, 1964, **53**, 259–266.—*Myzus persicae alatae* and *apterae* were constantly better vectors of sugar beet yellows virus than *Aphis fabae*, but there was little difference between the ability of *alatae* and *apterae* of each species to transmit. None became infective after feeding on the plant for only 5 minutes; a few were infective after feeding for 30–60 minutes.

* * *

The net accumulation of some mineral elements by sugar cane during the vegetative period. R. DIEZ *et al. Bonplandia*, 1962, **1**, 143–157; through *Soils and Fertilizers*, 1964, **27**, 257.—Monthly accumulation was recorded of N, P, K and Ca in the above-ground parts of a cane variety grown in a sandy soil very low in nutrients, except K. Variations in the soil content of N, P and K, within limits, did not much alter the general trend of the nutrient-absorption curves. It was concluded that fertilizer applications should be split.

* * *

Effect on yield and sucrose content of some major elements applied to sugar cane by spraying or in irrigation water. I. MOGILNER *et al. Bonplandia*, 1963, **1**, 245–257; through *Soils and Fertilizers*, 1964, **27**, 257.—Various salts (of B, Mn, Mo, Cu, Zn and Ni) were sprayed once or twice (at concentrations of 0·005–0·1%) or supplied in irrigation water at time of planting. Two sprayings of 0·005% $CuSO_4$ and $ZnSO_4$ (after shooting and a month before harvest) gave promising results.

Evaluation of pesticides against sugar cane mite. R. LAL *et al. Indian J. Agric. Sci.*, 1962, **32**, 305–308; through *Rev. Appl. Entomology*, 1964, **52**, Ser. A, 272.—Investigations were carried out at New Delhi to evaluate the residual effectiveness and ovicidal efficiency of several compounds against *Schizotetranychus andropogoni*, a web-forming mite pest of sugar cane. "Kelthane" appeared to be the most promising, both in residual effect and as an ovicide.

* * *

Blister mite damage to sugar cane in Mysore. M. PUTTARUDRIAH and G. P. CHANNABASAVANNA. *Mysore Agric. J.*, 1960, **35**, (4), 226–227; through *Rev. Appl. Entomology*, 1964, **52**, Ser. A, 272.—An unidentified Eriophyid mite spread rapidly on sugar cane in several areas of Mysore State, causing stunting and twisting of the leaf margins. Damage was found to be closely related to the number of gall-like blisters at the bases of the leaf sheaths.

* * *

Response of sugar beet to low soil moisture at two levels of nitrogen nutrition. R. S. LOOMIS and G. F. WORKER. *Agron. J.*, 1963, **55**, 509–515.—Both N deficiency and moisture stress reduced growth and increased sucrose concentration in roots. Beet purity and sucrose yield were increased by N deficiency but not by moisture stress. Allowing sugar beets to wilt just before harvest, by discontinuing irrigation, did not increase yield or quality.

* * *

A method of grafting F_1 hybrids of crosses of *Beta vulgaris* with species in the *Patellares* section. Z. SZOTA. *Hodowla Roslin Aklimatyzacja i Nasiennictiwo*, 1962, **6**, 105–110: through *Biol. Abs.*, 1964, **45**, 3552.—An easy method of grafting sugar beet with other species is described. Sugar beet cuttings at the first leaf stage are used. Takes were practically 100%. The plants reached the flowering stage.

* * *

Varieties of sugar beet. ANON. *Farmers' Leaflet* (National Institute Agric. Botany, Cambridge), 1964, (5), 6 pp.—Brief descriptions are given of varieties recommended by the Institute for cultivation in Britain, 16 in all. The leaflet is intended to help farmers in this choice of variety.

* * *

Response of eighteen consecutive sugar cane crops to N-P-K in Puerto Rico. J. A. BONNET. *Univ. Puerto Rico Agric. Exp. Sta. Tech. Paper*, 1963, (38), 63 pp. Fertilizer experiments begun in 1943 are reported and analysed; their main objective was to determine the best N-P-K fertilizer level per year to sustain optimum yields and quality.

Leaf scorch of sugar cane in the Philippines. O. R. EXCONDE. *Philippine Agriculturalist*, 1963, **47**, 271–297.—The detailed investigation on cane leaf scorch (*Stagonospora sacchari* Lo et Ling) here described is claimed to be the first of its kind in the Philippines (the disease is troublesome also in Taiwan) and was carried out at the Pathology Laboratory of the College of Agriculture, U.P., with financial and other assistance from the Victorias Milling Company. The morphological, physiological, cultural and diagnostic characteristics of the disease are dealt with, also suggestions for control based on experimental work and trials with fungicides. Burning of infected trash is considered important. The planting of resistant cane varieties is recommended. The varieties at present grown in the Philippines are listed according to their degree of resistance to the disease.

* * *

The effects of temperature, variety, and age on the response of *Saccharum* to gibberellic acid. T. A. BULL. *Australian J. Agric. Res.*, 1964, **15**, (1), 77–84; through *Biol. Abs.*, 1964, **45**, 5390.—Gibberellic acid treatment increased stalk length, fresh weight and fibre and sugar contents but decreased leaf area and leaf weight. Magnitude of response differed with variety, age of plant, and temperature.

* * *

Effects of long-term application of nitrogen to cane. A. SINGH. *Empire J. Exp. Agric.*, 1964, **32**, 205–210. The effect of long-term application of three sources of nitrogen (farmyard manure, groundnut cake and ammonium sulphate) on sugar cane from 1949 to 1962 was studied at the Sugar Cane Research Station, Muzaffarnagar. Relative yield responses for farmyard manure, groundnut cake and ammonium sulphate were found to be in the ratio of 2:3:4. Analyses showed no important changes in pH and organic matter content. It was considered that ammonium sulphate-treated plots had a greater production of root residues and that this maintained organic matter content; also that continuous use of ammonium sulphate with cane is conducive to higher yields and that it has no deleterious effect on the fertility and productivity of the soil.

* * *

Studies in the control of nut grass (*Cyperus rotundus*). R. G. NAIR and P. CHAMI. *Indian J. Agric. Sci.*, 1964, **34**, (1), 66–70.—This reports experiments in the control of nut grass (in coconut plantations) with chemical weedkillers. Of the three weedicides—"Bihedenol", "Tributon" and "Dowpon", the first two, at concentrations of 13·5 kg or more per hectare, were found to be effective. In 1962 only "Dalapon" was successful. This chemical, at a concentration of 5 kg per hectare, gave 86% mortality; at a high concentration of 20 kg per hectare it gave complete mortality.

RAW SUGAR POLARIZATION

Investigations carried out on the proposed Standard Method II for the determination of the ICUMSA Polarization of Raw Sugar

By D. G. PORTER and R. SAWYER

Introduction

At the Twelfth session of the International Commission for Uniform Methods of Sugar Analysis which took place in Washington in 1958, a method for the polarization of raw sugars was proposed for study with a view to its adoption as a standard method[1,2]. This method is essentially that which is at present in routine use in this laboratory. Subsequently, the International Referee for Subject 21 (Polarization of Raw Sugars) put forward an alternative method for consideration by the Associate Referees[3]. This alternative procedure was designed to take advantage of recently developed high precision automatic polarimeters employing Faraday effect compensation. The proposed method differs from the established method in three ways ; it substitutes a weight/weight method for a weight/volume method of preparing solutions, centrifugation is used instead of filtration, and the automatic polarimeter is used instead of the conventional visual instrument. These changes were made with the aim of minimizing experimental error.

The proposed method has been examined with the object of assessing its suitability for routine use in the laboratory. More than fifty samples of sugar, from a wide range of countries, have been examined, both by the new technique and simultaneously by the established official method. It has been found that the proposed method gives results that are low in comparison with the established method, and that there is a correlation between the magnitude of this difference and the polarization of the sugars.

Table I

Polarization values of a bulk sample of raw cane sugars

	Established method	*Proposed method*
	96·55	96·39
	96·49	96·37
	96·50	96·41
	96·54	96·40
	96·42	96·42
	96·48	96·43
	96·48	96·44
	96·52	96·43
	96·46	96·39
	96·47	96·35
	96·47	96·40
	96·50	96·38
Average	96·49	96·40
Standard deviation	0·036	0·026

The polarization values tabulated above are the results of twelve separate determinations carried out on a bulk sample of a raw Trinidad sugar.

Experimental

Preliminary investigations indicated that there was a small, but significant, difference between results obtained by the two techniques. The results of this preliminary work will be found in Table I. Further work was indicated in order to confirm the existence of, and to locate the source of, this difference. Since the difference was so small, standardized techniques of manipulation were evolved so as to minimize possible experimental errors.

The two instruments used in this work were:—

(a) Hilger and Watts "Microptic" Standard Visual Polarimeter Mk. III fitted with a sugar scale graduated in divisions of 0·1°S, which could be interpolated to 0·01°S, and used with sodium yellow (5893Å) illuminant.

(b) Bendix Ericsson Automatic Polarimeter Type 143A, coupled with a pen recorder which gave a full scale deflection over any prescribed interval of 5° Sugar Scale; the chart could be interpolated to 0·005°S. The instrument illuminant was a tungsten lamp with narrow band interference filter which gave maximum transmission at 5423A.

Both of these instruments were set up in the same temperature-controlled room operating at 20°C. Most of the preparatory work was carried out in this same room; it was necessary, however, to perform the weighing and centrifuging operations in an adjacent non-temperature controlled room. Time spent in this room was kept to a minimum.

Since the photoelectric polarimeter is sensitive to small temperature changes, care was taken to ensure that solutions in the polarimeter cell attained thermal equilibrium with the polarimeter before readings were taken. When a steady state had been achieved the pen recorder was allowed to draw a trace for ten minutes. The resulting two inch line was cut at ten equidistant points and the polarization was taken as the average of these ten values. With the visual instrument, ten settings were made and the average was deduced. The filled polarimeter tube was left in the instrument for at least five minutes before any readings were made.

Bulk samples of sugars from various sources were obtained and after sieving and mixing well were stored in airtight jars. Twenty nine samples of cane sugar from fifteen countries and thirteen samples of beet sugar from seven countries were examined. A

[1] Referee's report, *Proc. 12th Session ICUMSA* 1958, 84–86.

[2] Referee's report, *Proc. 13th Session ICUMSA.*, 1962, 83.

[3] *ibid.*, 84–85.

further seven samples of low polarization sugars were also studied. Polarization determinations were carried out simultaneously both by the proposed technique and by the established method. The recorded polarization values are the mean of at least three separate determinations carried out on different days. The proposed method was adhered to as far as was possible ; one amendment had to be made, however, since a high speed centrifuge was not available. The solutions were centrifuged until they were clear enough to read in the visual polarimeter (10 minutes was usually sufficient).

Results

The polarization values obtained are summarized in Tables II and III. It can be seen that the proposed method tends to give results that are low in comparison with those obtained using the established method. The average value of the difference between the two methods is + 0·05°S for cane sugars and + 0·08°S for beet sugar; the average discrepancy in both cases is highly significantly different from zero. The difference in results between methods decreases with increasing polarization, and tends to zero at 100°S.

Table II
Polarization values of cane sugars

Source	*Established method*	*Proposed method*	*Difference*
Antigua	97·57	97·62	—0·05
Australia 1	98·83	98·81	0·02
Australia 2	98·67	98·62	0·05
Australia 3	98·79	98·79	0·00
Australia 4	98·62	98·55	0·07
Barbados 1	97·26	97·24	0·02
Barbados 2	97·03	96·97	0·06
Br. Honduras 1	97·94	97·91	0·03
Br. Honduras 2	98·29	98·21	0·08
Cuba 1	96·50	96·39	0·11
Cuba 2	98·09	98·06	0·03
Cuba 3	96·18	96·11	0·07
Dominican Republic	97·77	97·73	0·04
Fiji	98·66	98·62	0·04
India	97·23	97·12	0·11
Jamaica 1	97·58	97·56	0·02
Jamaica 2	96·96	96·90	0·06
Jamaica 3	96·71	96·66	0·05
Mauritius	99·09	99·08	0·01
Peru	97·39	97·35	0·04
South Africa 1	98·81	98·77	0·04
South Africa 2	99·09	99·07	0·02
S. Rhodesia	97·70	97·61	0·09
St. Kitts	97·36	97·33	0·03
Trinidad 1	96·60	96·55	0·05
Trinidad 2	96·96	96·91	0·05
Trinidad 3	97·01	96·96	0·05
Trinidad 4	97·07	96·94	0·13
Trinidad 5	98·30	98·25	0·05
Mean			+0·05

Table III
Polarization values of beet sugars

Source	*Established method*	*Proposed method*	*Difference*
Bury St. Edmunds	98·59	98·49	0·10
Ely 1	98·76	98·77	—0·01
Ely 2	97·14	97·08	0·06
Peterborough	98·12	98·05	0·07
Wissington	97·99	97·92	0·07
Belgium	97·53	97·44	0·09
Czechoslovakia	99·98	99·93	0·05
France	98·08	98·03	0·05
Poland 1	96·82	96·67	0·15
Poland 2	97·59	97·46	0·13
Poland 3	96·71	96·58	0·13
Rumania	99·88	99·82	0·06
Russia	99·94	99·90	0·04
Mean			+ 0·08

Regression analysis shows that over the range of polarization 96°S to 100°S, relationships of the following form occur:—

Cane sugar

$P_I - P_{II} = 1{\cdot}68 - 0{\cdot}0167\ P_I$

correlation coefficient, $r = -0{\cdot}40$

Beet sugar

$P_I - P_{II} = 2{\cdot}46 - 0{\cdot}0242\ P_I$

correlation coefficient, $r = -0{\cdot}64$

where P_I = polarization by the established method

P_{II} = polarization by the proposed method.

Interpretation of results

HOPEWELL and WILSON, who assisted in the development of the proposed method, have examined 1200 Australian raw sugar samples in order to compare the two techniques[4]. They claim that results by the proposed method are in close agreement with those by the conventional method and at the same time are very much more precise, i.e. reproducible. The latter claim appears to be justified and will be discussed in more detail later (under "Repeatability"). Work carried out in this laboratory, however, does not confirm their claim that the two methods give the same polarization figures. A possible explanation of these conflicting conclusions may be that HOPEWELL and WILSON have examined only cane sugar samples taken from a limited area.

As a result of investigations carried out in this laboratory it is possible to put forward a tentative explanation for the disagreement between results obtained by the two methods. With cane sugars the difference appears to be the sum of the precipitate volume error[5] and an error arising from the effect of coloured solutions[6] which modify the effective wavelength of the light in the Ericsson polarimeter. A further complication is introduced with beet sugars where the difference between results by the two methods is greater than it is with cane sugars. This may be explained if we consider one of the assumptions made in calculating results in the proposed method.

The weight/weight method of preparing a solution for polarization requires an accurate knowledge of the density of the solution and its total weight. The density is calculated from the weight of sugar taken and the weight of the solution obtained; in doing this the moisture content of the sugar is ignored. HOPEWELL and WILSON have shown that for Australian raw cane sugar the slight dilution effect of the

[4] *ibid.*, 79.
[5] GASKIN and HANDS: *Analyst*, 1953, **78**, 334–339.
[6] MESLEY: *I.S.J.*, 1962, **64**, 7–8, 37–39.

moisture in the sugar is balanced by an increase in density caused by impurities present.

We have been able to confirm their findings, not only for Australian cane sugars, but for nearly all cane sugars, regardless of their country of origin. The moisture content of raw beet sugar, however, tends to be much higher than that of raw cane sugar, but it does not have a correspondingly higher proportion of impurity. The dilution effect of the moisture will not therefore be balanced by an increase in density due to the presence of impurities. As a result, the proposed method will tend to give a larger polarization discrepancy in the case of beet sugars than it will with cane sugars.

Further work would be necessary to confirm the explanations outlined above and to place them on a quantitative basis.

Comments on the proposed method

1. *Errors in manipulation*

There are four possible sources of operator error in the established method. These are:

(i) Weighing 26·00 g of sugar: This can be done accurately if sufficient care is taken, but, in routine work with large number of samples, the temptation to assume that a weight is "near enough" is always present. In the proposed method, provided that the weights indicated by the balance are recorded correctly, errors in weighing are virtually eliminated. One must also consider the possibility that a change in the moisture content of the sugar might occur owing to prolonged exposure to the air when weighing out 26·000 g $\pm$ 0·002 g of sugar.

(ii) Adjusting the volume of solutions to 100 ml: Here again, some accuracy may be lost when large numbers of samples are being dealt with. Errors may occur both in diluting to the mark and in adjusting the solution temperature to 20°C. One must consider, also, differences in interpretation of the level to which the meniscus should be adjusted[7]. This manipulation is eliminated in the proposed method.

(iii) Evaporation during filtration: This can arise if the filter funnel is not covered effectively, and also if there is a delay in filling the polarimeter tube once sufficient filtrate has been collected. Errors due to evaporation can be quite serious in a temperature-controlled room employing a system of forced ventilation; they are reduced, however, in the proposed method.

(iv) Reading the polarimeter: The personal errors which arise in setting the polarimeter can be minimized by taking the average of a large number of readings. Disadvantages of this procedure are that it takes more time and that it is self-defeating since it rapidly induces eye strain. This difficulty does not arise when a photoelectric polarimeter is used.

2. *Other sources of error*

The errors discussed above can be reduced to a very low level by careful attention to practical technique. The new method is designed to eliminate them entirely. There are two other possible sources of error in the established method not arising from faulty technique, which will also be elimated by the new method. These are:—

(i) Errors in the reputed capacity of the volumetric flasks used. In this laboratory these flasks are re-calibrated when new; any whose capacity falls outside the range 100·00 ml $\pm$ 0·02 ml are rejected. Regular re-calibration is essential to detect any flask whose capacity has changed either with age, or as the result of mis-handling.

(ii) The precipitate effect. This has been the subject of investigation by a number of workers for some years, most recently by GASKIN and HANDS[6].

The proposed technique, which does not require a volumetric method of preparation, eliminates both these errors.

3. *Repeatability*

The standard deviation of a routine polarization test carried out in this laboratory *at the rate of* 25 *per day* is 0·06°S. When all possible precautions are taken to minimize errors *and the number of samples examined per day is small* this standard deviation can be reduced to 0·04°S. The standard deviation of a polarization carried out carefully by the proposed method is 0·03°S. One would expect a similar figure for routine work, but since the proposed method has not been put into routine use in this laboratory it is not possible to check this assumption.

We can, however, compare these figures with the claim of the International Referee (R. W. RUTLEDGE) that the proposed method when in routine use in his laboratory gives a standard deviation, for a single polarization test, of 0·03°S[8]. He also records his observations, made in his capacity as ICUMSA International Referee, on the results of polarization tests carried out by the established technique in laboratories all over the world. He found that nearly all laboratories had standard deviations within the range 0·05 to 0·09°S.

4. *Calibration of the photoelectric polarimeter*

The Ericsson polarimeter does not give a direct indication of the degree of rotation of a sugar solution. It has to be calibrated by means of pure sucrose solutions the rotations of which have been determined previously by use of a conventional visual polarimeter. The standard deviation of a calibration figure determined on the visual instrument is 0·02°S. If we compare this figure with the standard deviation of a single polarization test by the proposed method of 0·03°S we see that the major source of error in the proposed method lies in the calibration of the Ericsson polarimeter. These figures suggest also that the originators of the method have succeeded in their aim of reducing to a minimum those experimental errors that arise in manipulation, viz. weighing, making to the mark and filtering.

[7] GASKIN: *I.S.J.*, 1955, **57**, 163–165.
[8] Referee's report, *Proc. 13th Session ICUMSA*, 1962, 78.

This necessity for the calibration of the photoelectric polarimeter is its chief drawback. Any laboratory that wishes to use it for sugar polarization must also possess an accurate visual instrument. No matter how much care is taken, the accuracy of the photoelectric instrument can never be any greater that that of the visual polarimeter. Any errors arising in calibration, for example in reading the calibration solution or the quartz control plate, temperature fluctuations, or variations in the light source, will be reproduced in all readings obtained on the photoelectric instrument. On the other hand, once calibrated by means of a series of very careful readings of a standard sucrose solution on the visual polarimeter, the photoelectric instrument will go on working for the rest of the day with no appreciable deterioration in the precision of reading. This is not true for readings obtained using the visual instrument, since it is impossible to maintain the standard of accuracy that one can achieve with the single solution necessary for the calibration of the photoelectric polarimeter. In routine work in this laboratory a series of twenty-five solutions are examined and the precision of reading tends to fall off through the series as the result of eye fatigue.

5. *Calculation of results*

The proposed method entails a rather lengthy calculation to obtain the polarization figure. Calculation by means of logarithms is out of the question. It would take the whole of a working day to obtain the results for 25 samples using 5-figure logarithms; in fact, the calculation really demands 7-figure logarithms. Some form of calculating machine is essential. By using a suitable electrically-operated machine it is possible to carry out the calculations for 25 samples in about 1½ hours. If the magnitudes of the variables involved in the calculation were kept as small as possible by using suitable dispensing apparatus for water and for basic lead acetate solution it might be possible to construct a set of tables for use in working out the polarization value. These might be more rapid in use than a calculating machine.

A digital display unit for the polarimeter is also a necessity for routine work. If a pen recorder is used the scale reading has to be converted to a polarization reading before it can be used for calculation; with twenty-five samples half an hour would be required for this conversion.

Conclusions

The proposed method gives polarization values that differ from those obtained by the established method. This discrepancy is most serious with low polarization (96–98°S) samples, being particularly pronounced in the case of raw beet sugars.

There is no "true" or "correct" polarization for a sample of raw sugar. A polarization is an arbitrary figure obtained by following a specified sequence of operations. We cannot, therefore, validly criticize the proposed method solely on the grounds that it gives a different polarization.

The established technique is accepted and used internationally and has evolved after many years of development. Considerable resistance might be met in any attempt to substitute a new method. The new method, however, is proposed as an alternative to the established method. It would clearly be unsatisfactory to have two ICUMSA official methods with give apparently non-concordant results. The advantages of adopting the proposed method as the sole official method would not be so great that they would compensate for the confusion that would arise as the result of, in effect, adopting a new polarization scale.

Leaving aside the discrepancy between the results, we find that the choice between the two methods depends very much upon the requirements of the individual laboratory. One must consider the level of accuracy required, the skill and experience of the staff available, the numbers of samples that have to be examined and the availability of the necessary apparatus.

Both methods are potentially capable of a similar degree of accuracy, but whereas the proposed method should give good results even in the hands of relatively inexperienced operators, the established method requires a considerable amount of practice as well as a high level of care, and attention to detail, to give the same repeatability.

If one needs a method of determining polarizations which in routine use will give a standard deviation of 0·03°S, then the proposed method is ideal. In practice, a lesser degree of accuracy is often satisfactory. If the higher degree of accuracy is really necessary, then perhaps there should be some provision in the method for ensuring that the sample is homogeneous. One might also consider whether the level of accuracy that is being sought is justifiable when one takes into account the difficulty of obtaining a representative sample from a large bulk.

The proposed method contains three new elements; preparation of solutions on a weight/weight instead of a weight/volume basis, the use of centrifugation instead of filtration, and the use of a new type of polarimeter. There does not appear to be any objection, apart from the cost involved, to the use of a centrifuge or a Faraday compensated polarimeter. The chief source of disagreement between the two methods appears to be in the weight/weight method of preparation of the solution. If this is accepted, the proposed method would seem to offer several advantages. It is more precise than the established method, requires less skill on the part of the operator and is particularly suited to the development of a semi-automatic technique, using a recording balance, solution dispensers and a print-out unit for the polarimeter, for example, in the examination of large numbers of samples.

Acknowledgment

We thank the Government Chemist for permission to publish this paper.

FLUORESCENCE MICROSCOPY OF SUGAR CANE

By D. WITHY

(Colonial Sugar Refining Co. Ltd. Research Laboratories, P.O. Box 39, Roseville, N.S.W., Australia)

THIS study was undertaken in an attempt to relate minor structural differences in cane varieties with their milling characteristics.

In sugar mills numerous varieties of cane are crushed and each forms a certain type of bagasse or residue after the juice has been removed. The bagasse consists of pieces of node, internode, rind, pith, fibres and various combinations of these. There is a range of particle size, dependent on preparation, from the largest pieces, up to 3–5 inches long, down to the smallest microscopic particles. As some juice remains in the bagasse after the first crushing, the bagasse is then macerated with water and crushed again, and this process is repeated several times in the milling train.

Two types of bagasse are generally found, one in which the composite particles are described as "fibrous" and "stringy", and the other which is known as "powdery"; for example the variety Pindar characteristically breaks up into a fibrous bagasse, whereas Badila gives a powdery bagasse.

Other workers in this field [1,2] have attempted to use classical anatomy, e.g. size of fibrovascular bundles, length of sclerenchyma fibres, etc., to correlate structure with these bagasse characteristics but have met with little success.

The phenomenon of lignification of parenchyma has been known for several years although we have found no reference to lignin patterns in pith parenchyma. With the aid of the fluorescence technique[3] we have succeeded in delineating lignin patterns in mature cane parenchyma and relating them with the bagasses formed during crushing.

The method requires the dye Acridine Orange (1:75,000 w/v) buffered to pH 7·4 with phosphate buffer. The specimens (10 μ thick) are stained for twenty minutes, washed for the same time and, after mounting, are studied under the microscope using a high pressure mercury vapour lamp as the light source and the necessary Zeiss blue BG12 and Kodak orange 15G filters.

Examination of the sections showed that the lignified cell walls stained a brilliant yellow green and the cellulose, a deep red. By this method it was easy to distinguish between the lignified and the non-lignified cells of the parenchyma tissue surrounding the fibrovascular bundles in the pith region.

Four types of lignification pattern have been found and cane varieties can be grouped into one or other of these types as shown in the following table. Over ten commercial varieties have been classified in this way as well as other canes used for breeding purposes.

Table I

Type	*Variety*
I (no lignification)	Badila
II (mottled lignification)	Ragnar, 40SN 746
III (radial lignification)	Pindar, Triton, Q.57, 40SN 1133, N:Co 310, POJ 2878.
IV (complete lignification)	Vidar, Jason

Varieties belonging to types I and IV give rise to powdery crumbly bagasses, whereas stringy, fibrous bagasses result from types II and III. These findings show that in canes where the pith parenchyma is heterogenous in character, that is, both lignified and non-lignified cells are present, then zones of weakness exist between these two classes, since the lignified cells tend to be hard and brittle and the non-lignified cells soft and elastic[4]. This difference is sufficient to allow fracture planes to start up and down the inside of the stalk so that when the cane is subjected to crushing a stringy fibrous material is the result.

In the case of the completely lignified and non-lignified parenchyma, which is homogenous one way or the other, no zones of weakness occur, and hence powdery bagasses are the result.

Strength differences between the highly lignified thick cell walls of the fibrovascular bundles and the thin walled parenchyma also exist but this phenomenon is common to all canes, and is important only in general break-up.

It is necessary to note that this property is not related in any way to the "toughness" of canes which are resistant to crushing but it does afford an explanation for the types of bagasses produced during milling.

One of the difficulties encountered during the crushing season is the need to mill simultaneously canes which give the different types of bagasses. It is hoped that the present work will be useful in controlling canes released to growers, so that other properties such as high sugar content, disease resistance, etc., being equal, canes which form the same bagasse can be grown for milling.

ACKNOWLEDGMENT

The author is indebted to the Colonial Sugar Refining Company Limited for permission to publish this paper.

[1] RAMANUJAM: *Proc. 9th Congr. I.S.S.C.T.*, 1956, 63–69.
[2] HUTCHINSON *et al.*: *Proc. B.W.I. Sugar Tech.*, 1954, 165.
[3] WITHY: Submitted to *Stain Technology*.
[4] ESAU: "Plant Anatomy." (John Wiley & Sons Inc., New York.) 1958.

ESTIMATION OF COMBUSTION LOSS IN PULP DRIERS

By A. CARRUTHERS, J. F. T. OLDFIELD and H. J. TEAGUE

Paper presented to the 17th Tech. Conf., British Sugar Corp. Ltd., 1964.

NORMAL procedures for deducing losses in driers require estimation of the dry substance in molasses, pressed pulp and molasses pulp and estimation of the weights of pulp and of molasses fed to the drier for comparison with the weight yield of molassed dried pulp. Variations in the molasses addition and in dry substance and the difficulties in weighing the feed materials give rise to considerable uncertainty in the methods.

To try to avoid these uncertainties, a method is now proposed for estimating the combustion loss by chemical analysis without invoking either the weight of materials entering and leaving the drier, or the relative proportions of molasses and pulp in the feed. The latter ratio however can be deduced from the procedure. Unlike the traditional procedures, the estimate does not include physical loss of material carried as solids through the cyclones or chimneys.

Theoretical considerations

If the feed to the driers consisted of a single homogeneous mixture, the combustion loss could easily be estimated by measuring the concentration of any convenient component X per 100 g of dry substance in the feed and in the dried pulp. The recovery, R, of dry substance from the drier per 100 solids fed would then be:

$$R = \frac{\text{concentration of } X \text{ in feed}}{\text{concentration of } X \text{ in dried pulp}} \times 100$$

This simple method cannot be applied to the analysis of the molasses:pressed pulp mixture fed to the driers because no single component is known to have a sufficiently similar concentration in both plain pulp and molasses. If the concentration of X were lower in pulp than in molasses, an under-estimate of the molasses addition or a surge in the molasses feed would give erroneously high estimates of the losses. Over-estimates of molasses addition would erroneously lower the loss.

This difficulty would be avoided if there was a suitable constituent present in molasses but absent in pulp and another measurable constituent was present in pulp but absent in molasses. The constituent peculiar to molasses would be diluted by the pulp and concentrated by any combustion loss, while the pulp constituent would be diluted by the molasses and concentrated by the same combustion loss. Consequently two simultaneous equations could be deduced to calculate the combustion loss.

Although no two suitable constituents are known to fulfil the above conditions, the simultaneous equations can also be deduced for any two constituents common to both molasses and pressed pulp provided

1. The concentration of each constituent relative to dry substance in pulp and in molasses was very different.
2. One component was present in the higher concentration in molasses while the other component was the more abundant in pulp.

Potassium and calcium can satisfy these conditions. The majority of the potassium in beet is extracted during diffusion so that potassium is more abundant in molasses than in pulp. Only a small proportion of the calcium in beet is extracted in diffusion and, if the juice is carbonatated to low lime salts, calcium is more abundant in pulp than in molasses.

If physical losses through the cyclones and chimneys are neglected, all of the potassium and calcium fed to the drier will remain in the molassed dried pulp and cyclone dust. The recovery of dry substance and the proportion of molasses in the feed can be deduced as shown below, without knowledge of the weights of dry material involved, from the potassium and calcium contents of molasses, pressed pulp, and molassed dried pulp.

Let potassium and calcium % dry substance in molassed dried pulp be K^* and C^*

Let potassium and calcium % dry substance in molasses be K and C

Let potassium and calcium % dry substance in pressed pulp be k and c.

Let us feed an unknown amount M of molasses and $(100 - M)$ of pulp to drier (dry weights).

Then the feed to the drier is:

$$\text{Potassium} = 0{\cdot}01\,[KM + k\,(100 - M)]$$
$$\text{and Calcium} = 0{\cdot}01\,[CM + c\,(100 - M)]$$

If R is the recovery of dry substance from the drier per 100 solids fed:

$$0{\cdot}01\,R\,K^* = 0{\cdot}01\,[KM + k\,(100 - M)] = 0{\cdot}01\,[M\,(K - k) + 100k]$$

$$\text{and } 0{\cdot}01\,R\,C^* = 0{\cdot}01\,[CM + c\,(100 - M)] = 0{\cdot}01\,[M\,(C - c) + 100c]$$

$$\text{Hence } R\,K^* - 100k = M\,(K - k) \quad \ldots\ldots\ldots\ldots (1)$$

$$R\,C^* - 100c = M\,(C - c) \quad \ldots\ldots\ldots\ldots (2)$$

Dividing (1) by (2)

$$R\,K^*\,(C - c) - R\,C^*\,(K - k) = 100k\,(C - c) - 100c\,(K - k) = 100\,(kC - Kc)$$

$$\text{Hence } R = \frac{100\,(kC - Kc)}{K^*\,(C - c) - C^*\,(K - k)}$$

$$\text{or, } R = \frac{100\,(Kc - kC)}{K^*\,(c - C) + C^*\,(K - k)} \quad \ldots\ldots\ldots (3)$$

Having found R, the molasses addition can be calculated from equation (1).

$$M = \frac{R\,K^* - 100k}{K - k} = \text{molasses dry substance per total dry substance} \quad \ldots\ldots(4)$$

The potential errors of sampling and analysis lessen with increasing difference between the analytical values in pressed pulp and molasses.

There is little scope for increasing the ratio of potassium in molasses to that in pulp. There would however be considerable advantage in choosing a factory with very low lime salts, to give low molasses calcium, and also with a high calcium in pulp since the calcium ratio is smaller than the potassium ratio. High pulp calcium is obtained if the diffusion make-up water is naturally hard and the value increases considerably if calcium treatment is practised. Unless the calcium chloride addition is uniform, the treatment provides a potential danger owing to severe fluctuations in pulp calcium which can nullify the improved calcium ratio.

Experimental

The calculation is illustrated by experimental results from the drying plant at Peterborough, where the calcium ratio is rather unfavourable. Six samples were taken of each material, the dried samples being taken 30 minutes after sampling the feed. Each individual sample was a composite of from 4 (for molasses) to 40 (for pressed pulp) sub-samples collected over a period of 10 minutes.

In the Büttner and Buell driers, the cyclone dusts were returned to the dried pulps in positions prior to the dried pulp sampling points but the dust from the Imperial cyclones returned to a mixture of pulp from different driers and so the outfall from the Imperial driers and the dust were sampled separately. Sample matching is difficult with the relatively small production of dust, but the figures for dust analysis are included as their similarity to the dried pulp analysis demonstrates that the dust does not consist of high ash residues as would be the case if the fine material was excessively burnt in the drier.

The pulp samples were dried to constant weight at 100°C and ground to a powder in a mill. Samples weighing 5 g were ashed at 700°C, after charring over a low flame; for the determination of calcium and potassium the ash was extracted with 20 ml hot 20% hydrochloric acid and made up to volume with water. Calcium was determined by EDTA titration and potassium by flame photometer.

The analytical results are shown in Table I and the recovery of dry substance from each type of drier, calculated from the mean results, are recorded in Table II.

Similar series of pulp and molasses samples were taken at three other factories. The mean results of these analyses are shown in Table III and the calculated recovery of dry substance from the driers at these factories in Table IV.

Table I

Analysis of Peterborough Pulp Samples—8th January, 1964. Ca and K expressed as % Dry Substance

	Sample No.						
	1	2	3	4	5	6	*Mean*
Molasses to Pulp							
Ca	0·16	0·17	0·17	0·17	0·17	0·17	0·17
K	4·45	4·57	4·57	4·45	4·45	4·45	4·45
Pressed Plain Pulp							
Ca	0·63	0·60	0·59	0·61	0·70	0·69	0·64
K	0·52	0·53	0·54	0·53	0·53	0·55	0·53
Molassed Dried Pulp							
Ca							
Imperial Drier	0·52	0·53	0·53	0·54	0·51	0·53	0·53
Imperial Dust	0·48	0·53	0·53	0·55	0·51	0·53	0·52
Büttner Drier	0·52	0·54	0·53	0·51	0·50	0·57	0·53
Buell Drier	0·50	0·54	0·53	0·53	0·51	0·57	0·53
K							
Imperial Drier	1·55	1·60	1·58	1·58	1·63	1·57	1·58
Imperial Dust	1·44	1·48	1·55	1·53	1·53	1·54	1·51
Büttner Drier	1·59	1·58	1·61	1·60	1·61	1·54	1·59
Buell Drier	1·65	1·63	1·62	1·63	1·62	1·59	1·62

Table II

Calculated Recovery of Dry Substance from mean results for all samples

Type of Drier	*Recovery %*
Imperial	97·8
Imperial Dust	100·3
Büttner	97·6
Buell	97·1

Table III

Analysis of Pulps from other Factories Ca and K expressed as % dry substance

	Newark 31.12.63	*Nottingham* 21.12.63	*Spalding* 19.12.63
Molasses to Pulp			
Ca	0·06	0·05	0·10
K	4·02	4·41	5·00
Pressed Plain Pulp			
Ca	0·57	1·06	0·57
K	0·54	0·21	0·51
Molassed Dried Pulp.			
Ca	0·44	0·87	0·43
K	1·46	1·18	1·95

Table IV

Recovery of Dry Substance from Driers at other Factories

Type of Drier	*Newark*	*Nottingham*	*Spalding*
Imperial	101·9	—	—
Büttner	96·3	96·3	97·8

It is interesting to note that none of the losses approach the values generally assumed for drier losses but it must be remembered that the molasses addition was low in the last campaign and this probably contributed to low losses.

Total sweetening matter in molassed pulp

Simultaneously with the sampling of plain pressed pulp, molasses and molassed dried pulp for analysis, samples of molassed pressed pulp were collected from the ducts feeding into the individual driers. Any fluctuations in the relative proportions of molasses and of pressed pulp are naturally reflected in molassed pressed pulp analysis and so individual samples do not provide a reliable basis for analytical conclusions, but confirmatory evidence can be obtained from examination of a series of samples.

The molassed pressed pulp samples were dried at 100°C and ground in a mill to obtain uniform subsamples. Aliquots of the powder were extracted for 30 minutes at concentrations of 4 g/100 ml in cold water. The total sweetening matter (T.S.M.) in the extract was determined after acid hydrolysis following the procedure normally employed for T.S.M. in molasses and these values were compared with T.S.M. in molassed dried pulp determined by the same procedure.

The individual results for the Peterborough series and the overall means for sampling at the remaining factories are recorded in Tables V and VI.

Table V
Total Sweetening Matter of Peterborough Pulp Samples
T.S.M. % dry substance

Drier	*Imperial*		*Buttner*		*Buell*	
Sample	*Molassed Pressed Pulp*	*Molassed Dried Pulp*	*Molassed Pressed Pulp*	*Molassed Dried Pulp*	*Molassed Pressed Pulp*	*Molassed Dried Pulp*
1	17·6	18·0	17·6	18·1	18·3	17·7
2	18·1	18·4	17·7	19·0	18·5	18·5
3	18·8	18·3	17·8	18·9	18·4	18·8
4	19·0	19·0	18·9	19·6	18·8	18·7
5	19·1	18·9	17·7	19·6	17·8	18·4
6	18·1	18·8	17·8	17·8	18·1	17·3
Mean	18·4	18·6	17·9	18·8	18·3	18·2

Overall means: Molassed Pressed Pulp 18·2%
Molassed Dried Pulp 18·5%

Table VI

Analysis of Pulp from other Factories
Mean T.S.M. % dry substance

		Molassed Pressed Pulp	*Molassed Dried Pulp*
Newark	31.12.63	25·5	26·2
Nottingham	21.12.63	20·9	20·5
Spalding	19.12.63	20·5	22·2

Despite the limitations of sampling molassed pressed pulp, it is clear that, under the conditions of drying at the 4 factories, there was very little if any loss of T.S.M. in the driers. If the destruction of sweetening matter in the drier were to be less than the loss of dry matter there would be an apparent increase in T.S.M. per 100 dry substance through the driers but it is more usual to expect a loss of T.S.M. during drying. The drier inlet gas temperatures for the Büttner and Buell driers were fairly high, ranging from 850°C at Peterborough to between 1000°C and 1060°C at the other factories but, as shown below, the rate of molasses addition was relatively low. It may be that there is some loss of T.S.M. when drying pulp with heavy molasses additions but, under the conditions experienced, the T.S.M. was sufficiently unchanged during drying to permit an alternative estimate of the proportion of molasses in the drier feed in terms of the T.S.M. per 100 dry substance in molasses, in plain pulp, and in molassed dried pulp:

$$\text{i.e. } M = \frac{100\ [\text{T.S.M.}_{\textit{dried pulp}} - \text{T.S.M.}_{\textit{plain pulp}}]}{[\text{T.S.M.}_{\textit{molasses}} - \text{T.S.M.}_{\textit{plain pulp}}]} \quad (5)$$

The proportion of molasses in the drier feed was therefore calculated both from the simultaneous equations derived for potassium and calcium analysis (equation 4) and from determination of T.S.M. (equation 5) and the results are recorded in Table VII.

Table VII
Calculated Molasses Addition to Pulp

		Molasses D.S. per 100 Total D.S.	
		Calculated from K and Ca analysis	*Calculated from T.S.M.*
Newark	31.12.63	24·9	28·1
Nottingham	21.12.63	22·0	24·9
Peterborough	8·1·64	26·3	25·3
Spalding	19.12.63	31·1	29·2

It is not suggested that T.S.M. analysis provides a particularly suitable method for assessing molasses addition and indeed the method would fail if the combustion losses were high whereas this limitation does not apply to the assessment of molasses addition from potassium and calcium analysis. Having found the combustion losses to be low, the T.S.M. assessment is included merely as confirmatory evidence to substantiate the values obtained from the simultaneous equations since some of the calculated molasses feed rates are rather lower than expected. As calculated from the formulae the molasses addition *M* is expressed as weight of molasses dry substance per 100 total dry substance in molassed pulp which gives values which are about 92% of those obtained by the less precise expression in terms of actual weights (total molasses % molassed pulp).

Discussion

The experimental results are recorded above to illustrate the application of potassium and calcium analysis to the calculation of combustion losses in driers. The results are only applicable to the particular conditions experienced during the sampling and firm conclusions should not be drawn from the actual values since the extent of physical losses of pulp through the cyclones and chimneys is still unknown.

If the potassium and calcium in plain pulp and molasses remain constant, the calculation is not influenced by fluctuation in rate of molasses feed, changes in drier temperature or the extent of mixing within the drier but with these fluctuations, the calculated loss and calculated molasses addition would refer specifically to each sample of molassed dried pulp. A number of samples of molassed dried pulp would then be required in order to assess the average loss and average molasses addition.

In practice, the molasses composition showed only minor fluctuations and mixing within the driers was sufficient to smooth out most of the effects of molasses feed rate and of variation in composition of plain pulp. The plain pulp analysis, however, did not remain constant; although the potassium content did not vary greatly, the calcium content fluctuated considerably during sampling. These fluctuations presumably arise from differences in composition of the beet and varying calcium content in the return water system of the diffuser and it is doubtful whether the situation could be dramatically improved by altering the sampling procedure. Probably the greatest improvement could come from a uniform addition of calcium chloride to the feed water both to raise the calcium level and also to override the natural calcium fluctuations in the beet. Since mixing within the drier prevents matching of individual samples into and out of the drier, the calculations of losses and molasses

addition have been applied only to the overall mean values for the series of samples to minimize the effects of variations in calcium content of pressed pulp.

The procedure could be adapted and simplified if any of the feed rates or weights were known precisely from alternative sources. For example, if the molasses addition M were known independently, it would be possible to calculate the combustion losses solely from the potassium measurements.

As an illustration, if the potassium content of molasses and plain pulp were as recorded in Table I but the molasses addition M were 34% (equivalent to 37% molasses on dried pulp), then the potassium content of molassed dried pulp would be 1·84 per 100 D.S. with zero combustion loss or 1·98 per 100 D.S. if the combustion loss were 7%. These potassium concentrations, which are clearly different from the experimental values in Table I, can readily be distinguished from each other and consequently the actual combustion loss can be calculated from the potassium content of the molassed dried pulp.

It is concluded that potassium and calcium determinations can provide useful information concerning losses in pulp driers, either alone as a measure of combustion loss, or as confirmatory evidence in conjunction with conventional loss assessment, or, if a reliable estimate of total losses could be obtained independently, as a means of separate assessment of combustion losses and physical losses in the pulp drying operation.

SUGAR PRODUCTION IN SOUTHERN RHODESIA[1]

The first trial cane fields in the Lowveld area in the south-east corner of Southern Rhodesia were planted by a pioneer farmer, Mr. T. M. MACDOUGALL, who built a tunnel through 1400 feet of solid granite to take water from the Mtilikwe River to a canal which could serve 5000 acres. By 1936 a sugar factory, purchased from Beneva in Natal, had been erected. In 1954, the Triangle Sugar Estate, the private company formed in 1934, was bought by a syndicate of Natal sugar planters, and a new company was formed to develop the production of sugar and other foodstuffs.

In 1957 approximately 99% of the share capital of this company was purchased by Sir J. L. Hulett & Sons (Rhodesia) Ltd., of which it is now a subsidiary. On 25th June of this year a £12 million factory was opened, which in 1964 is expected to have produced 120,000 tons of raw sugar. A second factory was purchased from Mauritius and commenced operations in October 1962. The crop from this is expected to be 45,000 tons of raw sugar in 1964. Thus, whereas all sugar for home consumption had been imported, it is now all supplied locally with a surplus available for export. Triangle have also made a start in crop diversification with the cultivation of tobacco, cotton, wheat and lucerne and are extending their activities into the field of animal feed production and other enterprises.

The Lowveld sugar industry is being given a further boost by the plans to build a second sugar factory for Hippo Valley Estates Ltd. five miles from the existing one. The £5 million required for the factory and extension of the cane area to 21,000 acres has been raised principally from the Anglo-American Corporation of South Africa, Rhodesian Breweries Ltd. and Tate & Lyle Ltd. The main contractors are A. & W. Smith & Co. Ltd., who are installing a 15-roller tandem of 84-inch mills with a grinding capacity of 250 t.c.h. Tate & Lyle Technical Services Ltd. have been appointed as consultants. Modifications to conventional sugar factory design provide for the generation of heavy electrical loads out of season to work the large pumping stations for irrigation purposes and meet the growing domestic needs of the new Chiredzi township, since the Electricity Supply Commission is unable to supply these remote areas from the main grid. Some of the boilers in the sugar factory will therefore be burning coal instead of bagasse.

Within the next three years, Triangle and Hippo Valley, together with the Chirundu Sugar Estates Ltd., who run one factory which in 1962 produced approximately 13,000 tons of 96° pol sugar, are expected to produce more than 300,000 tons of sugar.

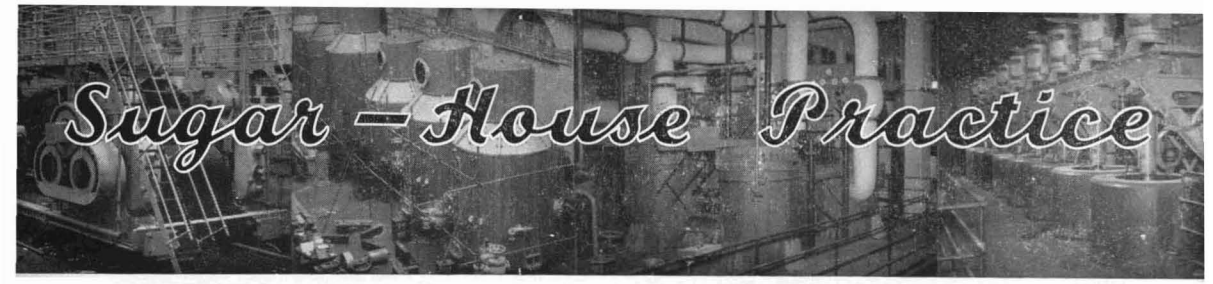
Further plans are afoot to extend the area under cane and the generation of hydro-electric power is planned; a dam at Chiredzi is at present under construction and many more are to be built. By 1967 a total of 69,000 acres should be under irrigation, while the known potential of the Lowveld is 600,000 areas of irrigated land. By 1967 the sugar industry in the Chiredzi-Hippo-Triangle area will probably be employing some 60,000 people.

The exporting of sugar will necessitate improvements in transporting facilities and to this end Triangle have agreed with Caminhos de Ferro Moçambique (C.F.M.) to assist in the cost of erecting a bulk loading terminal at Lourenço Marques in Mozambique. This will have a storage capacity of 60,000 tons of sugar and is due to come into operation in 1966. The Southern Rhodesian government has also erected a branch railway line with spurs to the sugar estates. It is expected that the terminal and the railway will help save some £2·5 per ton of sugar.

Thus, by 1967 the Southern Rhodesian government will have spent a total of £9·4 million while private spending on the part of the sugar estates will amount to some £21·5 million.

The picture is one of an energetic drive to increase the country's economy and establish a healthy sugar industry in an area which has lain dormant for centuries and which receives less than 16 inches of rain a year.

[1] *Tate & Lyle Times*, August 1964; *S. African Sugar J.*, July 1964.



Sugar research in Natal. (Ann. Rpt. 1963.) *Comm. Sugar Milling Res. Inst.*, 1964, (61), 25 pp.

A laboratory vacuum pan of 6 litres capacity with conductivity and B.P.E. controls operated satisfactorily and a 10 litre pan was subsequently built. The aim of these is to investigate factors affecting the refining quality of raw sugar, in view of the poor filtrability and "stickiness" of Natal raw sugar. Although gums formed when cane deteriorates do not greatly affect clarification, their presence in syrup was found to be capable of retarding crystallization almost to stopping point. The gum content of crusher juice from fresh, healthy cane was found not to exceed 0·3% on Brix. The "stickiness" of Natal raw sugar found by Japanese refiners was found to increase with decreasing pol, particularly below 96·5, but was mainly caused by too low a moisture content; a safety factor not lower than 0·20–0·21 (0·23) is therefore recommended for the moisture content. The temperature of the sugar and molasses used to lower the pol was to be kept to a minimum. Later reports from Japan indicated satisfactory handling. Tests in which a De Laval separator was used to remove from cold mixed juice the floc formed when the pH is dropped to 3·2 by introducing SO_2 (Dymond's acid pre-clarification) have given promising preliminary results. While the Jeffco cutter-grinder of Australian origin satisfactorily disintegrated fairly large cane samples at a sufficient speed for representative sub-samples to be analysed immediately, some parts were insufficiently robust. A Rietz "Varigrator" used for the analysis of the sub-samples was modified and is to be tested. The cutter-grinder and "Varigrator" were used to study the possibility of basing a method for checking the performances of individual mills on the analysis for absolute juice % fibre of bagasse samples removed from them. Preliminary results showed that the data were more reliable than those obtained in the conventional manner. Discouraging results were obtained in studies of (1) the changes that occur when a solution of sucrose, calcium hydroxide and a manganese salt is aerated, (2) the effect of sucrose and sucrose octa-acetate on phenol formaldehyde resins, and (3) the formation of sodium derivatives of sucrose with various solvents for sucrose. Sucrose polarization with prior addition of borax[1] was tested with final molasses and mixed juice samples. With the final molasses, addition of borax was found to give a pol greater than the sucrose content by 1·666 units, whereas the normal pol was 1·484 units lower than the sucrose content. With mixed juice the pol with borax added was greater than normal pol by 0·0043–0·0582 units but was 0·0025–0·010 units lower when the clarified juice was sampled. Mathematical expressions have been obtained from statistical analyses of refined and mill white sugars relating sulphated ash, total cations and conductivity of the aqueous solutions at concentrations of 5 g/100 ml and 26 g/100 ml; expressions relating raw sugar filtrability and quantities of individual non-sugars have also been obtained. No appreciable change occurred in affined sugar filtrability when the massecuite was kept in a crystallizer for a long time prior to curing, e.g. in the case of *C*-massecuites up to 60 hr. Preliminary studies on *C* massecuite crystallization showed that the crystallization rate of different samples varied appreciably. At a supersaturation on dropping of approximately 1·15, the purity drop on cooling and holding at 35°C varied from about 6 to 11 units. The time taken for *C*-massecuite to reach equilibrium at lower temperatures was considerably greater than at higher temperatures. Since maximum exhaustion was obtained by employing the maximum cooling rate, the rate of crystallization was greater with a high supersaturation at a lower temperature than with a low supersaturation at a higher temperature. Massecuite aeration increased viscosity considerably, that of a molasses sample filtered from *C*-massecuite and having about 20% (by volume) air content being double that of a similar air-free sample. A pilot-scale air slide classifier was tested on refined sugar. The device comprises a housing containing a suspended inclined stainless steel screen of such a mesh as to ensure good air distribution. Air was introduced below the screen and the fines from the sugar suspended in the air stream were separated. The air flow rate was the only significant factor affecting the modal crystal size after separation while the sugar feed rate significantly affected separation efficiency. A classifier operating with air suspension and separation by vibration gave more efficient separation, was more economical and required smaller dimensions for a given throughput. Acetic, butyric, succinic, aconitic, oxalic and malic acids have been found in fresh cane. Fumaric and glycollic acids have been identified using silica gel chromatography. While citric acid identified by silica gel chromatography had the same chromatrographic pattern as an acid from fresh cane juice, it did not have the same identity on a paper chromatogram. Acetic and butyric acids are apparently not connected with cane deterioration but possibly originate from microbiological activity, rather high amounts being found in freshly cut cane samples. Only small quantities of volatile acids were found in deteriorated cane juice. Fumaric and succinic acids increase by 200–300% with deterioration, possibly because of

[1] López: *I.S.J.*, 1963, **65**, 46–48, 72–73, 107–109.

enzyme activity which continues after the cane has been cut. Lactic acid has not been found in deteriorated cane. Paper chromatographic analysis of hydrolysates of gums from fresh and deteriorated cane showed that in both glucose is the main compound, with some arabinose also present. A preliminary analysis is given. Laboratory tests in which cane was kept in vessels through which moist air was passed showed hardly any increase in the gum content, although several moulds were growing on the cane. In dry atmosphere the gum content increased from 0·20% to 2·6% on solids after 20 days' dry storage compared with 0·50% after 21 days of moist air storage. Chromatographic analysis with a column of "Amberlite C.G.120" showed no great differences between the quantity of free amino acids in juice from fresh and stored cane. Syrup boiled in laboratory vacuum pans, which are briefly described, tended to yield a better quality raw sugar from irrigated than from non-irrigated cane. The sugar from the laboratory pans had better filtrability and a lower non-sugar content than did sugar boiled in factory pans from the same material. Decolorizing tests have been conducted with ion exchangers manufactured on a basis of cellulose and having an "open texture" which allow treatment of solutions of a colloidal nature without risk of blockage, as occurs with ion exchange resins. A 60–70% colour removal (measured at 430 mμ) was effected from 60°Bx raw sugar solution at 85°C, although the treatment had little effect on the other non-sugars.

* * *

Investigations into the sour storage rot problem. B. T. EGAN. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 15–26.—Further extensive investigations were made of "sour storage rot" disease of mechanically-harvested chopped cane stored over a week-end[1]. In all such cases there was a drop in c.c.s., juice purity and pH. Inconclusive field tests, handicapped by wet weather, did however indicate that the worse the cut made by the chopper-type harvesters the greater was the c.c.s. loss. While *Leuconostoc* organisms were absent in pre-harvest cane, isolation of these was possible within 19 min of harvest, the concentration being moderately high throughout the cane pieces within 17 hr. Tests with "Busan 881" bactericide showed that the c.c.s. of end-dipped cane dropped at a slightly greater rate and that *Leuconostoc* growth in cultures was evident even in the presence of 128 p.p.m. "Busan". The drop in c.c.s. increased with delay between burning and crushing, mainly owing to continued uptake of water by the cane roots. The stale cane deteriorated more rapidly than fresh cane if harvested by a chopper-type machine, the losses due to *Leuconostoc* infection easily outweighing those due to staleness alone. Some control measures mentioned could reduce the losses by at least one-third.

* * *

Bagasse milling studies. B. M. MUNRO and G. E. RUSSELL. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 45–51.—Tests were carried out with the Queensland University experimental two-roller mill to determine the effects of changing first mill feed, hot and cold imbibition and varying the Brix of the imbibition. The results were analysed statistically. The 2nd mill Brix extraction increased with increase in the 1st mill compression ratio and with finer cane preparation, but was unaffected by height of feed. The 2nd mill imbibition coefficient, total roll torque and roll vertical load showed no significant trends with the 1st mill variables studied. None of the 2nd mill factors studied showed any statistically significant variation with change in the temperature level of the added imbibition. The 2nd mill reabsorption factor increased with increase in the imbibition level while the imbibition coefficient fell with the imbibition level, suggesting that higher quantities of imbibition give a more uniform distribution of Brix within the mixture of juice and imbibition liquid. Second mill Brix extraction increased with the imbibition level, although it is suggested that the Brix of the imbibition liquid can quickly reduce any advantage gained by high imbibition levels. The imbibition coefficient varied considerably with variation in the imbibition liquid Brix. The reabsorption factor was unaffected by any changes in the imbibition quality variables, as were the total roll torque and roll vertical load. Factory data showed similar trends to the experimental mill data.

* * *

Seasonal variation of the milling and physical properties of cane. J. E. HOLT. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 53–60.—Cane samples from an area specially set aside were delivered in a pre-determined random order each week for 20 weeks to the Queensland University mill and the mechanical and extraction quantities measured and the fibre in cane and moisture in 2nd mill bagasse determined. While there was very little seasonal effect on mechanical or extraction quantities, there was a change in the distribution of Brix in cane over the season (expressed by the Brix distribution coefficient). Press tests confirmed the changes in physical properties found during the previous season, whereby the non-uniformity of Brix distribution increased as the season progressed. It was found that the less the cane is prepared the further removed will be the Brix of the first increment of juice from the average Brix of juice in the cane. It also appeared that the higher the extraction the lower is the Brix distribution coefficient, particularly at the lowest degree of preparation.

* * *

Return plate settings. D. S. SHANN. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 61–66.—A brief survey is presented of investigations into cane mill return plate operation. While it is assumed that feedability and drainage are the main factors affecting operation, the extent of knowledge on the subject

[1] *See also I.S.J.*, 1963, **65**, 369.

is very limited. Existing plate setting data from Queensland sugar factories as well as Philippine factories and Monymusk (Jamaica) factory are tabulated and discussed. Whereas the delivery roll contact angles used by Queensland mills are little different from those used in other countries, the fibre rates applied over the return plates are considerably higher than elsewhere. Although such practice, based on results, appears sound, with very large milling units being installed and the increase in crushing rates there will be a tendency for higher fibre rates per square foot of escribed roll surface. This may lead to such an increase in compaction over the plate (in both longitudinal and transverse directions) that drainage is adversely affected and the beneficial effects of low peripheral speed (whereby reabsorption is kept to a minimum) completely nullified. This can be overcome by a reasonable increase in roll speed and by laying out return plates according to a procedure which is outlined. Simple modifications to increase drainage (e.g. deep juice grooves in the back of the return place or drilled holes) may significantly affect overall extraction.

* * *

Low pressure feeding in the two roll mill. T. J. SOLOMON and C. R. MURRY. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 67–72.—Investigations of pressure feeding with the Queensland University experimental mill are discussed. Analysis of variance of the feed pressures used for the five preparation levels tested (a sixth preparation was discarded after preliminary tests) did not show any significant statistical trends because of considerable scattering. The effective coefficient of friction was calculated from the feed pressures by digital computer. It was found that friction was almost independent of the degree of preparation as found earlier[1]. Comparison of feed pressure values obtained from the theory (based on a knowledge of the coefficient of friction between the feed material and roll surface and on the pressure volume characteristic of the feed material) on the assumption of average coefficient of friction with measured values showed that the theory gives good representation of experimental trends and the measured value in most cases will be within about ± 40 lb/sq.ft. of the theoretical value.

* * *

Some notes on preparation plant in Mackay and district mills and its performance during (the) 1963 season. MEMBERS OF THE MACKAY INSTITUTE OF MILLING ENGINEERS. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 73–80.—Observations and comments on power consumption and operating problems of cane preparation equipment are presented. The average fibre content of cane is 13·5–15%, while the use of end loaders in cane fields has resulted in the frequent presence of stones in cane discharged to the carrier. The recommended mean power requirements for knives and shredders are summarized. The driving motors for the knives should be more powerful than would be required on the basis of average power consumption because of the present method of feeding the carrier by tipping the full load of a tram truck which results in severe and sudden surges in current. A wide cross carrier feeding the main carrier is regarded as a possible remedial measure. Modifications adopted to overcome the difficulties with stones are listed.

* * *

A review of the research work of Mr. J. E. Holt. M. SHAW. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 121–126.—A summary is presented of HOLT's work for a thesis on roll load prediction in cane crushing. Determinations of cane permeability with a specially designed cell (a toggle mechanism permitting cane compression to any desired compression ratio) showed that significant changes in permeability occurred with variation in the compression ratio, an increase from 1·0 to 3·0 in the compression ratio resulting in a reduction in permeability by a factor of 10,000. An insignificant variation with time was also noted, whereby the permeability decreased but then later regained the initial value. Flow per unit area was greater at the edges and sides than in the centre (in mill rolls this is due to incomplete filling of grooves). Cane preparation had a marked effect on permeability, although this was considerably smaller than that of compression. Comparison of calculated pressure distributions between rolls obtained from the permeability values in terms of compression ratio with experimental values obtained using a pressure pin showed very good agreement. Close agreement was also found between predicted and measured roll loads under the effects of variations in speed, compression ratios and preparation. It was found that the theory predicted too severe a reduction in roll load with increase in surface speed and a study of the reabsorption factor is being made. The roll load is given by $R = 0{\cdot}035\ D\ p_m(\alpha^\circ + 3{\cdot}5\phi^\circ)$, where R = roll load per foot (tons), D = roll diameter (in), p_m = maximum pressure (lb/sq.in.), α° = entry angle and ϕ° = angle of neutral plane. The maximum pressure at a speed of about 30 ft/min for 18-in diameter rolls is given by 900 (C_o — 1), where C_o = compression ratio.

* * *

The installation of a Scriven cooling tower at Isis Central mill. F. A. C. JABS. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 127–132.—Details are given of a 40,000 gal/hr cooling tower erected at Isis Central to replace the unsatisfactory spray pond system. Air is blown upwards by axial fans at the rate of 500,000 cu.ft./min and is discharged with its water vapour content through the bell-mouthed top. The water is distributed across the top of the tower and falls by gravity to the collecting pond below. The only storage is a 90,000-gal well below the tower providing 15 minutes' supply to the factory. The tower has operated satisfactorily throughout the 1963 season and enabled the crushing rate to be increased by providing greater quantities of cooling water with appreciably lower inlet temperatures.

[1] BULLOCK & MURRY: *I.S.J.*, 1958, **60**, 162–164.

Specification and design of mill gearing. R. F. BEALE and J. C. FLEMING. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 133–139.—The designing of mill gearing is discussed with respect to wear capacity, gear life and loading. The need to revise standard specifications difficult to apply to modern ideas is emphasized. The use of mill turbines involves certain problems not found earlier. The required design capacity of mill drive gearing should be determined by assessing the average milling power likely to be needed. The incorporation of a large safety factor is uneconomical and is contrary to the concept of design based on fatigue life. Wear service factors need more investigations, and gear capacity for momentary overload and for continuous reduced speeds should always be checked. While torque variations of $\pm$ 10% from the mean cover practically all load fluctuations, more frequent impulsive loading may require a higher service factor. The failure of a 10-ft gear wheel after 30 years' service at one sugar factory is attributed to a specified rim proportion that was inadequate for sugar mill conditions.

* * *

Stainless steel. K. DAVIS. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 141–149.—The properties of the three classes of stainless steel are summarized and their respective behaviour to corrosive media is discussed with descriptions of the main types of corrosion (intergranular, crevice and galvanic). Also covered is the combined effect of stress and corrosion. Some recommendations are offered for overcoming these difficulties. The advantages of welded stainless steel tubes over seamless steel tubes are discussed. The question of scale formation and removal is dealt with; the use of fermented molasses as a de-scaler and as inhibitor of attack by sulphuric and hydrochloric acids on steel is not recommended. The type and conditions of stainless steel to employ for juice heaters and evaporators are discussed. The annealing of austenitic stainless steel and the weld decay problem are considered.

* * *

The efficient use of compressed air. P. C. BEVIS and G. TOY. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 151–157.—The factors affecting choice of compressor are enumerated and the method of control, choice of electric motor and starter, filter types, oil and moisture elimination from pipelines, automatic drain traps, pipe size, pressure drop and valve care are considered. The general principles involved in the layout of the pipelines are described and basic safety rules in the operation of a system are listed.

* * *

The operation of sugar mill generating plant in parallel with the public supply system. H. T. PRIESTLEY. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 191–198.—The advantages of interconnexions between a sugar factory electrical system and the public supply system, whereby factories can sell surplus electricity to the public utility and draw from it when factory requirements exceed its own power supply, are discussed. The basic principles of interconnected operation and requirements in the design and operation are considered, as are operating and financial benefits and future developments.

* * *

The logicon static switching system for industrial applications. G. A. PETERSON. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 199–208. The replacement of electro-mechanical relay systems by static switching systems where the latter do not have the disadvantages of the former (these are considered) is discussed and the requirements of the logicon multi-function, solid-state switching system are listed. A description is given of the transistor and of the basic logic functions for the design of switching systems. The two forms of logicon units are (1) standard, built on a 15-way plug with components on a printed circuit board, and (2) encapsulated, built on a 12-way plug with the components solidly encapsulated in epoxy resin. Also dealt with are the plus, minus, timer, OR and power output units as well as initiating and output devices. The applications, installation and fault-finding techniques are briefly considered.

* * *

The application of D.C. to cane carrier drives. G. DREW and J. E. MATSON. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 209–212.—The use of D.C. for the control of cane carrier drives is discussed with a description of the development of the Ward Leonard system. A guide is given to drive selection. At Fairymead, where the first continuously variable closed loop cane carrier system in the Australian sugar industry was installed in 1961, killer plates transmit signals controlling the speed on the elevator and carrier drives. The silicon controlled rectifier converter as an alternative to the Ward Leonard system is briefly discussed.

* * *

Experiences with clarification aids. R. N. MANNING and R. I. DENNY. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 223–226.—In laboratory tests "Sedipur TF2" gave a juice settling rate which was double that given by "Separan AP-30" at the same concentration, while at half the concentration of "Separan" (1·5 p.p.m.. as against 3 p.p.m.) "Sedipur" still gave better settling and at 0·75 p.p.m. the results were almost the same. In factory tests there was no difference in the processing qualities of clarified juice treated with 0·050% "Separan" and 0·025% "Sedipur". The costs of the two chemicals are identical. Analysis of the sugar and ash showed that the ash content was reduced to 0·256% and 0·238% respectively when "Separan" and "Sedipur" were added. The significance of this in monetary savings is demonstrated.

Notes on hot liming. J. R. SESTERO. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 227–232. After modifications to the clarification station at Mourilyan it was possible to use hot liming with the result that raw sugar filtrability was increased. Very little difference was found in the filtration of muds from hot and cold liming, although with hot liming the volume of mud was greater. The average mud pol content was 2–3, i.e. the same as in previous seasons. The average phosphate content of clarified juice was reduced from 13 to 8 p.p.m. Fractional liming, in which about half of the saccharate lime was added to the cold juice and the remainder to hot juice, caused a drop in filtrability but did not improve juice clarity or mud settling and filtration rates. The pH of juice due to be stored over the week-end was raised to above 7·6 just before shut-down and the temperature reduced to about 190°F by re-cycling clarified juice to the mixed juice tank and pumping it through a secondary heater. The minimum temperature at start-up was 160°F. No difference in sugar filtrability was found but the purity drop was reduced.

* * *

The automatic control of dual first vessels in a quintuple effet evaporation station. D. A. KENNY and G. V. PERSHOUSE. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 267–269.—The method of transferring juice from one evaporator effect to another as described by HUGOT[1] was used for two 1st effects with the juice sections in series. The first vessel was of 5313 sq.ft. h.s. and the secondary (formerly a pre-evaporator) was of 2753 sq.ft. h.s. The vapour spaces were joined in parallel with vapour lines taking bleed to the primary juice heater and a pre-evaporator. Steam feed was regulated through butterfly valves on the steam inlets of both vessels. Descriptions are given of the two different entrainment separators installed. The coefficient of evaporation was reduced from 6·7 before the modifications to 6·3. Operation of the evaporator was efficient and free of trouble.

* * *

Continuous centrifugal operation on cane low grade massecuites. B. D. SOCKHILL. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 271–279. Three different continuous centrifugals were tested under factory conditions, one per factory, using a set test programme. The best arrangement for massecuite feeding was found to be a small overhead mingler supplying via a 12-in diameter pipe and resistance heater, a massecuite head of approximately 7 ft being maintained by a constant level device in the mingler. Massecuite viscosity had to be kept below 5000 poises to ensure even feeding onto the centrifugal screen, a viscosity of 2500–3000 poises being preferred. This was achieved by reheating to 1000 poises, i.e. by some 25°F, when molasses in the cooled massecuite was exhausted, a rate of 3 tons/hr then being possible, according to molasses viscosity and available screen area, compared with ¾—1½ tons/hr in a batch machine. The rate of centrifugalling was found to be more dependent on the viscosity of molasses in the massecuite than on the amount of water applied, massecuite viscosity and magma purity. With a screen aperture of 0·06 mm a molasses purity 0·6 units lower than with batch machines was obtainable. With a larger screen opening of 16% (compared with 4–5% with the other machines) (0·15 mm punched holes) partial re-heating in the mingler and crystallizers gave molasses purities 1·1 and 1·8 units higher than with batch machines, although the rate was increased from 130 lb to over 200 lb/min. A screen aperture of 0·06 × 2·2 mm is recommended. Increasing the amount of water by 1% on massecuite flow raised the magma purity by 2·0–2·5% although steam had a less noticeable effect. Re-solution of crystals by water or steam did not occur to any appreciable extent. Grain breakage occurred to varying degrees and increased the fines content in shipment sugar, although the effect was reduced with lower peripheral speeds.

* * *

The resistance heater for conditioning of low grade massecuites. P. G. WRIGHT. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 281–288.—The use of resistance reheaters for massecuite being fed to continuous centrifugals is discussed and results obtained with their use are reported. In the units described massecuite is warmed as it flows in the annulus between a set of cylindrical metal rings and a central metal pipe electrode, the rings being moulded into a glass fibre-reinforced resin body. Units of up to 25 kW heating capacity, i.e. sufficient to re-heat 3 tons of massecuite per hr through 32°F, have been built. A considerable reduction in the amount of sugar re-dissolved above the saturation temperature is possible compared with conventional water-heated minglers, and re-solution can be maintained at less than 0·7 units of molasses purity during re-heating through 20°F. The advantages of low initial and operating costs plus the possibility of reducing molasses purity are mentioned.

* * *

Some thoughts on double purging. E. D. JENSEN. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 241–244.—The question of impurities recirculation in the case of double purging is discussed and single purging favoured. It is considered preferable to install eight new centrifugals to give a high purity magma from a single purging, although the idea of installing two continuous machines to supplement existing low-grade batch centrifugals and using them to provide a 90 purity magma is also considered practical. The pros and cons of using high or low purity magma and the choice of vehicle to add to the first purged material in double purging schemes are discussed.

---

[1] "Handbook of Cane Sugar Engineering" (Elsevier Publishing Co., Amsterdam, Holland), 1960, p. 401.

A "Hercules" filter at Petoháza sugar factory. M. CZIRFUSZ. *Cukoripar*, 1964, **17**, 103–108.—An illustrated description is given of a "Hercules" pressure precoat filter manufactured by Herfilco K.G. of Vienna[1].

* * *

Rapid determination of the loading of horizontal cylindrical tanks. I. HARTWIG. *Cukoripar*, 1964, **17**, 119–121.—A nomogram is presented for use in determining the weight and level of molasses fed into a tank. The nomogram makes use of molasses viscosity and s.g. values most frequently encountered.

* * *

Methods and instruments for studying the physical conditions in sugar beet piles. M. Z. KHELEMSKII and N. T. POEDINOK. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **12**, 17–35.—Descriptions are given of the designs and operating techniques of instruments used to measure and record certain parameters associated with beet piles, viz. air temperature, heat exchange, air humidity, CO_2 and O_2. They are mostly of Soviet manufacture and include electrical thermometers (some using semi-conductors), thermocouples and a thermograph, calorimeters, spherical probes, an albedometer (for determining solar radiation reflected from the surface of protective layers), a Siemens electro-psychrometer, and various special devices for air sampling and analysis. The use of galvanometers enables readings to be received remote through the use of "tele-stations". A recommended scheme for locating the devices in a pile is given.

* * *

Modified universal equation for the diffusion process. E. T. KOVAL', A. YA. ZAGORUL'KO and YA. N. TAVARTKILADZE. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **12**, 71–78.—An equation earlier derived by the first two authors has been modified for use in working out an algorithm for a continuous computer control system. The equation may be used for diffusion with or without press-water return. In the development of the equation, the optimum feed point for press-water is considered to be at the tail end where it is fed together with fresh water. The equation has been found to be more accurate than the original one and gives an error of only 0·01–0·02% on weight of beet.

* * *

The technical value of sugar beet. K. KOLLMANN. *Zucker*, 1964, **17**, 211–218, 241–249.—The technical value of beet is expressed as the difference between press juice refractometric Brix and beet brei pol. This difference (Δ_R) includes both the non-sugars content (NZ_R) and the noxious nitrogen content (n) in beet. Its value remains constant during the growth period, any change within a given time sequence indicating changes in the genetical status of the beet. The effect of changes in n on the value of Δ_R is discussed mathematically and a graph drawn relating the two factors. Calculated and measured values of n agree closely. Equations are developed for calculating optimal beet pol and marc contents at a corresponding value of Δ_R and hence the optimal non-sugars content in beet juice. Whether a given optimal pol is obtainable, and to what extent, depends on the beet ripening process. From the equation

$$n = \frac{\frac{\Delta_R^2}{e^{\alpha}} \cdot \Delta_R^{4/3}}{100} \% \text{ beet}$$

where $\alpha = \frac{[\Delta_R^2]_{min}}{0{\cdot}0624}$, i.e. 118·6, expressions are derived for calculating (a) $\Delta_{R(min)}$ of the genetical purification process occurring in the beet itself, (b) the minimum non-sugars content in thin juice after the first main purification process (conventional), and (c) the minimum non-sugars content in juice after the second main purification stage (ion-exchange). An expression is derived for calculating the optimal molasses purity corresponding to a given raw material and based on the assumption that 1 part of noxious N prevents crystallization of 27 parts of sugar. Molasses sugar and yield can be calculated using expressions derived for conditions where foreign, non-precipitable salts are or are not introduced with the beet and where the sugar-house operates efficiently or inefficiently. Greater factory control with daily forecasts of results is possible by determining the non-sugars content and the degree of their elimination, comparing these with optimal values and applying the laws of juice purification as described mathematically in the article.

* * *

Automation of beet feeding from flumes to slicers. O. BÖHM and S. BOUČEK. *Listy Cukr.*, 1964, **80**, 83–86.—Details are given of the scheme at Čejeticky sugar factory, where the flow of beet from the flumes or Elfa plant to the beet slicers is automatically controlled from a central panel and depends on the diffuser requirements. Chain-operated slide gates at the flume and before the beet pump receive signals from the hopper above the diffuser, which also transmits impulses to the beet washer and to the central

[1] *See* HARTL: *I.S.J.*, 1961, **63**, 52.

control panel, to which signals are also transmitted from the beet weigher. The control panel is also linked with the slide gates, beet pump, beet wheel, flume water pump and beet elevator. The system was tested during the 1963/64 campaign and operated satisfactorily.

* * *

Electronics in Plattling sugar factory. H. GÜNTHER. *Zucker*, 1964, **17**, 250–252.—Analytical data are transmitted from the factory laboratory to individual stations by a "ZETFAX" electronic system. Data are recorded on continuous pre-printed forms of various colours and are then scanned by a photocell which transmits the information to a printer via the internal telephone system. The information is then reproduced in facsimile form on continuous rolls fed from the machine.

* * *

Mechanization and automation of the charging and dosing of lime and coke at the lime section of Opava sugar factory. A. SPRUŠIL. *Listy Cukr.*, 1964, **80**, 86–88.—The system described consists basically of an inclined rubber belt conveyor feeding a twin-sectioned hopper. The material in the hopper is fed via two drum feeders to a small mobile chute which transfers alternately coke and limestone to the skip hoist which is provided with a counter and a double weigher. In the kiln throat are a cobalt isotope transmitter and receiver at two different levels. The coke: limestone ratio is regulated by means of the weigher so that when a pre-set weight of coke has been fed to the hoist, the hoist rope attached also to the weigher registers this amount and a contactor then brings into operation the limestone feeder. The interval between feeds is regulated by a time relay. The limestone level in the kiln is governed by the cobalt isotope controller.

* * *

The possibilities of applying radio-isotopes in the sugar industry. H. GRUSZECKA. *Gaz. Cukr.*, 1964, **72**, 92–96.—Possible fields of application of radio-isotopes in the sugar industry are considered, including eradication of beet pests, for killing bacteria in beet piles, juices, sugar, waste waters, etc., for inactivation of enzymes such as invertase, and for level measurement and control. The question of costs and dangers from radiation and toxicity are discussed.

* * *

Exergetic studies in the sugar industry. IV. Study of a beet sugar factory. T. BALOH. *Zucker*, 1964, **17**, 234–241, 272–276.—The production of excess electrical power at a sugar factory for sale to the national grid is discussed and the required alterations to be made to an existing scheme are considered. High-pressure evaporation is not advocated because of the high pressure of the exhaust steam and pressure-vacuum evaporation is preferable even when this results in a slight loss in the condenser. In order to establish the extent to which it is economical to reduce exhaust steam pressure, five evaporation schemes were studied. The optimal scheme was found to be a quintuple-effect where the 1st effect is heated with steam at 120°C. The proportions of fuel for heating and electricity generation have been calculated. A sugar factory adopting all the measures mentioned (which are described in detail) can reduce fuel consumption by 44% compared with normal conditions. These improvements would yield a 9·3% exergy efficiency for sugar production, which is equivalent to the efficiencies obtained in other industrial processes.

* * *

Experiences with a montejus. F. W. MEYER. *Zucker*, 1964, **17**, 277–282.—While this piece of equipment, which may be used to raise sugar liquors from one level to another by means of compressed air or steam, has the disadvantages of manual and batch operation, it is cheap, simple and reliable and does find application in under-developed countries. Illustrated descriptions are given of the various applications at Ahvaz refinery, Iran.

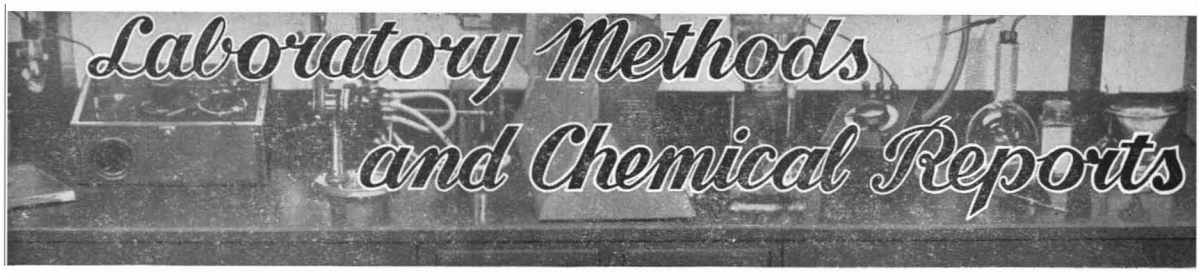
* * *

Influence of cossette shape on diffusibility. G. GENIE. *Sucr. Belge*, 1964, **83**, 297–309, 337–354.—The sucrose content of a cossette is proportional to its volume, while its extraction rate is proportional to its surface area. In order to study the inter-relationships theoretical dimensions of perfectly cut cossettes are calculated, allowing for variations between a chevron section of zero thickness and a diamond section. Practical applications are then considered for the calculation of these dimensions as produced by a 26-division Königsfeld knife, and as an example the ratio of volume:surface calculated for a proposed variation in cutting technique, which shows that diffusibility would be reduced. The case of asymmetric cossettes, produced by movement of the beets during slicing, laterally relative to the blades, and finally any cossette with parallel surfaces are considered.

* * *

Microbial contamination of healthy beets. P. DEVILLERS and A. SALSAT. *Sucr. Franç.*, 1964, **105**, 133–135. Examination under sterile conditions of beets by ATTERSON *et al.*[1] has shown that even inside the root there were osmophilic yeasts. Similar examinations were made of French beets; in healthy beets taken from the washer at one factory the counts were much lower than those of ATTERSON *et al.*, but the beet interiors were nevertheless not sterile. Examination of healthy beets harvested less than four days before from different trial fields showed a wide variation in mesophile and osmophile counts which were, however, related to some extent to the reducing sugars content. Examination of beets before and after 51 days' storage showed an average of 30% fewer mesophiles but a 3-fold increase in osmophiles, of which, however, there were very much fewer than mesophiles.

[1] *I.S.J.*, 1964, **66**, 126.



New table of concentrations of aqueous sucrose solutions. G. VAVRINECZ. *Cukoripar*, 1964, **17**, 37–38.—Using the density tables of SCHNEIDER *et al.*[1] the present author has calculated the specific gravity, volume concentration and specific volume of aqueous sucrose solutions at 20°C and at intervals of 0·1°Bx. The tables will appear in a number of issues of *Cukoripar*.

* * *

Fibre in cane by the dry substance method. H. J. BLAKE. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 245–253.—Tests were carried out to evaluate two formulae used in the determination of cane fibre based on Brix measurements without the use of juice scales. One formula was that portion of the c.c.s. formula used to convert Brix of first expressed juice to Brix in cane, while the other, derived by CLAYTON, takes the form $B_c = \frac{0{\cdot}98\ B_f\ (1{\cdot}01\ W - 1)}{100 - 0{\cdot}99\ B_f}$, where B_c = Brix in cane, B_f = Brix of first expressed juice, and W = water in cane. Brix was determined on filtered juice only, or on both filtered and unfiltered juice, the cane samples being obtained from hand-cut cane or mechanically-harvested chopped-up cane as well as from clean green cane. The analytical techniques are described in detail. Tabulated results show that the method using the Clayton formula is the most suitable, being rapid, easy to apply, free from bias and very reliable.

* * *

A survey of methods of analysis for sour juices. P. N. STEWART and C. A. REHBEIN. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 255–261. Nine analytical methods were investigated to decide which were the most suitable under Queensland conditions for determining the pol content of sour juice[2]. Five of the nine methods compared were eliminated as unsuitable for deteriorated juice. The remaining four were placed in the following order with increase in juice deterioration: (1) adding 4 drops of concentrated ammonia to 100 ml of juice before clarification with dry lead subacetate; (2) a variant of the normal weight method in which two normal weights of juice were used before adding Horne's dry lead; (3) as (2) but with the addition of 5 ml of alumina cream before making up to volume with distilled water; and (4) Herles' method. While the presence of dextran in deteriorated cane juice may distort the sucrose determination in the first three methods, Herles' method eliminates dextran almost quantitatively from test solutions. Excess lead was found necessary to effect satisfactory clarification.

Determining milk-of-lime density. A. K. KARTASHOV. *Sakhar. Prom.*, 1964, **38**, 362–363.—The Lenart table of milk-of-lime densities is more accurate than the Lunge & Blattner table, the former using the weighing technique (found to agree closely with titration values) and the latter using the Baumé hydrometer. Since a spindle will give accurate readings only after it has been shaken for a long time in the solution to give complete immersion, the technique of weighing in a 1 litre measuring flask is preferred.

* * *

The direct determination of fibre per cent bagasse by washing. B. M. MUNRO. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 263–266.—Bagasse was well mixed and divided into three parts (one for each analysis), one being weighed into a calico fibre bag with a total weight of about 1 lb. The bag and contents were washed in cold water by hand until the washings remained clear and then placed in circulating boiling water for about 4 hr. After a final washing in cold water the bag plus contents was oven-dried at about 105°C. The bagasse fibre content as given by this method (fibre % bagasse = $\frac{\text{weight of fibre}}{\text{weight of original bagasse}} \times 100$) was reasonably accurate and only slightly inferior to determination of fibre % cane, although better than (1) calculation from known fibre % cane, weight of cane and weight of bagasse and (2) determination by subtracting from 100 the moisture % bagasse by drying and Brix % bagasse by digestion. The fibre % bagasse values gave better estimates of both fibre and Brix (by difference) in bagasse than did direct analysis for Brix by digestion.

* * *

Viscometry in massecuites. M. F. BEHNE. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 289–296.—It has been found that measurements of low-grade massecuite viscosity by a Brookfield "Synchro-Lectric" viscometer, which is described, need correcting. A diluted massecuite of approximately 2000 poises viscosity was used in the tests and exhibited "pseudo-plasticity"[3] (the thixotropic effect in massecuite which has been found to increase with concentration[3]). It is therefore a non-Newtonian liquid, whereas calibration of the viscometer was apparently conducted with a Newtonian liquid. The viscometer reading will therefore be too high by 7½% where pseudo-plasticity does not occur, but the

[1] *I.S.J.*, 1963, **65**, 376; 1964, **66**, 127.
[2] *See* EGAN: *I.S.J.*, 1964, **66**, 391.
[3] ADKINS: *I.S.J.*, 1952, **54**, 142.

discrepancy will be greater under conditions of greater concentration and therefore greater pseudo-plasticity. Under pipeline flow conditions, however, the viscometer reading should be increased, although explanations of the behaviour of a massecuite under pipeline flow conditions are at present only tentative.

* * *

Determination of the viscosity of saccharate suspension. V. S. LISICHENOK. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **12**, 238–241.—The viscosity of saccharate suspension was determined at 5, 10, 15 and 20°C using a special unit which is described. The suspension was made up from 1·3 litres of molasses solution containing 6% sugar mixed with 128 g of technical lime (70% CaO) during 15 min in a device having abrasive rollers on a shaft rotating at 600 r.p.m. A given volume of distilled water was sucked into a tube above a capillary and the time taken for the meniscus to drop from one marked point to another under gravity was measured. Similarly the time taken for the suspension meniscus to fall was noted and the viscosity calculated using OSTWALD's formula. Results are tabulated and a graph drawn of viscosity *vs.* temperature.

* * *

Performance of a simple air-slide classifier on refined sugar. E. J. BUCHANAN. *S. African Sugar J.*, 1964, **48**, 291–303.—Tests were carried out on the removal of fines from refined sugar using a pilot air-slide classifier[1]. The principle of operation of the classifier involved the pneumatic transport of a fluidized bed of sugar over an inclined screen under gravity, the fines being pneumatically separated. It is pointed out that removal of fines has several technological advantages in later sugar handling. The results indicated that the unit had a good performance and was better than a commercial model operating with simultaneous air flotation and screen vibration. It is considered that a commercial unit of 20 tons sugar/hr capacity would be practical, simple and cheap to construct. The final assessment of its practical advantages should be carried out on a commercial scale unit.

* * *

Physico-chemical methods in sugar research with special reference to colloid science. I. VAVRUCH. *Sbornik Praz. Vys, Skoly Chem. Technol., Potravin. Technol.*, 1962, **6**, (3), 211–267; through *S.I.A.*, 1964, **26**, Abs. 153.—Analytical methods having a physico-chemical basis are reviewed (117 references) under the following headings: paper chromatography of beet non-sugars, beet protein hydrolysates, beet factory products, raffinose, and alkali cations; polarography of surface-active substances in refined, raw and white sugar, and of fructose and alkali cations; influence of various treatments on the results of the polarographic test for refined sugar; moisture determination; surface tension of sucrose solutions; adsorption on bone char; adhesion of suspended matter to glass walls; conductimetric and potentiometric control of carbonatation. The review is mainly confined to research carried out in Czechoslovakia.

* * *

Determination of the percentage of sediment in mixed juice. C. G. M. PERK. *S. African Sugar J.*, 1964, **48**, 305.—Pol in mixed juice is measured after filtering while total mixed juice weight is measured without filtering; this can result in a false fibre for "tons sucrose in mixed juice" because of insoluble solids present. It is proposed that a correction be made by allowing a 1-litre sample of mixed juice to settle in a decanting vessel (for 30 min when sand is present or longer with clay), washing by decantation, filtering and drying the residue which is then weighed.

* * *

Attempts at the application of chromatography to the investigation of conditions in the extraction of glutamic acid from molasses. S. ZAGRODZKI and A. KURKOWSKA. *Zeszyty Nauk. Politech. Lodz., Chem. Spozywcza*, 1961, (6), 173–189; through *S.I.A.*, 1964, **26**, Abs. 144.—Extraction under conditions taken from U.S. patents 2,517,601[2] and 2,688,037[3] was studied by paper chromatography. Planimetric and iodometric determinations were made of amino acids in (a) the crude molasses, (b) the molasses de-sugared by Steffen's methods, (c) the de-sugared molasses after hydrolysis of pyrrolidone carboxylic acid, removal of inorganic salts, or crystallization of glutamic acid. The methods are discussed, and are considered suitable for approximate determinations. The results showed incomplete hydrolysis of the pyrrolidone carboxylic acid in Polish molasses.

* * *

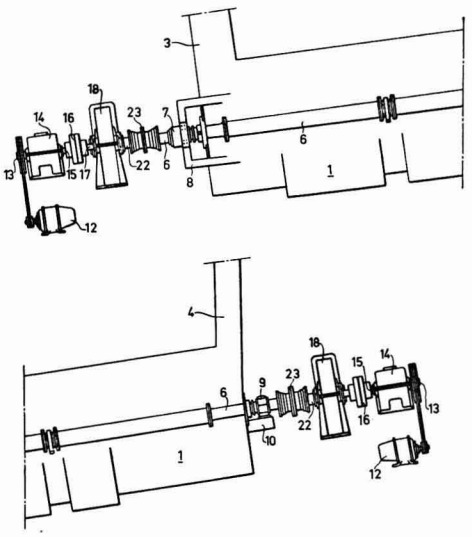
Quantitative determination of sucrose and raffinose in the presence of some reducing sugars. M. TROJNA and J. HUBÁČEK. *Kvasny Prumysl*, 1963, **9**, 147–149; through *S.I.A.*, 1964, **26**, Abs. 154.—Mixtures of sucrose, raffinose, glucose, fructose and melibiose were separated by paper chromatography of 10 µl spots with 4:1:5 *n*-butanol:acetic acid:water. After locating with benzidine, strips corresponding to the non-reducing spots were cut out, sprayed with a mixture of 4 ml of concentrated invertase solution and 96 ml of water, and hung in a water-saturated atmosphere at 50°C for 3 hr. The dried strips were then sprayed with 4% triphenyltetrazolium chloride in methanol, dried in an air current, and hung in a water-saturated atmosphere at 65°C for 1 hr. The pink formazan spots were cut out, eluted with methanol:acetic acid (10:1), and measured by colorimetry at 480 mµ. Raffinose was determined in beet molasses with a maximum error of ± 3·4%.

[1] TOYNBEE & LONDON: *Brit. Chem. Eng.*, 1962, **7**, 425.
[2] *I.S.J.*, 1951, **53**, 238.
[3] *I.S.J.*, 1955, **57**, 416.

PATENTS

Driving means (for conveyor screws in a trough-type beet diffuser). AB. LANDSVERK, of Landskrona, Sweden. **951,374.** 14th December 1962; 4th March 1964.

The inter-engaging screw conveyors in the inclined trough 1 of a beet diffuser are each driven at both ends by electric motors 12 coupled by chain drives or cone-belt transmissions to the primary shafts 13 of two multi-stage gearboxes 14. The secondary shafts 15 are coupled through flexible coupling 16 to



individual primary shafts 17 of a very strong distributing gearbox 18. The shafts 17 are connected by small pinions to two large intermeshing gears each connected via secondary shafts 22 and couplings 23 to the screw conveyors 2. Thus the screws are mechanically and positively interconnected at both ends and the motors 12 are so adjusted electrically that they supply mutually equal moments at the same rotational speed, whereby the gearboxes will not be subjected to unequal loads.

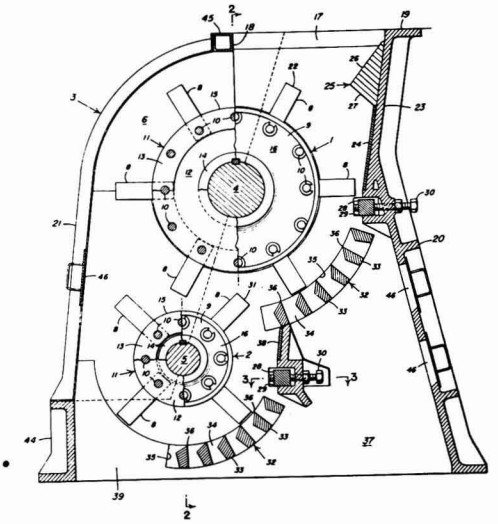
* * *

Producing citric acid. SVENSKA SOCKERFABRIKS AB., of Malmö, Sweden. **951,629.** 3rd November 1960; 11th March 1964.

Citric acid is produced from beet molasses by submerged fermentation with aeration with mycelium pellets of *Aspergillus niger* or related strains, HCl being added (after acclimatization and a fall in pH to 5·5–4·5 on formation of some citric acid) to the dilute molasses containing the pellets to bring the pH below 3·5 (below 3·0) The pellets are produced in a similar substrate, with agitation and aeration but more dilute than the main fermentation.

Shredder. HONOLULU IRON WORKS CO., of Honolulu, Hawaii, U.S.A. **951,913.** 22nd January 1963; 11th March 1964.

The shredder has not one but two rotary shafts each carrying a series of hammers to shred cane against the appropriate anvil bars. The hammers of



the auxiliary rotor fit into the space between adjacen hammers of the main rotor and *vice versa*, so that it is not possible for cane pieces to get between the hammer and shaft and go to process untreated.

* * *

Polyether polyols of sucrose. PITTSBURGH PLATE GLASS CO., of Pittsburgh 22, Pa., U.S.A. **955,488.** 21st April 1961; 15th April 1964.

A polyether glycol of M.W. 700–1800 is prepared by the reaction at ⩾200 p.s.i. and at 70–270°F of at least 4 (10–25) mols of a lower alkylene oxide having 2–4 C atoms (ethylene and/or propylene oxide) per mol of sucrose in the presence of a catalyst, substantially all the H_2O in the mixture (initially 5–50% by weight) being removed before adding the remainder of the alkylene oxide.

* * *

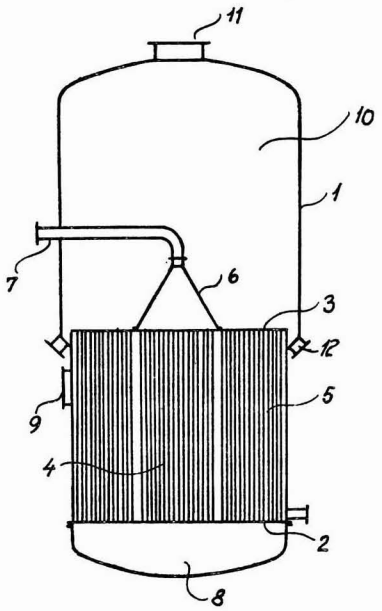
Sucrose organo-phosphorus ester. S.p.A. FERRANIA, of Milan, Italy. **955,757.** 17th April 1962; 22nd April 1964.

Sucrose octa-diphenylphosphate is prepared by reacting sucrose with monochlorodiphenylphosphate and anhydrous pyridine in molar proportions of 1:10:12 respectively, while cooling the mixture, then raising the temperature and carrying out the reaction until esterification is complete.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 4s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

Evaporator. A/S. DE DANSKE SUKKERFABRIKKER, of Copenhagen, Denmark. **953,627.** 18th April 1962; 25th March 1964.

The tubes of the evaporator 1 are in two groups 4 and 5; both are located between tube sheets 2 and 3, but juice to be evaporated is supplied through pipe 7 to a conical header 6 above tubes 4, down through



which it passes to chamber 8. It then rises through tubes 5, vapours collecting in space 10 to be withdrawn through outlet 11 while the concentrated juice overflows and is withdrawn through pipe 12. The tubes are heated by steam admitted to the steam chest through port 9.

* * *

Animal fodder. SIR J. L. HULETT & SONS LTD., of Durban, Natal, South Africa. **955,533.** 20th July 1962; 15th April 1964.

A sugar-containing liquid (e.g. cane juice) is neutralized to pH 8 (by adding $CaCO_3$ filter-cake), evaporated to a water content of 5–15%, maintaining in a saturated or supersaturated state, and added (sprayed on) to a substantially dry particulate material (a granular sugar, produced by the same process) with or followed by mixing with stirrers rotating at 50–300 r.p.m. Some of the product is separated for recycling.

* * *

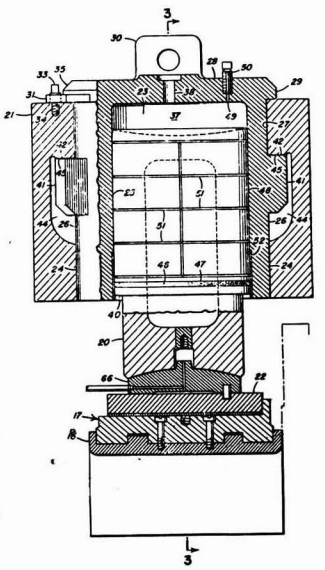
Treatment of natural (cane and beet) juices. P. R. PAYET, of Cambuston, Réunion. **955,799.** 16th May 1960; 22nd April 1964.

Buffering material (phosphoric acid or one of its salts) is added to the juice, the addition being matched to the natural pH of the juice so that it remains constant at this value during clarification, addition of clarifying reagent (lime) being matched by simultaneous addition of phosphoric acid, to form dicalcium phosphate *in situ*.

* * *

Sugar mill. HONOLULU IRON WORKS CO., of Honolulu, Hawaii, U.S.A. **954,004.** 27th February 1963; 2nd April 1964.

In order to avoid undue stress on the mill housing because of unequal loads from either side of the top roller, the point of action of the hydraulic ram is adjustable to provide a load in alignment with the resultant of the load on the other rollers. This is achieved by locating the ram 20 in a cylindrical



bore 23 in cylinder 24, this bore being eccentrically located in the cylinder. The latter, located in the corresponding opening 27 of the top cap 21, can be rotated whereupon the ram moves in an arc, giving the required adjustment. Its position is held by securing the cylinder 24 in the stages of its rotation by locating and locking bolts 33.

* * *

Stabilizing liquid phosphate-molasses animal feeds. NATIONAL DISTILLERS & CHEMICAL CORP., of New York, N.Y., U.S.A. **957,034.** 18th January 1963; 6th May 1964.

Gel formation in a liquid animal feed containing a phosphate material (½–5 parts of H_3PO_4), (mostly) molasses (70–175 parts) urea (10 parts) and ethanol (1–12 parts) is prevented by incorporating a minor

amount of a non-phosphatic acid (H_2SO_4, HCl, CH_3COOH, citric, tartaric acid) (0·025–0·045 parts of H_2SO_4).

* * *

Beet loader. J. SALMON, of Dunmow, Essex. **956,061.** 8th January 1963; 22nd April 1964.

* * *

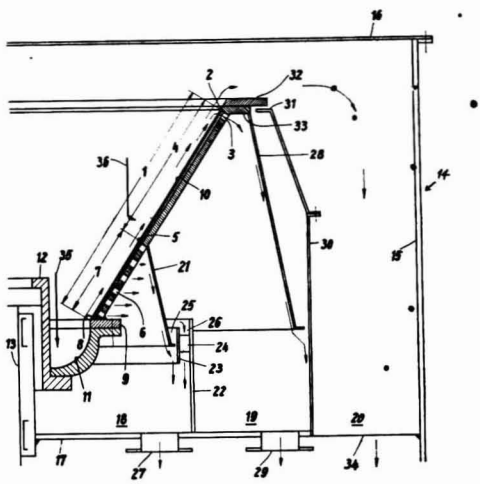
Purifying sugar esters. DR. SPIESS G.M.B.H., of Kleinkarlbach über Grünstadt, Rheinpfalz, Germany. **958,064.** 15th June 1961; 13th May 1964.

Sugar esters are purified by removing the organic solvent in which they were produced, adding (3–20 parts of) water and heating, agitating to produce an emulsion and precipitating the ester by heating and by adding salts (0·25–2·5 mols/litre) and/or (volatile) acids (CO_2) to bring the pH to between 4 and 7 (6–7) (at 30–60°C).

* * *

Centrifuge drum. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT AG., of Braunschweig, Germany. **959,866.** 9th July 1962; 3rd June 1964.

The continuous centrifugal drum is in the form of an inverted frustroconical body 1 having at its head 2 ports 3 for discharge of molasses and/or wash liquor, washing taking place in the upper part 4. Most of the molasses is separated in the lower part 7 of the drum through apertures 6, and is led off by inner hood or skirt 21 into chamber 18. The entire



inner surface of the drum is covered by screen 10, and a second hood or skirt 28 is attached to the upper end of the drum 1, discharging wash to chamber 19. A deflector ring 23 attached by clips 24 to partition 22 prevents molasses creeping over into chamber 19. The partition 30 prevents wash liquor from entering the sugar chamber 20 while collar 31 prevents sugar falling into chamber 19 after passing up the drum screen 10 and being discharged over cover plate 32.

* * *

Weakly polar synthetic resins (for colour adsorption from sugar solutions). VEB FARBENFABRIK WOLFEN, of Wolfen, Kr. Bitterfeld, Germany. **959,932.** 29th June 1960; 3rd June 1964.

The resin is made by condensing *m*-phenylene diamine with formaldehyde in the presence of paraformaldehyde (≮1/3 of total weight of HCHO).

* * *

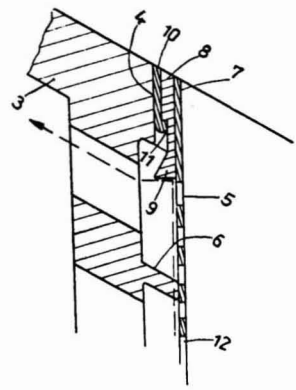
Sugar refining (Beet processing). ELFA-APPARATE-VERTRIEBS-G.M.B.H., of Mülheim/Ruhr, Germany. **961,738.** 9th April 1962; 24th June 1964.

(Frozen) Beet is (thawed and) heated for 20 min at up to 200°C under pressure (200 atm), triturated to a fine pulp and centrifuged immediately (simultaneously in a centrifugal separator with built-in abrading discs) to give a pulp and juice.

* * *

Device for deflecting molasses from the outside of a screening insert of a sugar centrifuge. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT AG., of Braunschweig, Germany. **961,778.** 24th May 1962; 24th June 1964.

The screen 5 of a conical continuous centrifugal bears at its upper end 7 against a ring 8 which has at its lower edge a deflector rim 9. Between ring 8



and the surface 4 of drum 3 is a further packing ring 10 located by a lip into the groove 11 of ring 8. This leaves a pocket which forms a labyrinth seal for any molasses not expelled by deflector lip 9.

* * *

Beet harvesters. (1) J. D. DYSON and C. R. DYSON, of Peterborough, Northants. **968,541.** 28th March 1962; 2nd September 1964. (2) F. A. STANDEN & SONS LTD. and P. STANDEN, of St. Ives, Hunts. **968,761.** 28th August 1963; 2nd September 1964.

TRADE NOTICES

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

"Hi-Hi" cane tractor. Massey-Ferguson (Export) Ltd., Banner Lane, Coventry, Warwickshire.

The new Massey-Ferguson "Hi-Hi clearance" 65 tractor has been specially developed from the Company's standard heavy-duty 65 model for use in sugar cane fields. The main changes are incorporated in the redesigned front and rear axles which give the tractor a full 33 inches clearance. The rear axle trumpet has been re-cast and the final drive has been achieved by a system of bull gears in drop axles to give the additional clearance. Power steering and differential lock are standard equipment. The diesel engine develops 58·5 h.p. at 2078 r.p.m. Overall height of the tractor to the top of the bonnet is 74⅜ inches, the overall width 75·7 in, and the overall length 132 inches. The photograph illustrates the tractor moving along a row of maize simulating sugar cane.

Wheel adjustments are : front 56–72 in (1420–1826 mm) fixed 66 in and 72 in. Rear 56–72 in (1420–1826 mm). Distance between the drop axles is 47 in.

In addition to sugar cane, the tractor is also designed for use in pineapples, tobacco, potatoes, cotton, yams, cassava and many other row crops.

Closed circuit dissolution of solids. Neldco Processes Ltd., Crossway House, Bracknell, Berkshire.

The simple Neldco method of dissolving solids continuously involves a centrifugal pump and a hydraulic cyclone. Liquid and solids are fed at controlled rate into the pump sump where most of the dissolution occurs. The pump discharges directly to a hydrocyclone which delivers the overflow solution as a finished product, while the underflow containing any undissolved solids is recycled to the pump.

The circulating load of dissolved solids tends to stabilize the circuit and ensure a steady solution concentration.

The pump and cyclone can be completely lined with rubber or plastic, so that any material can be handled without contamination. Units are available with overflow capacities up to 1400 g.p.m. The same system can be used for continuous feeding of suspensions such as milk-of-lime.

* * *

"Fabcon". Lansjal International, P.O. Box 220, Los Altos, California, U.S.A.

"Fabcon" partially substituted for lime in the fabrication of raw sugar greatly reduces evaporator scale formation, eases cleaning, and maintains juice clarity. Based on the severity of evaporator scaling, "Fabcon" should be substituted for 20–40% of the lime. 25% "Fabcon" and 75% lime is recommended initially if the usual cleaning cycles must be maintained, or one-third "Fabcon" and two-thirds lime to extend time between cleanings by approximately 100%.

The "Fabcon"-lime slurry is prepared in the normal manner. The pH in the liming tank can usually be reduced by about 0·3 to 0·5 units without lowering clarified juice or syrup pH.

* * *

PUBLICATIONS RECEIVED

HYGROMETERS, MOISTURE AND DEWPOINT METERS. Shaw Moisture Meters, Rawson Rd., Bradford, Yorkshire.

This new folder illustrates and gives brief descriptions of a wide range of hygrometers and other moisture detectors and recorders, some of which can be used for automatic control, to provide alarm signals, etc.

* * *

"NEPTON" ION-EXCHANGE MEMBRANES. Ionics Inc., 152 Sixth Street, Cambridge 42, Mass., U.S.A.

A new series of data sheets have been issued to describe an expanded selection of fourteen "Nepton" ion exchange membranes which are offered for experimental use in a variety of applications, including electrodialysis, electrolysis, etc. Both cation-and anion-selective membranes are included in a range of thicknesses, reinforcing materials, porosities, etc.

WORLD SUGAR REQUIREMENTS, 1965

International Sugar Council First Estimate

Country or Area	*(metric tons, raw value)*
A. FREE MARKET	
EUROPE	
Albania	11,000
Bulgaria	40,000
Cyprus	16,000
Finland	155,000
Germany, West	85,000
Gibraltar	2,000
Greece	82,000
Iceland	9,000
Ireland	19,000
Italy	375,000
Malta	15,500
Netherlands	110,000
Norway	160,000
Portugal (incl. territories)	55,000
Spain (incl. territories)	300,000
Sweden	57,000
Switzerland	230,000
United Kingdom	2,050,000
U.S.S.R.	1,600,000
Yugoslavia	70,000
Total	5,441,500
NORTH AMERICA	
Canada	735,000
Total	735,000
CENTRAL AMERICA	
Bahamas and Bermuda	6,000
Honduras	500
Panama Canal Zone	2,000
Virgin Islands (U.K.)	400
Total	8,900
SOUTH AMERICA	
Chile	190,000
Uruguay	55,000
Total	245,000
ASIA	
Afghanistan	45,000
Arabian Peninsula:	
Aden Colony and Protectorate	29,000
Saudi Arabia & Others	120,000
Brunei	4,000
Burma	30,000
Cambodia	19,000
Ceylon	219,000
China (Mainland)	500,000
Hong Kong	88,000
Iran	250,000
Iraq	250,000
Israel	78,000
Japan	1,300,000
Jordan	54,000
Korea (North)	20,000
Korea (South)	53,000
Laos	4,000
Lebanon	40,000
Malaysia:	
Malaya	225,000
Sabah	13,500
Sarawak	18,500
Singapore	77,000
Mongolia	15,000
Nepal	6,000
Pakistan	50,000
Syria	70,000
Vietnam (North)	20,000
Vietnam (South)	50,000
Total	3,648,000
AFRICA	
Algeria	240,000
Cameroon	10,000
Central African Republic	3,000
Chad	18,000
Congo (Leopoldville)	5,000
Dahomey	10,000
Gabon	1,000
Gambia	5,000
Ghana	38,000
Guinea	10,000
Ivory Coast	30,000
Kenya	71,500
Liberia	3,000
Libya	29,000
Mali	27,000
Malawi	18,000
Mauritania	22,000
Morocco	400,000
Niger	12,000
Nigeria	80,000
Senegal	70,000
Sierra Leone	22,000
Sudan	135,000
Tanganyika & Zanzibar	1,500
Togo	5,000
Tunisia	90,000
Upper Volta	10,000
U.A.R. (Egypt)	95,000
Zambia	15,000
Total	1,476,000
OCEANIA	
New Zealand	124,000
U.K. Admin. Oceania	3,000
U.S. Admin. Oceania	4,000
Western Samoa	4,000
Total	135,000
TOTAL FREE MARKET	11,689,400
B. U.S. MARKET	
U.S.A. net import requirements from foreign countries	3,075,000
C. GRAND TOTAL	14,764,400
GRAND TOTAL ROUNDED	14,765,000

Beet sugar in Israel[1].—Sugar beet cultivation in Israel is to be limited to 48,000 dunams; this area should yield a crop of about 240,000 tons, which is the capacity of the two sugar factories at Afula and Kiryat Gat. The third factory at Ramat-Gan has been wound up as it was obsolete and uneconomical.

* * *

Bagasse paper in Argentina[2].—A new factory in the Province of Jujuy, built by Ledesma at a cost of $25,000,000, is expected to begin producing high-quality writing and printing paper from bagasse in February 1965. An annual output of 36,000 tons is planned.

[1] *Overseas Review* (Barclays D.C.O.), September 1964, p. 50.
[2] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 806.

BREVITIES

India-Uganda sugar development[1].—It has been announced that India will help to set up four large sugar mills as a joint venture between industrialists and the Governments of the two countries. The cost of the project is estimated at between £12 million and £15 million. A Uganda Sugar Development Corporation is to be set up to supervise a £10 million development scheme. The aim of the development is to establish additional sugar manufacturing capacity of 100,000 tons. Indian participation in the equity capital of the Corporation will be 45% and the balance will be shared by the Uganda Government 45% and private investors 10%. Indian assistance will also be in the form of sugar machinery manufactured in India, and Indian factory building materials. They will also install the machinery and operate the factories and estates.

* * *

London Terminal price.—After almost two months during which the London Daily Price remained unchanged at £32·50 per long ton c.i.f. U.K., it fell on the 11th November to £32·00. With no business reported in the raw sugar market, the quotation was presumably adjusted on offers at this price.

* * *

Irrigation developments in Northern Rhodesia[2].—Work is well advanced on the irrigation canals on the 15,500-acre Nakambala Estate which has recently been acquired by the Ndola Sugar Co. Ltd. The Kafue River, from which source the water supply will come, has been breached. The system of canals will be inter-connected by a low-lift pumping station and the water delivered to the canefields via a high-lift pumping station and pipelines. A 300-acre block of land which is representative of the irrigable soils on the estate has been selected for trials during the 1964/65 season.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th November* 1964)	s d
Anglo-Ceylon (5s)	6/6
Antigua Sugar Factory (£1)	13/6
Booker Bros. (10s)	19/6
British Sugar Corp. Ltd. (£1)	19/–
Caroni Ord. (2s)	2/4½
Caroni 6% Cum. Pref. (£1)	14/3
Demerara Co. (Holdings) Ltd.	5/1½
Distillers Co. Ltd. (10s units)	24/7½
Gledhow Chaka's Kraal (R1)	21/3
Hulett & Sons (R1)	37/–
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	17/3
Manbré & Garton Ltd. (10s)	35/–
Reynolds Bros. (R1)	19/6
St. Kitts (London) Ltd. (£1)	18/9
Sena Sugar Estates Ltd. (5s)	7/6
Tate & Lyle Ltd. (£1)	34/6
Trinidad Sugar (5s stock units)	2/7½
United Molasses (10s stock units)	26/3
West Indies Sugar Co. Ltd. (£1)	11/3

CLOSING MIDDLE

New York Stocks (*at 16th November* 1964)	$
American Crystal ($5)	16½
Amer. Sugar Ref. Co. ($12.50)	19⅜
Central Aguirre ($5)	25¾
Great Western Sugar Co.	35
North American Ind. ($10)	13⅞
South P.R. Sugar Co.	30⅝
United Fruit Co.	17¾

Jamaica sugar production, 1964[3].—Final production for the 1964 crop, as reported by the Sugar Manufacturers' Association (of Jamaica) Ltd., totalled 474,277·5 tons, 3488 tons less than the 1963 crop.

* * *

Uganda sugar survey[4].—A team of industrial investment experts has surveyed the potentialities for a sugar industry in South Busoga at the Government's request.

* * *

French sugar factory for Algeria[5].—The Government of Algeria has ordered from Soc. Fives Lille–Cail a complete sugar factory of 1500 tons of beet per day capacity. Part of the plant will be supplied by Algerian industry. The factory will be built near Lavarande (El Khemis) and should start operations in the summer of 1966.

* * *

Honolulu Iron Works affiliation with J. & L. Engineering. The Honolulu Iron Works Company of Hawaii and J. & L. Engineering Company of Louisiana have become affiliated under a programme of stock-exchange. The J. & L. branch will continue its operations and will retain its identity as J. & L. Engineering Company, while its plant at Jeanerette, La., will undergo considerable expansion.

* * *

Dutch sugar factory exports[6].—A Dutch firm has received an order for two sugar factories for Iran. It has also signed a contract for the supply of a sugar refinery for Central Azucarera de Tarlac in the Philippines; this will have a daily capacity of 250 tons of raw sugar and will be capable of extension to 500 tons.

* * *

Spanish sugar production, 1963/64[7].—Sugar production in Spain in the season July 1963—June 1964 amounted to 367,545 metric tons against 422,698 tons in 1962/63, according to official sources. The total comprised 342,983 tons of beet sugar (399,882 tons in the previous season) and 24,562 tons of cane sugar (22,816 tons). The Ministry of Agriculture now assesses the sugar beet acreage for 1964/65 at 136,000 hectares compared with 114,000 ha in 1963/64, and the sugar outturn is expected to be 460–470,000 tons[8].

* * * * *

East German sugar production, 1963/64.—The following official figures for the 1963/64 campaign have been published[9]:

	1963/64	1962/63
Harvested beet area (ha)	232,152	232,432
Beet processed (metric tons)	5,764,400	4,520,400
Sugar extraction (%)	12·33	13·21
Sugar production* (metric tons, white value)	686,300	659,200
Sugar exports (metric tons)	195,700	213,100
Per caput consumption (kg)	29·9	30·4
Sugar production† (metric tons, raw value)	789,317	664,756
Beet yield† (metric tons/ha)	24·83	19·45
Extraction† (%, raw value)	13·70	14·68
Sugar yield† (metric tons/ha)	3·40	2·86

During the 1963/64 campaign 59 sugar factories were in operation compared with 64 in the previous campaign.

[1] *The Standard Bank Review*, October 1964, p. 5.
[2] *Overseas Review* (Barclays D.C.O.), September 1964, p. 33.
[3] *Willett & Gray*, 1964, **88**, 381.
[4] *Overseas Review* (Barclays D.C.O.), September 1964, p. 42.
[5] *Zeitsch. Zuckerind.*, 1964, **89**, 529.
[6] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (26), 11.
[7] *Public Ledger*, 26th September 1964.
[8] *ibid.*, 17th October 1964.
[9] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (27), 12.
* Figures for the calendar years, including the processing of imported Cuban raw sugar.
† Figures calculated by F. O. Licht K.G.

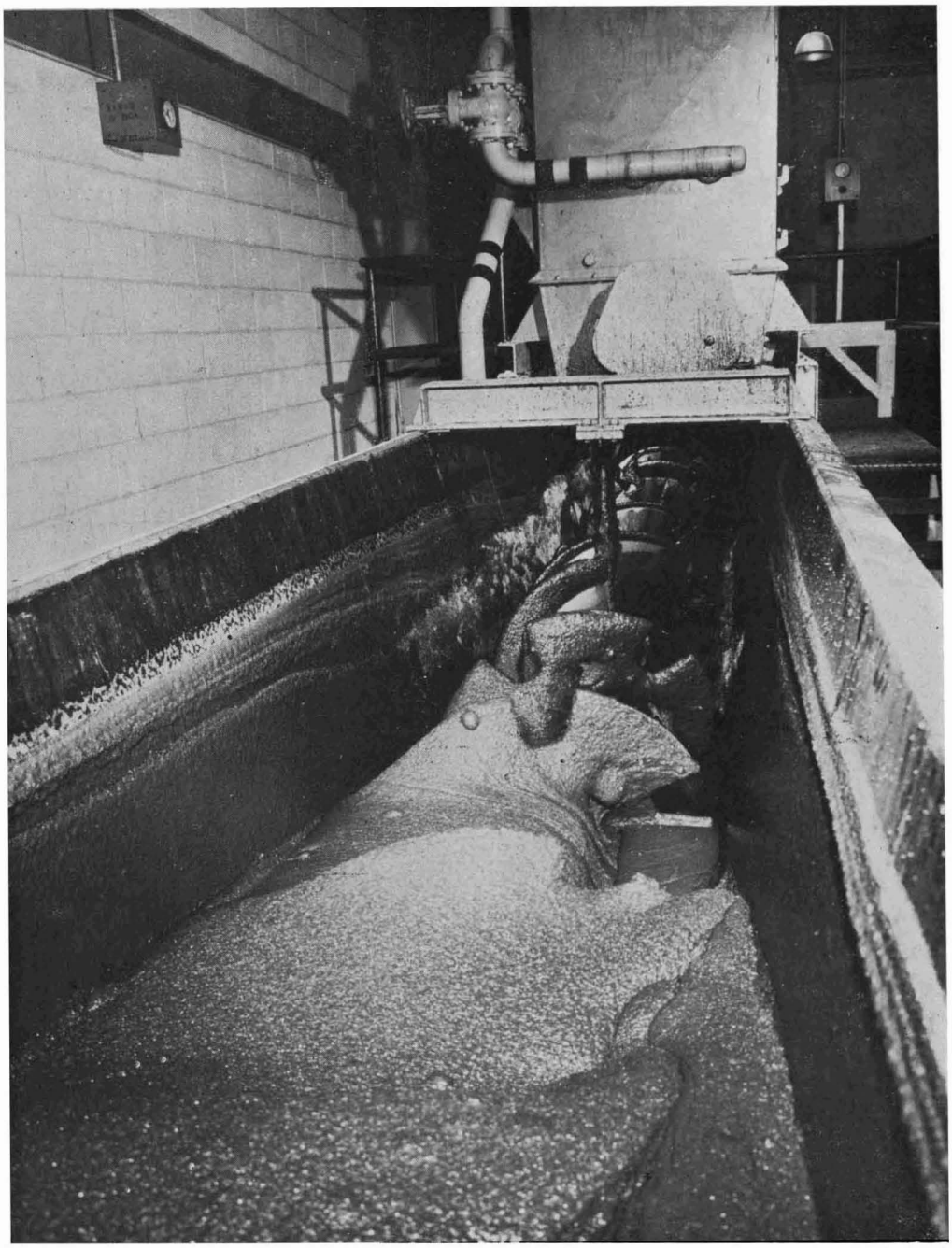


Photo by courtesy of Link-Belt Co.

RAW SUGAR MINGLING

INDEX TO VOLUME LXVI

SOME REMARKS ON ITS USE

In using this Index it should be noted that the principal entries cover the several stages of production : CULTIVATION (*see* Beet; Cane; Diseases; Fertilizer; Irrigation; Mechanization; Pests; Soil; Transport; Varieties; Weeds, etc.); SUGAR PROCESSING (*see* Bagasse; Boilers; Boiling; Carbonatation; Centrifugals; Clarification; Crystallization: Diffusion; Evaporators; Filter; Massecuite; Mills; Milling; Molasses; Pans, Vacuum; Scale; Sucrose; Sugar; Sugars; Sulphitation; Water, etc.); REFINING (*see* Bone Char; Carbon; Refinery; Refining; White Sugar, etc.); and BY-PRODUCTS (*see* Alcohol; Animal Fodder; By-Products; Fermentation; Paper; Pulp; Yeast, etc.).

Subjects covered separately include Ash; Bulk handling and Bulk storage; Colour; Control, Automatic and Chemical; Countries; Gur; Ion exchange; Juice; Micro-organisms; pH; Polarization; Weighing, etc. Glucose and Fructose are to be found under Dextrose and Levulose. Moisture is given under Water. Obituaries, Statistics and Trade Notices are collected together under those headings. "Sucrose" implies the pure chemical; "Sugar" the commercial product; and "Sugars" the chemical family, rather than grades of sugar. When looking under the author's name, it should be remembered that the surname may be the penultimate in Spanish.

(Abs.) indicates *Abstract*; (Brev.), *Brevity*; (B.B.), *Books and Bulletins*; (N.C.), *Note and Comment*; (Pat.), *Patent*; (Stat.), *Statistics*; (T.N.), *Trade Notice*.

SUBJECT MATTER

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

NAMES

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX