International Sugar Journal

Editor and Manager :
D. LEIGHTON, B.Sc., F.R.I.C.
Assistant Editor :
M. G. COPE, A.I.L.(*Rus.*)

Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

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

VOL. 68 *February 1966* No. 806

SCALE DOWN TUBE CLEANING PROBLEMS

How do you scale down a tube cleaning problem? Rapidly! By using "SKATOSKALO" flexible drive descaling equipment designed and manufactured by Gilmans of Warwick. Choose the power to suit your needs, electric, air or petrol engine, Gilmans "SKATOSKALO" can be driven by all three—and is—all over the world!

"SKATOSKALO" cleans most types of tubes including those in evaporators, juice heaters, vacuum pans and all types of water or smoke tubes. Gilmans manufacture "SKATOSKALO" machines from ½ to 5 h.p. to suit every requirement. Choose from a comprehensive range of machines (of which two are illustrated below) for descaling or brushing tubes from ½ in. i.d. up to 12 in. i.d.

SK 121

A single speed electric machine geared to give a speed of 4500 or 5000 r.p.m. Suitable for tubes up to 2 in. i.d. with shafts up to 32 feet in length.

SK 221

Twin drive air driven unit provides output speeds of 2800 × 2800 r.p.m. or 2800 × 4500 r.p.m. or 2800 × 1400 r.p.m. Suitable for tubes up to 4 in. i.d. with shafts up to 32 feet in length.

FLEXIBLE DRIVES···
GILMANS OF WARWICK LTD

manufacturers of
SKATOSKALO

Send for catalogue S.65/1

SKATOSKALO WORKS, Millers Road, Warwick.
Tel: 42693 *Grams:* SKatoskalo Warwick. *Telex:* 31451

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXVIII — FEBRUARY 1966 — No. 806

NOTES AND COMMENTS

Sugar supply and demand in 1966[1].

For many years after the war, world sugar consumption rose at a regular annual rate of about 4%. In 1961 there was an apparent doubling of this rate of offtake, probably due to a growth of invisible stocks encouraged by the low prices which prevailed during the second half of that year, but from 1962 to 1964 the annual increase was very small indeed. This, of course, stemmed from the high prices which ruled during these years and stocks in many parts of the world were reduced during this period, in some cases to dangerous levels, while consumers in some areas were even forced to go short of the commodity.

There is still insufficient information available to assess accurately what the overall increase was in 1965 and what it will be in 1966. Nevertheless, basing opinion on the statistics which are already partly available for 1965 it seems probable that pipe-line stocks of sugar are now being built up again to reasonably high levels and it is probable that deliveries during that year will eventually prove to have been more than 5% in excess of the 1964 level. Meanwhile a similar rate for 1966 would appear reasonable, taking into consideration the fact that expansion rates were so severely curtailed during recent years.

There are already several instances of expanding consumption in many areas among both developed and developing countries. Particularly noticeable in the former group is Japan, where within a space of two years a growth of more than 20% is anticipated. It would be impossible for some of the very high consumption countries to match this, but there is every sign that per capita consumption is being at least maintained if not increased while populations are expanding.

Statistics published by the International Sugar Council show consumption in 1964 to have amounted to 54·8 million metric tons. At the rate of expansion indicated above this would indicate a requirement in 1966 of at least 60·4 million tons.

A comparison of total production in 1965/66 with indicated consumption in 1966 shows an apparent surplus of up to 1·9 million tons. There are many indications, however, that the impetus of production expansion has eased, and provided the total world output for the 1966/67 crop can be maintained at around 62·0/62·5 million tons level the key objective must be to ensure that the currently indicated consumption requirement of 60·4 million tons is followed by a full 4% rise in 1967, taking it to about 63 million tons. Indeed, with a commodity the demand of which can ensure at least this rise, provided artificial barriers are not put in its way, an extra bonus can be obtained, since expanded stock levels are a corollary to expanding consumption rates. As in all agricultural crops, the possibility of a major disaster in producing areas which might radically change the statistical position can never be overlooked and this fact alone should serve as a warning that stock levels ought not again be permitted to fall to the point at which the world's supplies become vulnerable.

* * *

International Sugar Agreement extension.

It was originally intended that the International Sugar Agreement of 1958, which came into force on 1st January 1959, would extend for a period of five years only. The difficulties which have since occurred have so far prevented the negotiations of a fresh Agreement. Meanwhile the 1958 Agreement, without its economic clauses, has already been extended by protocol for a two year period to 31st December 1965. A further protocol extending its life for another year until the end on 1966 has now entered into force. The International Sugar Council has issued a statement indicating the complete acceptance of the protocol by all signatory governments, as follows:

"The requirements for the entry into force of the Protocol of 1965 for the further prolongation of the International Sugar Agreement, 1958, having been met by 1st January 1966, the Protocol entered into force on that date.

"The Protocol was adopted at Geneva during the closing stages of the September/October Session of the U.N. Sugar Conference 1965. It extends to 31st December 1966 the International Sugar Agreement of 1958 and is the second Protocol to be adopted with regard to that Agreement. (The first Protocol was concluded in 1963 and extended the Agreement

[1] C. Czarnikow Ltd., *Sugar Review*, 1966, (746), 17.

from 1st January 1964 to 31st December 1965). The economic clauses of the Agreement have been inoperative since 1st January 1962.

"The Protocol was open for signature at London from 1st November to 23rd December 1965. Within that period it was signed by governments holding 987 votes of the importing, and 980 votes of the exporting, members of the Council in 1965. Of the present members two exporting (Guatemala and Panama) and one importing (Ghana) countries failed to sign the Agreement within the stipulated period. It is understood that this failure was due to technical difficulties and that these countries will soon accede to the Protocol.

"All the signatory countries—these now include Tunisia—complied with the requirements for the entry into force of the Protocol. These provide for the entry into force of the Protocol on 1st January 1966 if by that date governments holding at least 600 votes of the importing countries and 700 votes of the exporting countries under the Agreement have become parties to the Protocol. By 31st December 1965 all the signatory governments had either become parties to the Protocol in accordance with their constitutional procedures or had complied with the special notification procedure provided for in the Protocol in this particular respect pending the completion of their constitutional procedures."

The extent of this support for the Protocol emphasizes the importance attached to maintenance of collaboration by all members of the I.S.A., exporting as well as importing, and this new extension provides a further year when, it is to be hoped, the Council can devise proposals which will be acceptable as a working basis for introduction of regulatory measures for controlling sugar availability on the world market and permitting a return to prices which bear some relation to the cost of production. The industry will await with interest the outcome of the meeting of the Council scheduled for the last week of January.

* * *

U.S. sugar supplies, 1966.

On the 15th November the U.S. Secretary of Agriculture proposed action to determine sugar requirements and to establish quotas for the calendar year 1966 totalling 9,800,000 short tons, raw value. Raw sugar importation were also proposed to be limited to 700,000 tons in the first quarter of the year and 1,700,000 for the first half of 1966. Explaining the need to limit exports early in the year, the Secretary stated that: "In view of the wide differential between the price of domestic raw sugar and the world price of raw sugar, there would be a strong tendency for an excessive quantity of foreign sugar to be shipped to the U.S.A. early in 1966. This would preclude meeting the price objectives of the Sugar Act. Accordingly, provision has been made for quantitative limitations on the total importation of raw sugar from foreign countries for the first quarter and the first half of the year".

The proposals were open to comment by the sugar trade until the 30th November but were confirmed on the 8th December. Details of the quotas appear below.

On the 22nd December the Department authorized the importation of 700,000 tons during the first quarter of 1966[2]. The shares of this amount are also tabulated.

Area	*Quota short tons, raw value)*	*Import authorization*
Domestic Beet	2,025,000	
Mainland Cane	1,100,000	
Hawaii	1,110,000	
Puerto Rico	1,140,000	
Virgin Islands	15,000	
TOTAL DOMESTIC AREAS	6,390,000	
Philippines	1,060,860	240,294
Argentina	43,594	0
Australia	168,752	3,810
Bolivia	4,218	0
Brazil	354,381	71,028
British Honduras	10,312	0
British West Indies	141,564	14,643
Colombia	37,500	7,524
Costa Rica	41,720	7,650
Dominican Republic	354,381	93,433
Ecuador	51,564	11,605
Fiji	37,032	1,561
French West Indies	44,532	9,824
Guatemala	35,156	11,878
Haiti	19,688	9,917
Honduras	4,218	0
India	67,502	0
Ireland	5,351	0
Malagasy Republic	7,969	0
Mauritius	15,470	0
Mexico	362,350	121,128
Nicaragua	41,720	9,664
Panama	26,250	4,893
Peru	282,662	70,648
Rhodesia*	6,094	0
El Salvador	25,782	5,795
South Africa	49,688	1,508
Swaziland	6,094	110
Taiwan	70,314	3,087
Thailand	15,470	0
Venezuela	17,812	0
TOTAL	9,800,000	700,000

* Withheld for reallocation among Western Hemisphere countries.

* * *

Indian record sugar production[1].

Sugar production in India during the 1964/65 season, which was completed on 31st October 1965, reached a new record, total sugar production amounting to 3,260,000 metric tons, compared with only 2,569,000 tons in the 1963/64 season. The previous record was established in 1960/61, when sugar production reached 3,029,000 tons.

With initial stocks of 156,212 tons, about 3·4 million tons of sugar were available during the 1964/65 season. Domestic consumption reached about 2·4 million tons and some 300,000 tons were exported. Thus, turnover stocks at the end of October are calculated as about 700,000 tons.

[1] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (32), 18.
[2] *Lamborn*, 1965, **43**, 216.

JUICE PRESERVATION DURING SHUTDOWNS

By J. DUPONT DE R. DE SAINT ANTOINE and E. C. VIGNES
(Mauritius Sugar Industry Research Institute, Réduit, Mauritius)

Paper presented to the 12th Congress, I.S.S.C.T., 1965.

PART II

Industrial results

In the light of the results obtained in the laboratory, it was decided to study the problem on an industrial scale by carrying out tests in a number of factories. The results are given in Table IV and those from each factory will now be considered in turn.

In factory A, the normal practice followed every week was to increase the lime addition some four hours prior to shutdown so as to obtain a pH of about 7·4 in the clarifier by the time the mills ceased crushing. At the same time mud filtration was accelerated so as to leave as little solids as possible in the clarifier at the beginning of the shutdown period, but the temperature of the heated juice was not reduced. Under these conditions a purity drop of about three points was encountered every week-end, for a stoppage period of approximately 24 hours, as confirmed by runs No. 1 and 2. For the purpose of tests 3 and 4 the same conditions were maintained except that the temperature of the heated juice was reduced to about 181°F (83°C) four hours prior to shutdown. The temperature in the clarifier was continuously recorded throughout the storage period. In the case of run No. 3, for which the storage period lasted almost two days, it had fallen to 165°F (75°C) whilst for run No. 4 the final temperature after only 19·7 hours' storage was higher, namely 179°F (81·7°C). The corresponding purity drops recorded were 1·2 and 0·7, a marked improvement over that obtained in current practice. Even the seemingly high figure of 1·2 points is good since it corresponds to a storage period of 47·6 hours.

After these few tests it was observed that the final pH of the juice at the end of the storage period was somewhat low, in the range 6·2–6·5. It was therefore believed that deterioration losses could possibly be reduced further if the pH could be kept at a higher level. However, in practice it is not possible to keep it up by merely increasing the addition of milk-of-lime to the raw juice since at the high alkalinities

Table IV
Industrial results

Factory	*Run No.*	*Date*	*Storage time (hours)*	*Temperature (°C) Initial*	*Temperature (°C) Final*	*pH Initial*	*pH Final*	*Purity Initial*	*Purity Final*	*Purity Drop*
A	1	11·8	26·0	90·0	82·0	7·4	6·3	87·4	84·5	2·9
	2	17·8	26·3	92·0	84·0	7·3	6·2	87·9	85·1	2·8
	Ave.	—	26·2	91 0	83·0	7·4	6·3	87·7	84·8	2·9
	3	3·8	47·6	82·3	74·0	7·6	6·3	87·9	86·7	1·2
	4	15·8	19·7	84·7	81·7	7·3	6·5	88·3	87·6	0·7
	5	1·9	24·2	81·8	77·5	7·6	6·6	89·1	88·1	1·0
	6	15·9	21·2	81·0	77·0	7·5	6·6	89·6	88·5	1·1
	7	22·9	25·4	81·5	77·0	7·6	6·9	88·8	88·1	0·7
	8	29·9	26·3	78·0	74·0	8·3	6·6	88·7	88·1	0·6
	9	6·10	26·0	85·0	81·0	7·3	6·6	88·9	88·1	0·8
	Ave.	—	27·2	82·0	77·5	7·6	6·6	88·8	87·9	0·9
B	10	11·8	19·0	98·0	85·0	6·9	6·4	84·0	81·6	2·4
	11	25·8	26·0	98·0	84·5	6·9	—	85·6	82·5	3·1
	12	1·9	25·5	90·0	78·0	6·9	—	86·5	84·1	2·4
	13	8·9	26·0	98·0	85·0	6·8	6·3	85·9	81·7	4·2
	14	15·9	26·0	93·0	80·0	6·8	6·2	87·3	84·8	2·5
	Ave.	—	24·5	95·4	82·5	6·9	6·3	85·8	82·9	2·9
	15	22·9	28·3	84·0	74·0	7·0	6·5	86·6	86·0	0·6
	16	29·9	30·0	88·0	77·0	7·0	6·5	86·5	84·9	1·6
	17	6·10	28·0	84·0	74·0	7·1	6·3	86·6	86·3	0 3
	Ave.	—	28·8	85·3	74·8	7·0	6·4	86·6	85·8	0·8
C	18	8 9	24·0	93·4	83·4	7·3	6·5	88·7	86·6	2·1
	19	22·9	27·0	89·2	80·0	6·9	6·2	86·7	84·4	2·3
	Ave.	—	25·5	91·3	81·7	7·1	6·4	87·7	85·5	2·2
	20	15·9	23·5	82·0	73·0	7·1	6·4	85·4	84·5	0·9
	21	29·9	23·8	81·8	73·0	6·9	6·3	85·4	84·7	0·7
	22	6·10	24·0	84·7	75·5	7·3	6·6	86·3	85·6	0·7
	Ave.	—	23·8	82·8	73·8	7·1	6·4	85·7	84·9	0·8
D	23	13·7	26·0	96·0	—	7·1	5·5	86·0	83·3	2·7
	24	19·7	27·0	96·0	—	7·5	5·7	86·6	84·0	2·6
	25	18·8	27·3	95·9	86·0	7·6	5·9	86·0	83·0	3·0
	Ave.	—	26·8	96·0	—	7·4	5·7	86·2	83·4	2·8

prevailing then reducing sugars are destroyed and acid decomposition products formed which tend to lower the pH. Further more lime salts find their way into the clarified juice, colour formation is favoured and viscosity of boiling house products is adversely affected. It was therefore decided to add milk-of-lime to the clarified juice after the latter had been kept in storage for a number of hours. For this purpose milk-of-lime was added continuously and the limed clarified juice pumped back from the sump tank into the flocculating chamber for several hours to try and ensure proper admixture. This procedure resulted in a slight drop in temperature, but in no case did the final temperature at the end of the shutdown period fall to below 165°F (74°C).

Fifty kg of lime were thus added in runs 4 and 5, and 100 kg in runs 6 and 7. As a result, the final pH of the juice was a little higher, but purity drops showed no marked improvement, averaging 0·85 for runs 5–8. This is no better than the figure obtained without lime addition during runs 3 and 4 and as confirmed in run No. 9 when a purity drop of 0·8 was recorded.

In factory B it was not usual practice to increase the lime addition nor to decrease the temperature a few hours prior to shutdown. Instead a fairly large amount of lime was added on Sundays, and the juice recirculated. Under these conditions a purity drop of about 2·6 units was registered weekly as shown by the results of runs 10, 11 and 12. For the two following runs similar conditions were maintained except that no lime was added during the storage period. The purity drops recorded under these conditions were not markedly different, amounting to 4·2 and 2·5 points. However, when the juice temperature was reduced very good results were obtained, the average purity drop for runs 15 to 17 amounting to only 0·8. This figure is in agreement with that obtained in factory A, namely 0·9.

The same conclusions may be drawn from the few runs made at factory C where the average purity drop registered when the juice temperature was lowered to 181°F (82·8°C) amounted to 0·8 as against a figure of 2·2 for a juice temperature of 196·5°F (91·3°C).

Finally, runs 23 to 25 of factory D, where the juice temperature could not be reduced, confirm that under these conditions of high temperature storage purity drops are marked, amounting to 2·8 on the average. This figure is in agreement with those obtained under similar conditions in factories A, B and C.

Conclusions

Both the laboratory and the industrial scale experiments reported here confirm that the deterioration of juice stored in clarifiers during shutdown periods can be reduced to a minimum by exercising strict control on the juice temperature. Under the conditions prevailing in Mauritius where week-end shutdowns amount to about 24 hours, purity drops may be reduced to less than one point.

For best results, the initial average clarifier juice temperature should be such that, by the time the mills start crushing again, the final temperature has not fallen to below 160°F (71°C) so as to prevent micro-organic destruction from setting in. It is therefore necessary to pre-determine, in each particular case, the temperature drop resulting from a 24-hour, say, stoppage and to adjust every week the initial clarifier juice temperature accordingly. It is also recommended to use a thermograph after locating the most appropriate place in the clarifier for placing the bulb.

When the temperature is reduced to 176–180°F (80–82°C) three hours or so prior to shutdown, difficulties are often experienced with clarification. However these difficulties are generally easily overcome by adding a polyelectrolyte, "Separan AP-30" for instance, to the juice from the moment the temperature is reduced. Also, the amount of bagacillo present in the stored juice is higher than under normal working conditions, so that it is advisable to fine-screen the clarified juice, for a few hours at least, when the mills start crushing again. In Mauritius this is no problem since most factories are equipped for continuous screening of the clarified juice.

Finally it should be stressed that whenever purity drops are used to measure sugar losses, special attention should be paid to sampling in order to make sure that samples representative of all the juice contained in the clarifier at the beginning and at the end of the shutdown periods are obtained. Also a precision refractometer should be used to measure the Brix so as to eliminate the influence of differential amounts of suspended solids on the Brix and hence on the purity values.

Summary

Deterioration of clarified juice over week-end shutdowns was studied during 1963. In the laboratory, lime, sodium carbonate and "Magox" were used and their effect on purity drop, reducing sugars and final pH observed. Results show that less deterioration occurs when the temperature of storage is lowered and initial pH raised. Under local conditions lime was found more economical for raising pH.

For best results on an industrial scale the initial average clarified juice temperature should be lowered so that the final temperature does not fall below 160°F (71°C) by the time the mills start crushing again. It is recommended to use a polyelectrolyte in the case of settling difficulties. Special precautions should be paid to sampling and refractometer Brix used to eliminate the influence of suspended solids on purity.

INVESTIGATIONS INTO FROTHING CLARIFIERS

Summary of a thesis presented by A. P. SARANIN (*Millaquin Sugar Co. Ltd., Bundaberg, Queensland*) *for consideration for the degree of Master of Engineering (Chemical) of the University of Queensland,* 1962

Introduction

THIS work deals with the performance of a Bulkeley-Dunton "Colloidair" clarifier installed at Millaquin Sugar Co. Ltd. in 1956. Initially this clarifier was not successful, but as a result of the investigations described, the process was modified and, since 1959, the "Colloidair" has been successful in clarifying the full throughput of the refinery, amounting to 28,000 tons per annum. The thesis runs to 225 pages and includes 43 figures. It is a model investigation.

The history of phosphatation is reviewed and it is mentioned that the two smallest refineries of the Colonial Sugar Refining Co. Ltd. at Perth and Adelaide use clarifiers while the remaining four refineries use carbonatation, Pyrmont since 1911. The first "Colloidair" was installed at Crockett in 1952, followed by another at Gramercy in 1953. There are others in operation in India, Canada and Australia. Gramercy have abandoned their unit.

The principle of the "Colloidair" is to pump aerated melter liquor into a retention tank held at 50–90 p.s.i.g. When the pressure is released, the air comes out of solution and attaches itself to the phosphate floc. Scum is scraped off and clear liquor drawn from the bottom of the clarifier. The capacity of the "Colloidair", Model 50, is about 5 c.f.h. of liquor per sq.ft. area, or 3 c.f.h. per cu.ft. volume. Scums are generally pressed using kieselguhr although some operators use centrifuges. Sugar recovery from scums is complex and troublesome.

In early trials at Millaquin melter liquor was at 58–60°Bx and 180–190°F, phosphate content was 0·03% P_2O_5 on solids and the pH was adjusted to 7·2–7·8 using lime solution of 10°Bx. Preliminary trials all failed owing to carryover of floc into the char filters. Reaction between phosphate and lime was not completed in the clarifier but continued in the char. Prefiltration of the liquor with kieselguhr allowed 90–95% of the floc to be floated off and increasing the temperature to 195°F improved operation considerably, but the clarified liquor was still milky.

Sand filtration of clarified liquor was unsuccessful, first runnings containing fine floc and air bubbles, while heating to 200–210°F resulted in heavy secondary precipitation. Back-washing of the sand was slow and inefficient. The crux of the problem lay in the "Colloidair" itself; the reaction *had* to be complete and all the floc *had* to be floated off.

The first improvement was to convert the sand filter tank into an after-heater (210°F) and second flotation chamber. Liquor drawn from this second cell was excellent and scum was up to 2% by volume on melt, compared with 6–8% on melt of "Colloidair" scum. The second improvement was to pass the melter liquor through a rotary screen of 80-mesh, rotating at 50 r.p.m. In this way it became possible, for the first time, for the refinery to run on phosphatation for a week at a time.

It was concluded that:

(i) melter liquor should be screened through 40-mesh or finer,

(ii) the temperature of the liquor was very important in promoting floc formation,

(iii) sand filtration was unpractical, and

(iv) there was need for a better understanding of the chemical reaction and of the flotation process.

Laboratory Investigations

In order to reach this better understanding, laboratory investigations were instituted. Published data were confusing and contradictory so the first step was to devise an aerator, incorporating a container for defecant and an air-bleed system to promote turbulence inside the aerator. Colour was determined with a Lange nephelometer and scum filtrability was measured using a micro-filter. Methods of mixing and of analysis and determination of the air content of the liquor and scums are described in detail in the original thesis.

Experiments were made to examine the effect of pressure, time and intensity of agitation on the solubility of air in liquor. It was found that solubility of air in liquor increased with pressure, with increase of agitation and with time, the air content varying between 0·5% and 2·0% on melt within the ranges of variables examined. It was further shown that:

(i) dissolved air increases with both Brix and temperature of liquor,

(ii) flotation velocity of bubbles increases with rise in temperature and with a fall in Brix, and

(iii) flotation velocities ranged from 2 to 8 f.p.h. under the conditions studied.

In a study of the phosphoric acid-lime saccharate reaction, four methods of adding the defecants to liquor were examined. The period of 2 minutes between the start of liquor discharge from the aerator and the time when flocculated liquor was placed in the water bath was found to be critical. This is the period when bubble formation, floc formation and linkage of the two take place. By far the best method of defecating was to add the defecants to the liquor after it left the aerator. Significantly better clarification was obtained by intensive mixing during the flocculation period. Provided that mixing is intensive it is unimportant whether acid precedes saccharate or *vice-versa* or the additions are simultaneous. But if mixing is slight it is better to add the acid first.

Floc seeding was tested at two levels—5% and 10%; it was found that floc seeding reduced colour and turbidity by nearly 10%. These results were significant to the 5% level with 5% seed and to 1% with 10%

seeding. Best results, as far as residual soluble phosphate is concerned, were obtained by intensive mixing coupled with floc seeding. Residence time beyond 10 minutes had no practical value.

The effectiveness of clarification, as witnessed by colour, turbidity and residual phosphate, increases with intensity of mixing but reaches an optimum and diminishes thereafter. Very great intensity of mixing destroys the floc. As clarification improves so the scum volume increases.

Increase in phosphoric acid improves clarification; up to 400 p.p.m. P_2O_5 the improvement is rapid while above 500 p.p.m. there is no further improvement. Very little improvement in turbidity is found above 250 p.p.m. Multiple clarification has no advantages and produces an excessive volume of scum.

Clarification is as good at 70° as at 50°Bx, while residual P_2O_5 is lowest at 60°Bx. CaO and ash removal are better at high Brix and, while scum volume increases with Brix, sharply after 65°Bx, velocity of flotation is reduced.

Colour, turbidity, residual phosphate and lime, scum volume and flotation velocity are all improved by higher temperature. Increase in pH increases colour and lime content significantly but decreases residual phosphate. It increases turbidity and scum volume to a slight extent. The best level of pH is apparently 7·0–7·2.

It was concluded from the results of a series of experiments that:

(i) the lower the liquor purity, the more colour and turbidity will be removed at a given phosphoric acid level, but residual phosphate will be higher,

(ii) scum volume increases with lower purity liquor while flotation velocity decreases,

(iii) the time required to form a floatable coagulum increases with lower purity, e.g. from 1 minute at 99·0 purity to 9 minutes at 93·7 purity,

(iv) added colloidal material (corn starch and trypton agar) has no significant impeding effect on clarification,

(v) adding unsulphated molasses ash had no impeding effect, but did tend to increase scum volume, and

(vi) the effect of adding raw molasses and refinery molasses indicated that impurities derived from a refinery have more effect in impeding clarification both on colour and turbidity.

It was also found that the greater the air:floc ratio, the higher the flotation velocity.

Modified "Colloidair" Clarifier

As a result of the study it was possible to modify the clarifier to give improved performance. The main modifications were:

(*a*) increasing the capacity of the reaction chamber to give a retention time of 5 min,

(*b*) installation of a controller to govern an open steam heater so as to maintain a temperature of 185°F,

(*c*) fitting a new arrangement for floc seeding and for adding phosphoric acid in four stages between the aerating tank and the reaction tank, 10°Bx lime solution being added to blow-ups having 12 min retention time,

(*d*) incorporation of a second flotation cell fitted with a tubular heater and divided into four compartments (inlet, flotation, scum and outlet) of 20 min retention time, at 205°F, and

(*e*) use of a 12 sq.ft. 100-mesh screen after the second cell.

Subsiding at 25°Bx was abandoned in favour of straight pressing of scums using kieselguhr.

In September 1961 the system broke down for 2½ weeks because the scums from poor filtering raws could not be pressed fast enough, although the clarifier work was satisfactory. This temporary reversion to a kieselguhr filtration process allowed some comparisons to be made (Table I).

Table I
Comparison of kieselguhr filtration with clarification

	Kieselguhr	*Clarification*
Colour removal (%)	16	40
Colour removal by char (%)	65	85
Combined colour removal by defecation and char (%)	71	91
Char usage (% on melt)	35	29·5
Turbidity removal (%)	41	66
Turbidity removal by char (%)	41	64
Combined turbidity removal by defecation and char (%)	67	88
White sugar colour (°St. at 60°Bx)	6·0	2·8
Turbidity	6·1	2·7

Performance data

The unit handles 7 tons of melt per hour with 1·2 tons of remelt, equivalent to 410 c.f.h. at 58°Bx. Phosphoric acid is added to the extent of 0·025% P_2O_5 on melt, while 0·068% of hydrated lime is used. Kieselguhr usage is 0·177% on melt.

There is no significant change in liquor analysis during the process although it may be noted that melter liquor is poor, containing 0·22% invert and 0·18% ash. Apparent colour removal is 38%, the melter liquor colour being measured at pH 6·8–7·1 and clarified liquor at pH 7·2–7·4.

Lime added in the blow-ups reduces the likelihood of acid inversion, but thermal inversion is a hazard in the second flotation tank where the liquor is held at 205°F for 20 minutes. The data yield no precise figures for comparison, however.

Dissolved air is about 1% on volume of melter liquor while the effluent from Cell 1 contains 0·08% air and that from Cell 2 is air-free. The mean scum volume is 6·5% on liquor volume, compared with a calculated volume of 6·8%.

There is need for improvement in flocculation efficiency; the process uses gainfully only half the phosphoric acid added. Melter liquor in the reaction chamber contained 287 p.p.m. P_2O_5 but, of this, only 138 p.p.m. had been precipitated by the time the liquor entered the flotation cell. More than half can thus be considered to be wasted. Of the total P_2O_5 precipitated, 84% comes out in the reaction chamber, 11% in the first cell and 5% in the second cell. Residual P_2O_5 in liquor is adsorbed by char.

It has been shown in the laboratory that residual P_2O_5 can be reduced to 75 p.p.m. or less; if achieved in the factory this could reduce phosphoric acid addition by 22% or remove an additional 7% colour. Longer retention is not the answer, however, and more intensive blending of reagents is needed, e.g. by mechanical stirring of acid and saccharate.

Optimum phosphoric acid addition seems to be 250–300 p.p.m. P_2O_5, while optimum retention time in the flotation cell is thought to be 12–14 minutes at 200°F. The process is very sensitive to temperature fluctuations and should be controlled to ±1°F. It is also very sensitive to variations in Brix which should also be controlled, to ±0·5°Bx. There should be no difficulty in working at 65°Bx and very close pH control to 7·2–7·4 will improve colour removal and reduce residual P_2O_5. Phosphatation is at its best with high purity melt liquors.

Scum treatment

If scums are well deaerated and diluted to about 30°Bx they will subside, solids in mud being 5·5–7·5%. The filtration rate of these muds is 1·4 c.f.h. per sq.ft. compared with some factory figures of 0·04 c.f.h. for incompletely deaerated scums. Present practice is to filter at 185°F using 1·25% kieselguhr on weight of scums (0·167% on melt). Average pressing rate is 0·03 c.f.h. per sq.ft. and average cycle duration 8 hr, variation being between 3 and 17 hr.

Laboratory investigations have shown that there is a fairly good relationship between filtering quality of scum and the raw sugar from which it is derived. Deaeration and subsequent boiling help materially as also do flocculating agents.

The Determination of Extraneous, Water-Insoluble Matter in White Sugars using Membrane Filters

By D. HIBBERT and R. T. PHILLIPSON

(British Sugar Corporation Ltd., Central Laboratory, Wharf Rd., Peterborough, England)

Introduction

THE quality of white sugar as produced in most countries is such that water-insoluble material is usually only present in very small amounts, but the nature of this material may vary considerably and, in certain circumstances, be readily visible even in the dry sugar. From this point of view, its presence or absence may be regarded as one of the more important criteria for judging the suitability of sugars for commercial sale. This has been recently emphasized by the decision of the Codex Alimentarius Commission of the Food and Agriculture Organization that insoluble matter should be one of the factors to be incorporated in any proposed specification for sugars used for human consumption. The formulation of acceptable standards has been, so far, hampered by the lack of a suitable recognised method.

In the past, a number of widely varying methods have been proposed and, in broad terms, these fall into three categories. Firstly, filtration through paper has been suggested, either for a purely qualitative appraisal, or for an approximate quantitative measurement by visual comparison with standard discs as proposed by CULP[1]. Secondly, filtration through sintered glass crucibles has been used for a quantitative measurement of the weight of material removed from a solution and, thirdly, filtration through membrane filters has been suggested[2]; the last method was recommended for further study at the 13th Session of ICUMSA in 1962.

It is the authors' opinion that filtration through paper may give a reasonable visual assessment of the nature of the insoluble matter present in sugars, but that any attempt to obtain a quantitative result by comparison with permanent standards is quite unpractical by reason of the variation of the nature and size of insoluble particles found in different types of sugar. Filtration through sintered glass may, under certain circumstances, give reasonable quantitative results but the method has a number of quite definite disadvantages. The weight of the container is excessively high in relation to the weight of material to be weighed after separation; pore sizes are by no means consistent; blockage of the pores may frequently occur; no permanent record of visual appearance is available, and cleaning of the crucibles is difficult and tedious.

The use of membrane filters is clearly capable of overcoming most, if not all, of the disadvantages inherent in the use of either filter papers or of sintered glass. Many types are commercially available and, in general, the pore sizes of these are of remarkable consistency. They have a low weight in relation to the weight of insoluble matter which they remove; their filtration rate and total capacity may both be very high enabling a rapid test to be carried out; they retain most, if not all, of the insoluble matter on their surface where it may readily be seen and in-

[1] *Proc. 13th Session ICUMSA*, 1962, 58.
[2] BRITISH NATIONAL COMMITTEE: *ibid.*, 58.

spected; they may be conditioned to constant weight enabling an accurate gravimetric assessment of insoluble matter; they are easily mounted between glass plates to give a permanent record and, additionally, some types are obtainable in both white and black form, enabling the visual estimation of both light- and dark-coloured particles by contrast. Moreover, membranes, or parts of membranes, may be cleared with immersion oil and examined microscopically with transmitted light.

Tests on commercially available membrane filters

The degree of compliance with the advantages outlined above varies to a considerable extent according to the type of membrane under consideration and tests were therefore undertaken on a number of different membrane types available in Great Britain. These originated from Membranfiltergesellschaft m.b.H., Göttingen, Germany, from the Millipore Filter Corporation, Bedford, Massachusetts, U.S.A. and from the Gelman Instrument Company, Arbor, Michigan, U.S.A. The determination of insoluble matter in white sugars requires that the membranes are sufficiently strong and pliable not to break up during a test, that they will filter quickly a solution containing at least 1 kg of sugar and that there is no change in the weight of the membrane during the course of the test. It is desirable that the membranes should be available in both black and white forms and that they are reasonably priced. The membranes tested

Table I
Filtration rates of various membrane filters

Manufacturer	*Filter type*	*Pore size (microns)*	*Sugar sample*	*Filtration time (seconds) per 500g aliquot* 1	2	3	4	5	6
Membranfilter-gesellschaft	MF 500	5·0	A	35	44	58	61	54	138
	MF 500	5·0	B	51	64	60	56	59	81
	MF 500	5·0	C	48	53	73	81	54	57
	MF 500	5·0	D	44	61	65	75	81	89
	MF 250	2·0	A	58	63	72	77	78	*
	MF 250	2·0	B	124	360	*			
	MF 250	2·0	C	66	74	101	116	*	
	MF 250	2·0	D	83	*				
	MF 150	1·0	A	63	85	114	134	*	
		1·0	B	111	240	*			
	MF 150	1·0	C	111	130	237	*		
	MF 150	1·0	D	111	*				
	MF 125	0·9	A	74	90	101	120	*	
	MF 125	0·9	B	102	134	*			
	MF 125	0·9	C	91	*				
	MF 125	0·9	D	290	*				
	MF 100	0·8	A	219	*				
	MF 100	0·8	B	245	*				
	MF 100	0·8	C	286	*				
	MF 100	0·8	D	*					
	MF 05	0·6	A	195	245	*			
	MF 50	0·6	B	430	*				
	MF 50	0·6	C	*					
	MF 50	0·6	D	*					
Millipore	SM	5·0	A	118	45	78	83	139	124
	SM	5·0	B	75	*				
	SM	5·0	D	65	121	*			
	SS	3·0	A	55	58	70	89	114	199
	SS	3·0	B	*					
	SS	3·0	D	80	162	*			
	RA	1·2	A	66	79	83	115	200	*
	RA	1·2	D	77	112	*			
	AA	0·8	A	150	*				
	AA	0·8	D	*					
Gelman	VM 100	10·0	C	37	62	96	121	*	
	VM 100	10·0	D	59	86	186	*		
	VM 1	5·0	C	46	61	137	*		
	VM 1	5·0	D	36	36	54	125	*	
	GA 1	5·0	C	*					
	GA'1	5·0	D	*					

Note.—In the above table an asterisk (*) indicates that filtration of the aliquot in question stopped completely or became so slow as to necessitate discontinuation of the test.

were available in a wide choice of sizes but the largest suitable diameter common to all types was 47 mm and this was therefore chosen as the standard.

Initial filtration tests were carried out to establish the relative abilities of the filters available to pass an adequate quantity (up to 3 kg) of sugar in solution in a reasonable time. For these tests, four samples of sugar were used; two were of ordinary crystalline sugar produced by direct boiling from beet sugar factory standard liquors (A and C). One was of a fine-grained sugar produced by screening of sugar similar to that which comprised the first two samples (B), while the fourth was a refined cane sugar known to contain sufficient sub-microscopic undissolved material to impede filtration under some conditions (D). Aliquots of a 50°Bx sugar solution at 60°C were filtered through the test membrane, each aliquot being equivalent to 500 g of sugar, and the filtration times of these increments were measured; unless the filtration stopped or became extremely slow, a total of 3 kg of sugar was passed through each membrane.

The main results of these filtration tests are shown in Table I and, from the data presented, it is quite evident that, of the membranes tried, only the MF 500, made by Membranfiltergesellschaft m.b.H., gave the satisfactory flow rates required for the four samples of sugar tested, and these were therefore used in all subsequent tests.

It is emphasized that, although the MF 500 membrane filters were found to be ideal, it is not intended to suggest that other manufacturers would be unable to produce a membrane capable of meeting the requirements of the tests, but only that those available at the time had an inadequate flow rate under the conditions used. The authors would welcome the opportunity of carrying out comparative tests on other types of membranes which might be thought to be suitable.

Weight constancy of MF 500 membrane filters

Some membranes have been found to contain a significant amount of water-soluble material which would inevitably reduce the accuracy of quantitative tests on sugar samples when these are passed through the membranes in the form of hot, aqueous solutions.

White MF 500 membranes were boiled for four minutes in distilled water, dried, boiled for a further four minutes, dried, and then boiled for a final four minute period and dried again. Weight losses in the second boiling were found to range from 0·4 to 1·7 mg per membrane while losses in the third boiling did not exceed 0·1 mg per membrane. In a second experiment, white MF 500 membranes were boiled for eight minutes in distilled water, dried, boiled for a further four minutes, and dried again; under these conditions, weight losses during the second boiling varied from nil to 1·0 mg per membrane.

Subsequently, tests were made on black MF 500 membranes and it was found that a boiling time of 13 minutes was required to ensure complete weight constancy; it was noticed, however, that membranes treated in this way gave abnormally high results when used for the determination of insoluble matter in white sugars due, apparently, to a reduction of the pore size. Investigation of alternative treatments established that this difficulty could be avoided by boiling for only five minutes, after which further losses in weight did not exceed 0·1 mg per membrane when 2 litres of hot, distilled water were subsequently passed through individual membranes. This was also found to be true of the white MF 500 membranes and therefore, for all further work, a single six-minute boiling was adopted.

Preparation of black membranes

During the early stages of the investigational work, black MF 500 membranes were not available from the manufacturers and they were therefore prepared in the laboratory as follows. A saturated solution of "Methasol Nigrosine" (Imperial Chemical Industries Ltd.) was made by prolonged agitation of the dye with iso-propanol at room temperature; the solution was filtered through sintered glass (porosity No. 5 on 3). The white MF 500 membranes were dipped in the filtered dye solution and suspended vertically, the excess solution being removed by touching the bottom edge of the membranes with filter paper. After air drying, the membranes were heated for 45 minutes at 60°C and then brought to weight constancy by two successive boilings in distilled water of four minutes each. The fact that this treatment had no effect on the pore size was confirmed by measurements of the flow rate of distilled water through the treated and untreated membranes. With a pressure differential of 25 cm Hg, there was no significant difference in the time taken to pass 500 ml (about 14 to 17 seconds). It is emphasized that the remarks on black membranes in this section refer only to membranes prepared in the laboratory and not to the commercially available black membranes referred to in other parts of the paper.

Effect of temperature on membranes

Experiments were carried out to establish the optimum temperature for drying membranes prior to, and after, filtration of sugar solutions. It was found that equally satisfactory results could be obtained by drying at any temperature between 56° and 105°C without any loss in strength of the MF 500 membranes, although some other types of membrane became brittle and difficult to handle at the higher temperature. In later work, all tests were carried out with drying at 60°C, primarily because outer containers were easier to handle at this temperature.

Method of analysis of sugar samples

On the basis of the work reported above, the following method for determining the water-insoluble extraneous matter in white sugars is proposed.

(*a*) *Preparation of membranes:*

MF 500 membranes are washed by immersion in boiling distilled water for six minutes and, after draining excess moisture, are transferred individually to clean, dry, polystyrene Petri dishes. The membranes in their dishes, with the tops removed, are dried for one hour at 60°C, after which the tops are replaced prior to cooling for 30 minutes in a desiccator. The cooled membranes are weighed directly on the balance pan to $\pm$ 0·1 mg and the weights recorded on the outer dishes.

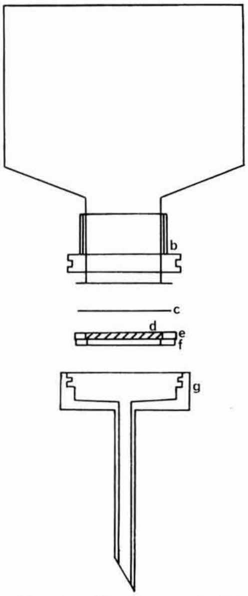


Fig. 1. Filtration apparatus, scale $\frac{1}{3}$-linear. Key: *a*, funnel; *b*, fixing collar; *c*, membrane filter; *d*, sintered bronze disc; *e*, *f*, rubber sealing rings; *g*, base.

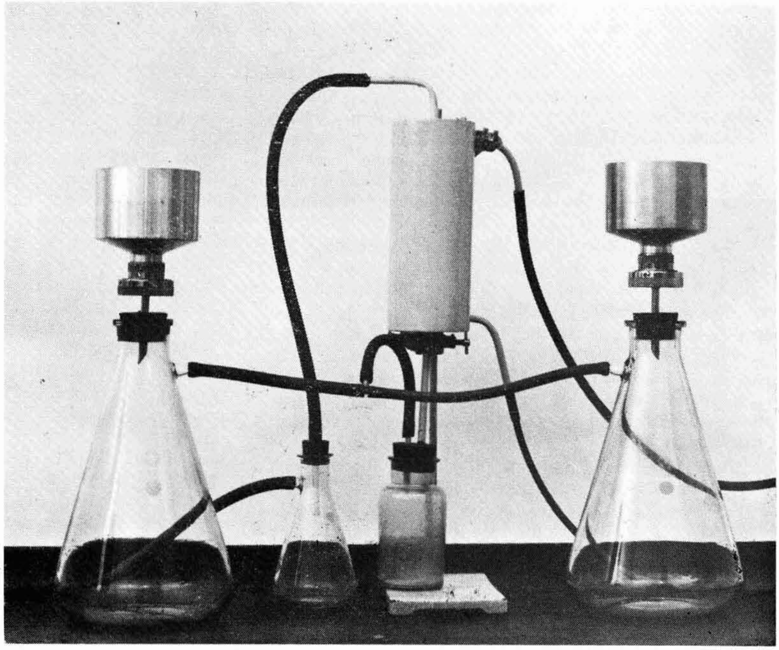


Fig. 2. Complete filtration apparatus

Note: The basic membrane filter holder (Cat. No. FD-350) was supplied by A. Gallenkamp & Co. Ltd., Christopher St., London E.C.2. The funnel was spun from aluminium, incorporating the fixing collar during manufacture, by Manchester Tinning Co. Ltd., Clough Rd., Blackley, Manchester 9.

The sintered bronze disc (Cat. No. PMP 5031, grade B) was supplied by Sintered Products Ltd., Hamilton Rd., Sutton-in-Ashfield, Notts.

(*b*) *Preparation of sugar solution:*

A clean, stainless steel jug of 2000 ml capacity is carefully rinsed with distilled water and 1000 g ($\pm$ 1·0 g) of the sugar is weighed directly into it. Hot (about 95°C) distilled water is added to bring the total volume to about 1800 ml and the mixture is then heated over a Bunsen flame or hotplate, with stirring (using a stainless steel rod), until the temperature of the solution reaches about 95°C and all the sugar is dissolved.

(*c*) *Filtration of sugar solution:*

A specially designed membrane filter holder (Fig. 1) is fitted into a conical filtration flask of 4000 ml capacity as shown in Fig. 2. The flask is connected to a vacuum supply through a water-cooled condenser and a trap. A weighed membrane filter is moistened by floating it on distilled water in a Petri dish and inserted in the filter holder. The hot sugar solution is then passed through the membrane under reduced pressure and the beaker and stirring rod are carefully rinsed into the funnel with hot, distilled water; a polyethylene "squeeze bottle" is convenient for this purpose. The membrane is also carefully washed with hot, distilled water and a total volume of wash water of about 1000 ml is used.

(*d*) *Final washing of the membranes:*

In order to remove the last traces of sugar which are always present in the periphery of the membrane, a final washing, after its removal from the filter holder, is essential. Experience has shown that this is most conveniently achieved by the use of a square-mesh sieve of 20 cm diameter (mesh size about 0·4 mm). This is set in a level pan of hot, distilled water in such a way that the water is just in contact with the screen, and covered by a lid. The membrane, after removal from the filtration apparatus, is placed on the wet sieve for one hour. The washing is shown in Fig. 3.

(*e*) *Drying and weighing of the membranes:*

The membrane filter, after washing, is returned to its original dish and dried, with the lid removed, for one hour at 60°C; after replacement of the lid,

Fig. 3. Final washing of membranes

the dish is cooled for 30 minutes in a desiccator and the membrane re-weighed. The difference in weight recorded in milligrams is a direct measure of insoluble matter in mg per kg (parts per million).

(*f*) *Qualitative aspects of the test:*

The nature of the insoluble material may in general be readily assessed by examination of the membrane under a low-power microscope. In practice, it has been found convenient to mount the membranes permanently between lantern slide cover glasses, 7 cm × 7 cm (Kodak Ltd.), as shown in Fig. 4.

(*g*) *Special Precautions:*

The effectiveness of the final washing is vital to the accuracy of the test and this may be checked by spraying occasional membranes, after use, with a standard α-naphthol/phosphoric acid chromatographic spray reagent and heating at 105°C, when the membrane should be entirely free of any trace of violet coloration. Drying cloths may be a serious source of contamination and it is therefore important that all apparatus should be rinsed thoroughly with distilled water, but not dried, immediately prior to use.

Recovery tests

Several batches of a solution were prepared by dissolving 500 g of sugar in 1000 ml of distilled water; these solutions were then filtered through membrane filters of 0·8 micron pore size to remove all suspended material. Subsequently, varying amounts of a standard suspension of kieselguhr in water were added to the individual batches of solution and the insoluble matter measured by the technique described above. The membranes were then treated with a few drops of sulphuric acid and incinerated in a furnace at 550°C, and the residue weighed. Results of typical tests are shown in Table II and it is considered that these indicate a satisfactory recovery of insoluble matter by the method proposed.

Table II

Results of recovery tests

Test Number	*Insoluble matter on membrane (mg)*	*Residue after incineration (mg)*
1	16·5	16·8
2	13·6	13·4
3	8·9	8·9
4	4·8	4·4
5	2·4	2·2

Inter-laboratory concordance tests

In order to assess the within-laboratory and between-laboratory errors inherent in the test, determinations were undertaken on three samples of sugar by three different laboratories. The results of these

Table III

Results of Tests at Participating Laboratories

(Insoluble Matter mg/kg)

Laboratory	*Test Number*	*Sample X*	*Sample Y*	*Sample Z*
A	1	1·3	8·1	2·7
	2	1·2	8·7	3·1
	3	1·5	8·4	2·5
	4	1·1	9·2	2·6
B	1	1·7	8·8	2·6
	2	1·9	8·5	2·7
C	1	1·8	8·9	2·8
	2	1·7	9·4	2·7

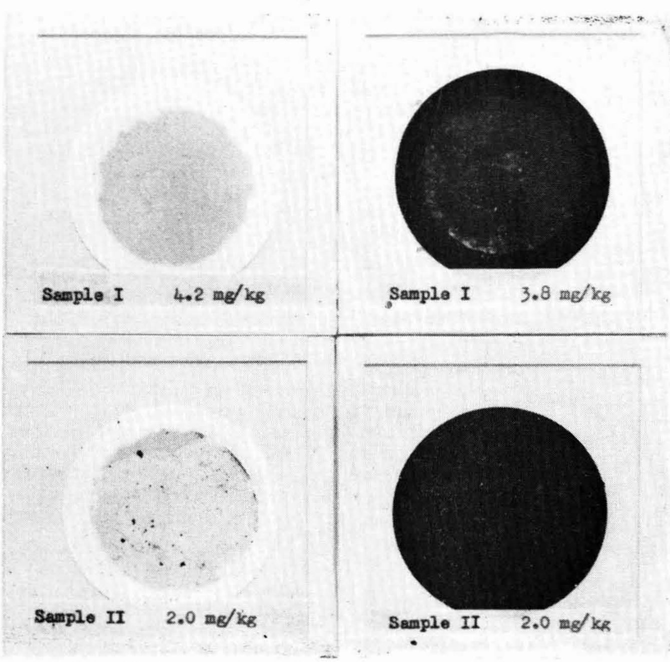


Fig. 4. Duplicate membranes from two sugar samples after mounting

determinations are shown in Table III and it is considered that these indicate a satisfactory degree of reproducibility of results.

Summary

The use of membrane filters is proposed as a suitable method for assessing the amount of extraneous water-insoluble matter in direct consumption sugars. The use of MF 500 membranes is recommended, using a filtration apparatus described in detail. Agreement of results between and within laboratories is considered satisfactory.

Acknowledgments

The authors wish to express their thanks to Messrs. W. R. FERGUSON (Tate & Lyle Refineries Ltd.) and H. A. JONES (Rowntree & Co. Ltd.) for their helpful cooperation in the concordance tests.

CORRESPONDENCE

To the Editor, *The International Sugar Journal.*

Dear Sir,

Polarization Temperature Corrections

I have read with interest the paper "Polarization Temperature Corrections" by Dr. Robert A. M. WILSON (*I.S.J.*, 1965, **67**, 234–236, 265–268). Whilst it is unquestionably a learned treatise on temperature corrections, I cannot agree that it clarifies the reasons and purposes for making the corrections.

From early in the text, the author adopts the academic form of equation:

$$P_{20} = P_T + P_{20}\, k \Delta t.$$

As applied to a quartz control tube this form is convenient because an acceptable value for P_{20} on the right hand side of the equation is engraved on the tube. But what about when one is working with a random solution; is one to transpose and solve for P_{20}? The standard practice in this case is to invoke the ancient approximation that the reciprocal of $1 - x$, when x is small, may be taken as $1 + x$. This leads to the simpler and more familiar formula:

$$P_{20} = P_T (1 + k \Delta t).$$

After all, if it is reasonable to let NS equal P_{20} it is also reasonable to let it equal P_T.

In dealing with the various corrections, the author has proceeded with confidence and accuracy as far as Solution Preparation Corrections on p. 236. Here he seems to have encountered the problem of knowing that he had to reverse the sign of the coefficient of expansion of the liquid, apparently without being certain why. On p. 235 he says "The temperature coefficient is therefore equal in magnitude to the volume expansion coefficient and is positive", and from this he derives equation (6). The statement and the equation are correct in the circumstances. However, on p. 236 he makes a directly contrary statement and produces equation (16) which is untrue. For verification, let $T_r = T_m$, which is a legitimate case, and equation (16) contradicts equation (6).

The fact of the matter is that equation (6) corrects for the expansion of the liquid over the temperature range $(T_r - 20)$. If a solution is made to the mark at T_m, then the expansion of the liquid is of no consequence in the range $(T_m - 20)$. Hence to convert the limited form of equation (6) to an expanded form providing for the existence of T_m, it is necessary to UNcorrect for the expansion of the liquid over the range $(T_m - 20)$. So

$$P_{20} = P\,[1 + k\,(T_r - 20)]$$

becomes

$$P_{20} = P_T\,[1 + k\,(T_r - 20) - k\,(T_m - 20)].$$

The negative sign of the $(T_m - 20)$ term is to neutralize the effect of the same term as a positive component of the $(T_r - 20)$ term. To put it simply, the expansion of the liquid matters only in the range $(T_r - T_m)$.

The easiest way to comprehend these temperature corrections is to group the coefficients according to temperature ranges. The general formula is:

$$P_{20} = P_T\,[1 + \alpha\,(T_r - 20) + \beta\,(T_r - T_m) + \gamma\,(T_m - 20)].$$

The coefficient α is the algebraic sum of the coefficients for the rotations of sucrose and reducing sugars, the saccharimeter, and the cell or tube. The coefficient β is that of the liquid and γ is the coefficient of the standard flask. In calculating the value of β it is necessary to note that the temperature difference factor for the second order term is not $(T_r - T_m)^2$ but $(T_r - T_m)\ (T_r + T_m - 40)$ because the expansion formula is based on 20°C.

In the general formula, for the particular case of a solution made up and tested at one temperature, $T_r = T_m$, and the β term disappears. For solutions made up at 20°C and for w/w solutions, $T_m = 20$ and the γ term disappears.

The statement on p. 265 about the normality of juices polarized directly has probably suffered from the accidental omission of the words "dissolved solids in" before "100 ml"; however temperature corrections are hardly worth applying unless the sucrose purity is close to 100, and then the normality is near enough to the polariscope reading divided by 100.

Yours faithfully,

JOHN L. CLAYTON,
Chemist,
Central Sugar Cane Prices Board, Brisbane.

FLOATING *versus* FIXED CALANDRIAS FOR VACUUM PANS

By H. J. SPOELSTRA

PART II

Flow resistances

We have already made it a condition that both types of calandria shall have the same specific resistance. It is very difficult to analyse mathematically the specific resistance in the bottom. Theoretically it is conceivable that the bottom might be arranged in such a way as to give approximately the same specific resistance with both types of calandria. Therefore we shall only compare the resistance to massecuite flow *through the downtakes*, for which we make use of the ratio $R = \frac{\Delta P_2}{\Delta P_1}$ in which ΔP_2 and ΔP_1 are the friction head losses in kg/sq.m. respectively for Type II and Type I.

We presume laminar flow with a resistance coefficient

$\lambda = \frac{64}{Re}$ (*Re*=Reynolds number) for cylindrical ducts and $\lambda = \frac{\phi 64}{Re}$ for annular ducts. The value of ϕ ranges between 1 and 1·5 depending on the diameter ratio of the annular duct. In our case we could take $\phi = 1{\cdot}4$.

As general equations we find after transformation:

For Type I, $\Delta P_1 = \frac{32\eta\, w_1 H}{x^2\, D^2}$, and

for Type II, $\Delta P_2 = \frac{32\eta\phi w_2\, z_1\, H}{(1-y)^2 D^2}$, and

$$R = \frac{\Delta P_2}{\Delta P_1} = \frac{1{\cdot}4\, z_1\, x^2\, w_2}{(1-y)^2\, w_1},$$

where w_2 and w_1 are the massecuite velocities.

If M_1 and M_2 are the massecuite volumes passing, and presuming that these volumes are proportional to the heating surfaces, we can write:

$$\frac{w_2}{w_1} = \frac{x^2\, M_2}{(1-y^2)\, M_1} = \frac{x^2\, y^2}{(1-y^2)\,(1-x^2)}.$$

According to equation (2), $z_1 = 1 - 0{\cdot}061\, fy$.

In most of the cases f is slightly higher than 4 and the value of $0{\cdot}061\, f$ may be taken as equal to 0·25.

We then get for R:

$$R = \frac{1{\cdot}4\,(1-0{\cdot}25\, y)\, x^4}{(1+y)\,(1-y)^3} \times \frac{y^2}{1-x^2} \quad \ldots\ldots..(8)$$

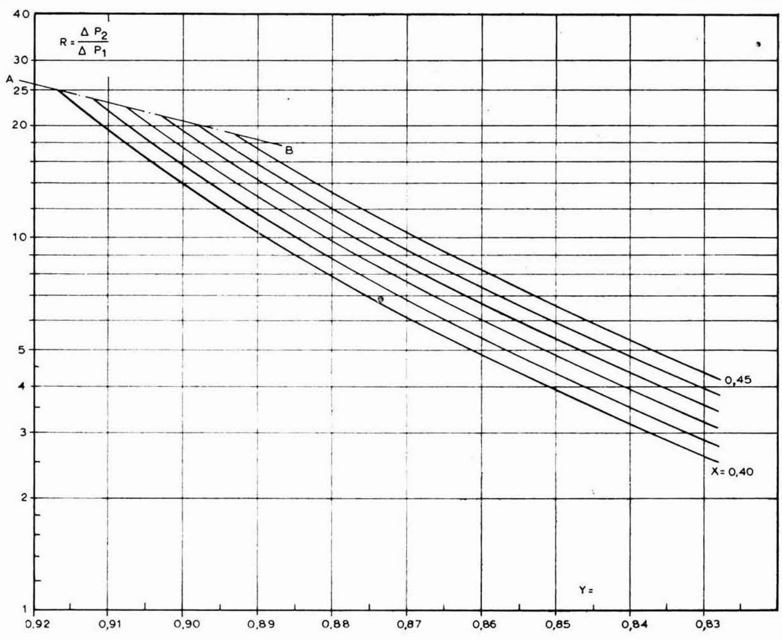


Fig. 4

In Fig. 4 are given the curves showing the relationships between R and x according to equation (8).

For equal HS, $y^2 = 1 - x^2$ and the values of R are to be found through the line A–B.

For $x = 0{\cdot}436$ we then find a flow resistance for Type II about 20 times higher than for Type I.

To reduce the specific resistance for Type II the value of y must be decreased, but from Fig. 3 we see that the value of S may then become >1.

For keeping S approx. equal to 1 the y-value can only be reduced to about 0·87 at most, in which case we still have a higher specific resistance in the annular downtake of Type II ($R \sim 9$). Also the HS for Type II will then be smaller than for Type I giving a relatively lower heating capacity for an equal strike volume.

It may be of interest to know the ratio between the ΔP in the heating tubes and the ΔP in the central downtake for Type I, given by the following equation without going into the details of the derivation:

$$R^1 = \frac{\Delta P \text{ tubes}}{\Delta P \text{ centrewell}} = 222\ D^2\ \frac{x^4}{1-x^2} \quad \ldots (9)$$

For $x = 0{\cdot}436$ we find the following values:

$D =$	3·5	4·0	4·5	5·0
$R^1 =$	121	158	200	247

We see that for our presumed conditions the specific resistance of the calandria is very much higher than that of the central downtake.

For Type II, however, supposing an equal HS, we have to divide the R^1-values by about 20 and this means that the resistance for the annular downtake may then have a substantial influence on the total resistance and on the circulation.

Massecuite level

Without going into the details of the derivation we give below the equations for the massecuite heights above the upper tube plates for $x = 0{\cdot}436$ and equal heating surfaces for both types.

$$\text{Type I} \quad L_1 = \frac{14{\cdot}58\,H}{K} - 0{\cdot}555\,H - 0{\cdot}061\,D - 0{\cdot}140 \quad \ldots (10)$$

$$\text{Type II} \quad L_2 = \frac{14{\cdot}58\,H}{K} - 0{\cdot}555\,H - 0{\cdot}0121\,D - 0{\cdot}426 \quad \ldots (11)$$

Table I gives the values of L_1 for some different values of H and D, when $K \doteqdot 5{\cdot}5$ and $6{\cdot}0$.

Table I. Values of L_1 (m)

D	$K = 5{\cdot}5$			$K = 6{\cdot}0$		
$H =$	0·90	1·00	1·10	0·90	1·00	1·10
3·5	1·53	1·74	1·95	1·33	1·52	1·71
4·0	1·50	1·71	1·92	1·30	1·49	1·68
4·5	1·47	1·68	1·89	1·27	1·46	1·65
5·0	1·44	1·65	1·86	1·24	1·43	1·62

The difference in massecuite level $\Delta L = L_2 - L_1$ can be calculated from

$$\Delta L = 0{\cdot}073\ D - 0{\cdot}286.$$

As is to be expected we also find here the critical diameter $D = 3{\cdot}9$ for equal levels ($\Delta L = 0$).

For $D < 3{\cdot}9$ Type II will show lower levels.

$D > 3{\cdot}9$ Type II will show higher levels.

The absolute values of ΔL, however, are very small and practically negligible.

From Table I it can be seen that in almost all cases the massecuite heights are not of such magnitude that the pan cannot be considered as of the "low head" type, and consequently in most of the cases a widening of the diameter would not be necessary.

If for any reason the massecuite level should be lowered at the same strike volume a widening of D above the calandria is better adapted to the circulation flow pattern for Type II.

The fact, however, that a great number of Type I pans with widened vapour belt have already been working with satisfactory results shows that apparently no especially unfavourable influence has been experienced from such widening.

Conclusions

From the foregoing comparisons we may summarize the following conclusions:

(1) For the same pan diameter D and starting from equal heating surfaces and equal K-values the floating calandria will give relatively lower seeding volumes for $D > 3{\cdot}9$ m and relatively higher seeding volumes for $D < 3{\cdot}9$ m.

(2) The massecuite levels hereby are practically the same and the pans can still be considered as of the "low head" type.

(3) Widening of the vapour belt (if required) to reduce the height of the massecuite level is better adapted to the circulation flow pattern for Type II. However, the practical significance cannot be expressed in comparable figures.

(4) The flow resistance in the annular downtake is substantially higher than for the circular central downtake.

(5) While maintaining approximately the same seeding volume percentages ($S \sim 1$), the y-value for Type II can be reduced in order to lower the flow resistance in the annular downtake. This, however, can only be done with pan diameters $> 3{\cdot}9$ m and on a limited scale, so that the specific flow resistance in the downtake remains higher than for Type I.

(6) At the same time the heating surface for Type II will become relatively smaller which means for equal strike volumes a relatively lower heating capacity.

(7) Under condition of equal heating surfaces the flow resistance for the Type II downtake could also be reduced by increasing the pan diameter, which would lead to a relatively higher seeding volume or alternatively to a lower K-value and lower heating capacity if the seeding volume (S-value) is to be kept equal to that of Type I.

(8) Since the heating tubes of the Type II calandria have different lengths, heat transmission to the massecuite content of the pan may tend to be non-homogeneous.

(9) Floating calandrias with steam supply from the side or from the bottom will have the disadvantage of the extra resistance caused by those steam ducts.

(10) The fixed calandria pan with central downtake has the advantage that—if so required—later on a mechanical circulator can be built in.

(11) There is not one outstanding reason why the floating calandria should be considered as *basically* superior to the fixed calandria. It is rather the other way round if one puts a high value on flow resistances in connexion with circulation properties.

Effective control of sugar cane leaf hopper by fogging of gamma BHC in Uttar Pradesh. T. P. S. TEOTIA and V. G. RAJANI. *Indian Sugarcane J.*, 1964, **9**, 19–22. Fogging of gamma-BHC by means of a "swing-fog" generator was effective against *Pyrilla perpusilla* in both spring and autumn planted crop. A 20% emulsifiable concentrate, at a dose of 12 oz in 2 gallons of kerosene oil per acre, was used. The cost of the treatment was Rs 7·15 (10s 9d) per acre.

* * *

Effect of pre-harvest burning of sugar cane on cane weight and juice quality. K. K. PRASADA RAO and B. S. I. NARASINGA RAO. *Indian Sugarcane J.*, 1965, **9**, 77–85.—Investigations at the Sugar Cane Liaison Farm, Tanuku, during 1960–62 on how long burned cane may be left standing in the field and how long harvested burned cane may safely be stored before milling are reported. In harvesting up to 24 hours after burning there was no appreciable change in juice quality or sugar yield. Standing burned cane should be harvested as speedily as possible.

* * *

A comparison of two different methods of cane planting under Uttar Pradesh conditions. G. N. MISRA and K. KAR. *Indian Sugarcane J.*, 1965, **9**, 86–91. Experiments showed that, in general, in the drier areas of Uttar Pradesh (central and western tracts) flat planting gave the best results. Under the more humid conditions of eastern U.P. and with intensive cultivation trench planting was more satisfactory.

* * *

Phosphate nutrition of sugar cane in India. S. C. SRIVASTAVA. *Indian Sugarcane J.*, 1965, **9**, 92–94. The writer points out that the phenomenon of lack of response of the cane crop to phosphate fertilizer has not been solved, as far as northern India is concerned, and that more fundamental research on this problem is needed. In recent years however marked response to phosphates has been observed in some areas. These are indicated.

* * *

Chemical control of weeds in sugar cane. H. S. GILL, S. SINGH and B. S. SIDHU. *Indian Sugarcane J.*, 1965, **9**, 95–100.—The results of trials carried out during 1960–62 at the Sugar Cane Research Station, Jullundur, Punjab, are given; 2,4-D (sodium salt) proved fairly effective against nut-grass (*Cyperus rotundus*), the worst cane weed present. A dose of 3 lb acid equivalent per acre sprayed 5–7 days after planting and 3 lb in the post-emergence stage appeared to give good results.

Estimate of losses from sugar cane pests in Bihar. Z. A. SIDDIQI. *Indian Sugarcane J.*, 1965, **9**, 105–107. The monetary losses due to sugar cane pests, mainly borers, have been worked out for the State of Bihar from past survey data collected at 28 factories during the period 1959–62. The total annual loss for Bihar is estimated at Rs. 38.1 million (£2,850,000).

* * *

Resistance in sugar cane varieties to Eriophyid mite (*Aceria* sp.). R. A. AGARWAL. *Indian Sugarcane J.*, 1965, **9**, 108–110.—In parts of the Punjab this mite has become more troublesome with sugar cane in recent years. Some cane varieties (including *S. officinarum* and "wild" forms) are much more resistant than others. Lists are given.

* * *

New strain of ***Hypochnus sasakii*****, causal organism of banded sclerotial disease of sugar cane.** R. K. SINGH B. SARKAR and G. SHARMA. *Indian Sugarcane J.*, 1965, **9**, 111–113.—This strain was collected from maize and differed from that from cane in certain morphological and cultural growth characteristic.

* * *

Effect of frost on buds of different sugar cane varieties. O. P. MATHUR and P. S. TOMAR. *Indian Sugarcane J.*, 1965, **9**, 121–122.—Cane in northern India may be severely injured by cold, as in the winter of 1963–64. The effect of frost on the buds of important sugar cane varieties was studied at the Research Station at Sriganganagar, Rajasthan. Results are tabulated. There were wide varietal differences—ranging from less than 10 to over 90% undamaged buds.

* * *

Iron deficiency in the ratoon crop of sugar cane in canal-irrigated soils of Rajasthan. P. S. TOMAR, O. P. MATHUR and D. S. OBERAI. *Indian Sugarcane J.*, 1965, **9**, 123.—One spray of 3% or two sprayings of 2% ferrous sulphate at an interval of two weeks was effective and completely restored the green colour of leaves. A $1\frac{1}{2}$% solution was quite ineffective.

* * *

Sugar cane cultivation in the Gal Oya valley, Ceylon. J. L. AMARATUNGA. *Indian Sugarcane J.*, 1965, **9**, 127–138.—This region is considered well suited for cane with its abundant rainfall, constantly high temperature and good though variable soils. All aspects of cultivation are referred to and a list given of the diseases known to be present.

Dealing with cane diseases. Anon. *Producers' Rev.*, 1965, **55**, (5), 57.—It is pointed out that disease is not the scourge it used to be, provided correct measures are taken. The following diseases and their control are briefly referred to—ratoon stunting, chlorotic streak, pineapple disease, yellow spot, leaf scald, bacterial mottle and top rot.

* * *

Leaf analysis as fertilizer indicator. Anon. *Producers' Rev.*, 1965, **55**, (5), 71.—The advantages of the work carried out at the Foliar Analysis Laboratory of the Colonial Sugar Refining Co. Ltd., commenced in 1959, are outlined. Two important considerations are—the accuracy of the leaf analysis (now assured) and the accuracy of the information supplied by the grower, especially in relation to fertilizer applied the previous year.

* * *

"Aretan" improves germination of Phil. 58-260. Anon. *Victorias Milling Co. Expt. Sta. Bull.*, 1965, **12**, (4 & 5), 4.—This promising new Philippine sugar cane variety does not germinate from setts as readily as do many varieties but germination is greatly improved by treatment, before planting, with "Aretan" at 1·5 gal/100 gal water.

* * *

A comparison of sugar cane productivity in different regions of Brazil. C. P. Rae. *Bol. Informativo Copereste* (São Paulo), 1965, (extra edit.), 9 pp.—The writer points out how average rainfall, temperature and other climatic factors vary throughout Brazil, and notes the wide variation in soils. Areas considered are—Remanso, Santarem, Belém, Fortaleza, Recife, Salvador, Campos and Piracicaba.

* * *

Sugar crops in Argentina. L. A. Santillán. *Enciclopedia Argentina de Agricultura y Jardineria*, Ed. L. R. Parodi. 1964, **2**, (2), 1049–1066.—A chapter (Ch. 27) in this interesting new agricultural and horticultural encyclopaedia is devoted to sugar cane (pp. 1049–1066) and to sugar beet (pp. 1066–1071) in Argentina. Notes are given on the early history of the crops in Argentina, plantation or field practice, harvesting, varieties and diseases. Good line drawings of the sugar cane and sugar beet plant are included.

* * *

Forecasting the severity of sugar beet yellows. G. W. Hurst. *Plant Pathology*, 1965, **14**, 47–53.—A correlation has been proved to exist between the incidence of this virus disease in summer and temperature anomalies earlier in the year. It is spread by the green aphis, *Myzus persicae*. Air temperatures in late winter and early spring especially constitute a good pointer to the subsequent disease level. Above average temperatures at this time precede a year with a high percentage of plants attacked by yellows, while low temperatures precede a season with a relatively slight attack.

On the nature of the damage leading to Docking disorder in sugar beet. J. Daniels. *Plant Pathology*, 1965, **14**, 69–73.—This disease has been prevalent in the Docking area of north Norfolk since it was first recorded in 1948. It has also been reported from other counties in England. No organism causing the disease has been definitely located or identified. Experiments are described which now suggest that adverse soil conditions and root pathogens, acting singly or in combination, may be the cause.

* * *

Nitrogen status of sugar cane leaves and the fecundity of a Hemipterous pest. J. R. Metcalfe. *Nature*, 1965, (207), 219–220—This is a study, based on glass-house experiments, of the cane fly (*Saccharosydne saccharivora*) which has become more troublesome in Jamaica in recent years. The experiments were designed to determine whether the fecundity of cane-fly was related to the nitrogenous content of the leaf. Cane was grown in drums and received different amounts of ammonium sulphate. Results showed a very significant relationship between the nitrogen status of the leaf and the fecundity of cane-fly. An increase from 1·5 to 2·5 nitrogen per cent dry matter, which is the range that is normally encountered under field conditions, resulted in an increase in fecundity of more than 100%. The increasing importance of cane-fly as a pest is attributed to the higher standards of sugar cane agriculture and improved nutritional status of the crop. Future work is planned to determine whether it is the amino-acid rather than the total nitrogen content of the leaf which is critical, and to ascertain the relevance of varietal susceptibility.

* * *

New sugar cane diseases in Mauritius in 1964. R. Antoine. *Rev. Agric. Sucr.* (Mauritius), 1964, **43**, 373–375.—Reference is made to increased severity of gummosis and leaf scale and to the appearance of two new diseases—yellow spot (*Cercospora koepkei*) and rust (*Puccinia kuehnii*) and *P. erianthi*). Information on the reaction of cane varieties grown in Mauritius is given.

* * *

Molybdenum—a new trace element deficiency in Mauritius. D. H. Parish. *Rev. Agric. Sucr.* (Mauritius), 1964, **43**, 376–377.—Molybdenum deficiency is considered to exist over a wide area (100,000 acres), notably on latosolic brown forest soils and humic ferruginous latosols. Application of sodium molybdate at rates as low as 1 oz/acre is sufficient for some crops.

* * *

Soil moisture and sugar cane yield in Louisiana. G. Lal and W. H. Patrick. *Sugar J.* (La.), 1965, **27**, (10), 88–90.—Details of experiments in several parishes are given. It was concluded that, with the rainfall and flat terrain of Louisiana, excessive moisture during the early part of the growing season is detrimental to yield, internal drainage being poor in most soils. Yield could probably be increased more by an improvement in drainage than by supplementary irrigation.

Trash mulch in cane culture at Cuddalore. D. RAJAMANICKAM and C. EKAMBARAM. *Indian Sugar*, 1965, **27,** 751–756.—Results of experiments involving various treatment are given. These showed the value of trash mulching in the dry season (on light soil). Not much difference in tillering was noticed. In trashed plots the incidence of early shoot borer was less, as was weed growth. Yield was higher (by 3 tons/acre) and 10-day irrigation intervals could be used in place of 5, with a saving in labour costs.

* * *

Hormones and sugar cane germination. A. SINGH and U. S. SINGH. *Indian Sugarcane J.*, 1964, **9,** (1), 1–5. Results of trials of soaking planting setts in different concentrations of indole-3-acetic acid for varying periods are given. Uniform single eye setts of a poor-germinating variety (Co 527) were used. Greatly improved germination was obtained. Both concentration and duration of soaking influenced results; 24 hours' soaking with 20 p.p.m. concentration gave optimum germination. Soaking longer than 24 hours was detrimental.

* * *

Distribution pattern of soil manganese in major soil types on different canals of the Bombay-Deccan (area). G. K. ZENDE and K. S. PHARANDE. *Indian Sugarcane J.*, 1964, **9,** (1), 46–51.—Data on the prevalence and distribution pattern of manganese, from 31 profiles representing 6 major soil types, are given. Some soils showed a concentration of manganese in the upper soil layers, others in the lower layers.

* * *

Aphids as pests of sugar cane. H. DAVID. *Indian Sugarcane J.*, 1964, **9,** (1), 53.—Aphids are not normally serious pests of sugar cane in India but severe damage in a cane area in Tanjore, due to *Longiunguis sacchari* and *L. inosacchari*, is here reported.

* * *

Occurrence of *Sesamia inferens* **on mature sugar cane in South India.** T. VENKATARAMAN and P. P. V. MENON. *Indian Sugarcane J.*, 1964, **9,** (1), 53–54. The pink borer, known to attack rice, wheat, ragi and other graminaceous crops is here recorded as severely attacking cane (Chingleput District), to the extent of 32·1%, 2 or 3 internodes being generally bored.

* * *

Effect of temperature and relative humidity on the viability of chlamydospores of *Ustilago scitaminea.* A. M. KHAN and S. K. SAXENA. *Indian Sugarcane J.*, 1964, **9,** (1), 54–55.—Spores of sugar cane smut collected in 7 different localities were used in the experiments. High temperatures and high humidity both affected viability adversely.

Reaction of some sugar cane varieties to red rot disease in West Bengal. S. K. MUKHERJI and P. K. S. GUPTA. *Indian Sugarcane J.*, 1964, **9,** (1), 55.—Results are given of inoculation experiments (using the "plug" method) on about two dozen sugar cane varieties, these being classified as resistant, moderately resistant and susceptible.

* * *

Sugar cane leaf-hopper, *Pyrilla perpusilla:* **a review.** D. K. BUTANI. *Indian Sugarcane J.*, 1964, **9,** (1), 60–75.—This is a general description of the insect, regarded as a sporadic pest of sugar cane. It is found all over India and in adjoining countries. A lengthy bibliography (4 pages) is included.

* * *

Safety in the cane growing industry. ANON. *Queensland Cane Growers' Assoc. 38th Ann. Rpt.*, 1965, 27–28.—Nearly 25,000 tractors are in use on Queensland cane farms. Investigations have shown that most accidents are due to some incorrect action on the part of the operator. Experiments on a tractor fitted with remote control and protective canopy are described. These were carried out by the Mechanical Engineering Dept. of the University of Queensland.

* * *

Control of Fiji disease and leaf scald. ANON. *Australian Sugar J.*, 1965, **56,** 855.—Two recent proclamations on these diseases are explained, it being incumbent on owners of growing cane to notify the disease. Where leaf scald (*Xanthomonas albilineans*) occurs, the variety Q 63, which is very susceptible, may not be grown except by permit.

* * *

Investigation of soil moisture during growth of sugar beet. W. AHRENS. *Zucker*, 1965, **18,** 192–199.—Different methods of soil treatment or cultivation were carried out on a loess loam soil during the dry years 1929, 1963 and 1964, but had little effect on yield.

* * *

Sugar cane root distribution. R. A. WOOD. *S. African Sugar J.*, 1965, **49,** 231.—Differences in development of sugar cane roots in a light sandy soil and a soil of poor physical status (Dwyka tillate) are explained. Photographs of soil profiles showing root development are given.

* * *

The tale of three rats—a progress report. B. F. LOWERY. *Rpt. 23rd Conf. Hawaiian Sugar Tech.*, 1964, 65–69.—The common or Norway rat and the black or Alexandrine rat are briefly referred to while the Hawaiian-Polynesian rat (*Rattus exulans*) and its control are discussed at some length. Both old and new rodenticides are dealt with, as is the successful use of a water-resistant plastic coating which protects from rain the baits which carry the toxin.

Seed farm and seed cutting machine. C. GUERREIRO. *Rpt. 23rd Conf. Hawaiian Sugar Tech.*, 1964, 70–72. Owing to difficulties of obtaining labour for the hand-cutting of seed cane and increased demand for seed cane a cutting machine was used. Details are given of performance and the changed layout and row spacing adopted at the seed farm.

* * *

Evaluation of HSPA pre-emergence and post-emergence herbicide programme. H. W. HILTON. *Rpt. 23rd Conf. Hawaiian Sugar Tech.*, 1964, 78–80.—Some details are given of the work on weedkillers for sugar cane carried out at the Experiment Station of the Hawaiian Sugar Planters' Association. Emphasis is given to the effects that climatic and edaphic factors can have. Data for grasses indicate that "Diuron" is definitely superior and for broadleaf weeds "Atrazine" is superior. Comparisons of "Ametryne" with "Diuron" and with "Atrazine" indicate that "Ametryne" is currently the superior herbicide for the kind of general non-selective control that is sought, yet with the maximum crop tolerance.

* * *

A reference on developments in non-metallic piping materials. W. BOWKER. *Rpt. 23rd Conf. Hawaiian Sugar Tech.*, 1964, 81–84.—The greatly increased use of plastic piping during the last 10 years, due largely to improved techniques in manufacture, is stressed. Hints on field installation methods for irrigation and on solvent cementing are given.

* * *

The effect of different herbicides in the control of *Aeginetia indica Roxb.* M. E. LOPEZ and R. L. BARILE. *Sugar News*, 1965, **41**, 71–83, 91.—This parasitic weed of sugar cane, which is a flowering plant (like mistletoe), has been troublesome in the Philippines, but may be effectively controlled with various herbicides, e.g. "Atlacide", sodium arsenite and 2,4-D. Tables indicate the effect of different treatments.

* * *

Modern beet growing and occurrence of pests. E. GERSDORF. *Zucker*, 1965, **18**, 239–241.—It is pointed out that new cultivation methods may change the spectrum of sugar beet pests and the view is expressed that the pygmy mangold beetle, thrips and the springtails (notably the genus *Onychiurus*) might become of greater importance.

* * *

Mechanization of beet cultivation by electronically controlled singling machines. H. LÜDECKE and H. SCHAFMAYER. *Zucker*, 1965, **18**, 264–273.—A description is given, with photographs, of a tractor-drawn singling machine operating in three rows at a time in Germany.

* * *

Gated pipe irrigation. ANON. *Australian Sugar J.*, 1965, **56**, 941.—A new method of flood irrigation of sugar cane using gated 8-inch aluminium piping is described. Power for the pump was supplied by a tractor running at idling speed. Fuel used was not excessive.

Overhead power lines and mechanical harvesting. ANON. *Australian Sugar J.*, 1965, **56**, 943.—An account is given of a conference, held in Brisbane, aimed at overcoming the danger of overhead power lines to operators of mechanical harvesters and loaders. Representatives of cane growers, machinery manufacturers and electricity supply authorities attended.

* * *

The influence of fertilizers on cane quality. R. A. YATES. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 101–111.—Results of fertilizer trials over a period of 4 years are recorded. Potash fertilizer was found not to affect cane quality, and phosphate had a negligible effect. Nitrogen depressed sugar content in the immediate pre-harvest period but the increased yield more than compensated for this. Once cold winter weather had started, nitrogen had very little effect.

* * *

The effect on germination of fertilizer applied to planting material. R. B. MOLLER. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 119–122. Trials indicated that the application of fertilizer to cane used for planting material can stimulate germination. Nitrogen appeared to be the chief nutrient involved, but potash may play a part under certain conditions.

* * *

The pre-harvest application of desiccants to sugar cane foliage. A. C. ARVIER. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 123–132.—"Paraquat" ("Gramoxone") and "Diquat" are discussed. With the trials conducted it was concluded that a depression in sugar content of the cane sprayed with "Paraquat" appeared too quickly to be offset by any benefits derived from improved burning efficiency, and commercial activity with "Paraquat" in sugar cane at present appears to be best directed towards temporary weed control.

* * *

Development of "Domatol 66". W. J. BURKE. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 133–139.—This new wettable powder herbicide containing "Fenac" and "Atrazine" (in 1:1 ratio) is here described. It is considered to be a safe pre-emergence herbicide giving effective and persistent control of common weeds and grasses found in Queensland cane fields under a wide range of conditions.

* * *

An analysis of the failure of "Lindane" to control soldier fly. R. B. MOLLER. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 171–175.—Trials indicated that with young first ratoons of cane, crude BHC dust was effective again soldier fly (*Altermetoponia rubriceps*) irrespective of particle size and method of mixing with the soil. All "Lindane" formulations were partially to totally ineffective, but could be used combined with BHC.

The principles and methods of sugar cane cultivation. B. A. MARKS. *Proc. 32nd Conf. Queensland Sugar Cane Tech.*, 1965, 177–186.—Conditions prevailing in the three cultivation regions of the Australian sugar cane industry are outlined. The four principal methods of tractor cultivation with sugar cane are described, single-row cultivation being suitable for farms up to 1100 acres and two-row cultivation recommended for larger farms or holdings.

* * *

Severe drought setback for cane. ANON. *S. African Sugar J.*, 1965, **49**, 324–327.—The South African sugar cane crop has suffered a severe setback as a result of drought, the worst summer drought for 40 years in the cane belt, shrivelling up cane fields and drying up rivers. The need for water conservation is stressed in an editorial article.

* * *

The biological background to cane diseases. G. ROTH and C. WHITEHEAD. *S. African Sugar J.*, 1965, **49**, 331–333.—This is the first of a series of articles to explain, in simple terms, the causes of disease of sugar cane and to outline the basic features of research necessary to understand the micro-organisms concerned. Reference is made to bacterial, fungal and virus diseases.

* * *

The effects of trash conservation on soil moisture and the sugar cane crop in Natal. G. D. THOMPSON. *S. African Sugar J.*, 1965, **49**, 365–387.—Under conditions prevailing on the cane belt of the Natal coast, long term experiments, comparing a trash blanket with burning, showed that consistently favourable results were obtained with trash conservation. This was due to conservation of soil moisture and reduction of run-off and evaporation. Average increase in yield was 4 tons of cane or ½ ton sucrose per acre per annum.

* * *

Time of manuring ratoons under deficient irrigation conditions. A. NATH and B. K. MATHUR. *Indian Sugar*, 1965, **14**, 803–804.—Results are given of an experiment conducted at Shahjahanpur regarding the times of application of nitrogenous manures under deficient irrigation conditions. The best results in terms of numbers of tillers, millable canes and cane yield per hectare were obtained with early application of nitrogen.

* * *

Field mechanization. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1965, **60,** (5), 20–22.—Three new cane harvesters are described, viz.: the modified Duncan cut-load machine (Louisiana) and two Australian machines—the new Don Mizzi, a cut load machine that is mounted on a tractor, and the "Harvestall", a new whole-stick harvester, also mounted on a farm tractor. A new Hein mechanized cane planter from South Africa is also described. It ploughs a furrow, plants seed pieces, covers them with soil and applies fertilizer, all in one operation. Labour requirements are reduced by 70%. Any tractor of 37 h.p. or more can tow the machine.

* * *

The effect of incorporation methods on weed control with "Tillam" in the Rocky Mountain region. E. G. ECKROTH, E. M. HOLST and D. F. PETERSON. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 195–200. Four different types of machine (two expensive and two cheap) were used in trials to incorporate "Tillam" herbicide in the soil at planting time. It was concluded that the inexpensive layering methods of incorporation were as effective as those with the more expensive machines.

* * *

The effect of simulated hail injuries on yield and sugar content of beets. M. M. AFANASIEV. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 225–237.—Tests were carried out over a six year period in parts of Montana subject to hail. It was found that only completely defoliated beets suffered serious loss in yield.

* * *

Losses caused by beet mosaic virus in California grown sugar beets. R. J. SHEPHERD, F. J. HILLS and D. H. HALL. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 244–251.—This virus is widespread in beet areas in California and exists in several strains. The strain tested reduced top growth slightly and root yields by 9·7% and 5·9% respectively in 1962 and 1963. It had no effect on percentage sucrose in infected roots.

* * *

Methods of loosening tight seed caps in monogerm seed to improve germination. F. H. PETO. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 281–286.—Seedcaps of monogerm seed were found to be 23·5% thicker than those of multigerm seed from the same sample, which accounts for lower germination. Acid treatment (3% HCl) was successful and might be adopted on a commercial scale.

* * *

Wet weather harvesting. J. B. HELSHAM. *Producers' Review*, 1965, **55,** (6), 3–13.—An account is given of the expediencies or devices tried with mechanical harvesters during the excessively wet 1964 season in Queensland. Trailers and haulage matters are also discussed.

* * *

Soldier fly control. R. B. MOLLER. *Producers' Rev.*, 1965, **55,** (6), 43.—The nature of the damage caused by this pest (*Altermetoponia rubriceps*) is discussed besides the best methods of control—chemical and cultural. The best methods of using crude BHC dust and "Dieldrin" are outlined. N:Co 310 proved to be the most resistant variety.

Rotation and intercropping systems of sugar cane in Taiwan. H. Chang. *Taiwan Sugar Quarterly*, 1965, **12**, (1), 17–22.—The different methods of intercropping practised in Taiwan are fully explained. With one method (spring paddy sugar cane) the farmer produces one crop of cane and one crop of rice within a year, early maturing varieties of cane and rice (ponlai rice) being used. A hulled rice yield of 4000 lb and millable cane yield of 120–160 tons (12·5–13% available sugar) may be obtained per hectare.

* * *

The Australian sugar industry: a survey. Anon. *Sugar y Azúcar*, 1965, **60**, (6), 47–50, 79.—A general account is given of the Australian sugar industry with notes on its early history as well as a list of present-day refineries and their capacities.

* * *

Mechanization of cane harvesting in Australia. K. A. Blyth. *Sugar y Azúcar*, 1965, **60**, 51–53.—Mechanical harvesting has not developed as rapidly in Australia as in some countries (Hawaii and Louisiana) because Australian farms are small by comparison. Different methods of mechanical harvesting adopted in different parts of Australia are explained.

* * *

Research in the Australian sugar industry. N. J. King. *Sugar y Azúcar*, 1965, **60**, (6), 54–56, 78. Sugar experiment stations were established in 1900 but it was not until the period 1925–60 that progress in research was really made. An indication is given of the work done or in progress on cane breeding, diseases, insect pests, agronomy and sugar cane nutrition.

* * *

Sugar cane breeding programme at Canal Point, Florida, 1964-65 season. N. I. James and P. H. Dunckelman. *Sugar Bull.*, 1965, **43**, 231, 234–235. The erection of a large plastic covered crossing house and the development of improved techniques for the treatment of flowering stalks have largely been responsible for the success of the crossing programme. The use of a railway truck system for moving large numbers of plants from outdoor conditions, giving protection from cold, is also important. Cold resistance and resistance to mosaic are important factors in selection work. Details of the crossing work are given.

* * *

Choice of sugar cane varieties in tropical Africa. Anon. *Cahiers d'Agriculture Pratique des Pays Chauds.*, 1965, (2), 81–84.—It is pointed out that in many African countries now wishing to become self-supporting in sugar the varieties of sugar cane already there are "chewing canes" and unsuitable for commercial sugar cane production. The need for quarantine in introducing new varieties is stressed. A list of the more important commercial sugar cane varieties grown in different parts of the world is given, by countries.

More sugar through fertilizers. P. N. Jakate. *Fertilizer News*, 1965, **10**, (7), 21–25.—Emphasis is given to the need for more extensive use of potash in cane fertilizing under Indian conditions, especially with new high yielding varieties making heavier demands on the soil. Results of experiments carried out in Rajasthan, Uttar Pradesh and Maharashtra in support of this are given.

* * *

Summer weed control in Louisiana sugar cane for 1965. E. R. Stamper, D. T. Loupe and L. L. McCormick. *Sugar Bull.*, 1965, **43**, 256.—Recommendations are made for the treatment of those weeds that are resistant to 2,4-D used alone. These include the use of "Silvex" and "Decamine"-2,4-D.

* * *

Handling and transporting sugar cane in Louisiana. Anon. *Sugar Bull.*, 1965, **43**, 258–263.—This is a summary of a publication by J. Nelson Fairbanks dealing with the comparative costs of handling and transporting sugar cane by three different methods.

* * *

Preliminary trials with rice beans in the far north. A. I. Linedale. *Gane Growers' Quarterly Bull.*, 1965, **29**, (1), 21–22.—It is pointed out that the cow-pea (*Vigna unguiculata* or *V. catjiang*) as a green manure crop with sugar cane in northern Queensland often fails under very wet conditions, while the rice bean (*Phaseolus ricciardianus*) does not and is a good substitute for it. But in dry seasons it does not do as well as the cow-pea. The suggestion is made to sow a mixture of both so that one or the other will thrive whatever the season.

* * *

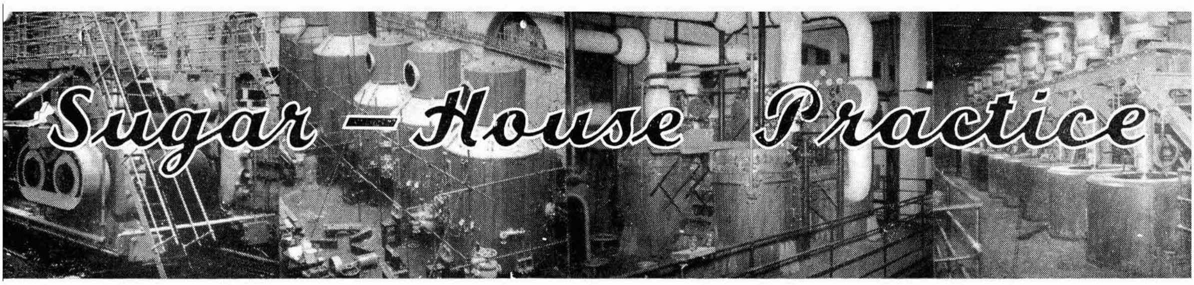
Does hilling-up reduce lodging? J. C. Skinner. *Cane Growers' Quarterly Bull.*, 1965, **29**, (1), 26–28.—The advantages of steep hilling of the rows with cane grown for selection work, to prevent lodging, is emphasized. The suggestion is made that Queensland cane growers might experiment themselves to test its advantages or disadvantages (in harvesting) under their own particular conditions.

* * *

Good drainage vital for high yields. Anon. *Producers' Review*, 1965, **55**, (7), 17.—The disadvantages of bad drainage in sugar cane fields in Queensland are discussed, especially where heavy machinery is used, since this may become bogged down.

* * *

Power line danger to harvesters and loaders. Anon. *Producers' Review*, 1965, **55**, (7), 91.—Reference is made to recent fatal injuries suffered by operators of mechanical cane loading equipment in Queensland coming into contact with overhead power lines. The need for constant vigilance in this connexion is stressed.



Continuous modernization: Victorias road to expansion. ANON. *Sugar y Azúcar*, 1965, **60**, (7), 48–50. Details are given of the processes and equipment at Victorias Milling Co. sugar factory-cum-refinery in the Philippines.

* * *

Purification of sugar solutions by means of granular activated carbon. N. TSUDA. *Kemikaru Enziniyaringu*, 1964, **9**, (5), 449–452; through *S.I.A.*, 1965, **27**, Abs. 327.—The "pulsed bed" apparatus for the decolorization of cane sugar solution developed by Pittsburgh Chemical Company is outlined. The apparatus consists mainly of the adsorption column, from which the spent carbon is removed at the bottom, and the regeneration kiln. The decrease in pH of the sugar solution during the adsorption process is compensated by adding dead-burned magnesite into the granular carbon (made from bituminous coal). The advantages of this technique are considered.

* * *

Mechanics of sugar cane crushing. J. L. CRIBB. *Austral. J. Appl. Sci.*, 1964, **15**, 106–119; through *S.I.A.*, 1965, **27**, Abs. 404.—A unified system of partial differential equations is proposed, in which ρ_f, ρ_{jl} and ρ_{j2} are the apparent densities (amounts in unit volume) of fibre, fixed juice and free juice respectively, u and w are the vector velocities of fibre and free juice respectively, r_f and r_j are the true densities of fibre and juice respectively, P = porosity, K = permeability (sq.ft.) as given by HOLT, $k = K/P^2$, S = macroscopic stress, p = pressure, and μ = viscosity:

$$\text{div}\,(\rho_f u) = 0,\ \text{div}\,(\rho_{jl} u + \rho_{j2} w) = 0,$$

$$\frac{\rho_f}{r} + \frac{(\rho_{jl} + \rho_{j2})}{r_j} = 1,\ \frac{\rho_{j2}}{r_j} = P,$$

$$\nabla \cdot S = \text{grad}\,(Pp),\ P\,\text{grad}\,p = (\mu/k)\,(u - w).$$

The distribution of pressure in cane between the rolls is calculated for a typical 2-roll crusher (roll diameter 34 in), assuming 65% of broken cells in the feed and 90% in the bagasse, for the two cases of ungrooved and grooved rolls. In the latter case the juice pressure at the roll surface is assumed to be zero, so that the pressure varies in a vertical plane also, and the following equation is derived:

$$\text{div}\,[(K/\mu)\ \text{grad}\ p] = \text{div}\ u,$$

which can be evaluated by a relaxation method. The values agree well with those found experimentally, and demonstrate a plane or line of maximum pressure $\sim$1 inch on the cane side of the minimum opening, with consequent squirting of juice in the direction of movement faster than the movement of the mat, and with a tendency towards fibre extrusion or slip at higher roll speeds; both tend to reduce extraction. Grooves are shown to improve the juice flow with a consequent reduction in the maximum pressure and power consumption.

* * *

Factors in S.M.R.I. save-all design. C. G. M. PERK. *S. African Sugar J.*, 1965, **49**, 585–591.—Instructions and calculations are given for designing the centrifugal save-all recommended by the S.M.R.I. and based on the Kestner arrangement located on the upper tube plate of the climbing film evaporator.

* * *

Factors regarding vapour and steam pipe diameters. C. G. M. PERK. *S. African Sugar J.*, 1965, **49**, 593. It is considered preferable to base vapour and steam line diameters on the pressure drop per unit of pipe length rather than on vapour pressure. The Hausbrand table of steam and vapour capacities of pipes of varying diameters at varying pressures and vacuum levals[1] has been converted to British units and is reproduced. The advantages of basing pipe diameters on average and not maximum evaporation rates are discussed.

* * *

Juice clarification experiments on trashy *vs.* clean cane. E. E. COLL, W. F. GUILBEAU, J. T. JACKSON and S. J. CANGEMI. *Sugar Bull.*, 1965, **43**, 245–248. Juice from clean cane (3% trash) and "trashy" stubble cane (10% trash) was clarified and the "trashy" juice found to require 30% more lime while yielding 15% more mud than the controls. The insolubles content was 35% more per ton of cane than could be accounted for by the excess soil in the juice (the soil content was double that of the controls) and is attributed to organic matter from the excess trash. There was no apparent difference between clean and "trashy" plant cane harvested later in the season, suggesting that inadequate topping is a more serious problem early in the season. Clarified juice filtrability was not affected by the trash, but purity, clarity, CaO and P_2O_5 contents were adversely affected, being 3·5 units (5%) lower, 20% lower, 20% higher and 35% higher, respectively, than with the controls.

* * *

Chile's Viña de Mar stresses efficiency. M. E. MOLINA F. *Sugar y Azúcar*, 1965, **60**, (8), 17–20.—Information is given on the equipment and processes at the Viña del Mar and Penco refineries, which have capacities of 15 and 10 tons/hr respectively.

[1] "Verdampfen, Kondensieren und Kühlen", 5th edn. (Julius Springer Verlag, Berlin.) 1912, p.224.

Rôle of cane quality in evaluating mill extraction. T. A. BALINSKI. *Sugar y Azúcar*, 1965, **60**, (8), 22–24. A study of the performance of the Gutehoffnungshütte 5-mill tandem at La Providencia, Tucumán, Argentina, showed that sucrose extraction % sucrose in cane is affected by the ratio of sucrose:fibre in cane and therefore does not depend only on mill performance, but also on cane quality. The most suitable criterion is MITTAL's Whole Reduced Extraction[1], use of which permits comparison of mill performance during various grinding periods or of the performances of various mills without need to consider cane quality.

* * *

Magnetic separators aid mill maintenance. ANON. *Sugar y Azúcar*, 1965, **60**, (8), 26–29.—The advantages of Eriez magnetic separators for tramp iron removal are discussed and examples of their use in cane sugar factories mentioned.

* * *

Bulk transport of white sugar. M. D. SPEKTOR. *Sakhar. Prom.*, 1965, **39**, 506–508.—The need for bulk transport of white sugar in the Soviet Union is discussed and the choice of suitable vehicles considered. Preliminary tests on a Soviet-built flour-carrying tanker indicated the possibility of using this for white sugar, although further prolonged tests are thought necessary to ascertain the effect of pneumatic unloading on the sugar.

* * *

Colour code for pipelines and services. D. H. JONES. *S. African Sugar J.*, 1965, **49**, 693.—A standard colour scheme based on a system proposed by the S.M.R.I. includes only colours from British Standard 381c, bold colours being used for dangerous products such as caustic soda. A list is given of the colours with the B.S. 381c number and the particular application.

* * *

Some notes on automatic boiler control. G. BAX. *Rev. Agric. Sucr.* (Mauritius), 1965, **44**, 109–117. The principles of automatic boiler control and their application in the sugar industry are discussed with descriptions of parallel and series systems and comparison of pneumatic with electronic control. The economics of boiler control are considered and the control of boilers in Mauritius sugar factories is mentioned. The systems covered include damper, feed water and bagasse feed control.

* * *

How to control bagasse-fired steam generators. H. A. SANTOS. *Sugarland*, 1965, **11**, (4), 8–16.—The automatic control of a Riley 2-drum water-tube boiler with an hourly capacity of 120,000 lb of steam is described. The controls regulate bagasse fuel, air, gas and water feed. A variable bagasse feeder proportions the fuel feed according to steam pressure; the volume of air for combustion fed by a forced-draught fan depends on the fan speed and position of the under- and over-fire dampers; flue gas is removed by an induced-draught fan, the variable drive of the fan ensuring negative draught in the furnace; the supply of feed water is regulated according to steam flow and drum water level.

* * *

Additional equipment at Victorias Mill. P. Y. CAPAY. *Sugarland*, 1965, **11**, (4), 20–22.—Details are given of the 3-roller mill added to the "B" tandem to make it a 17-roller train with one set of knives and a shredder. As 5th mill, the new unit has increased the extraction by the tandem to 93·9% at a grinding capacity of 100 t.c.h., while at least 94% extraction has been achieved at 120 t.c.h. and the possibility of attaining 200 t.c.h. while maintaining an extraction of 93% is envisaged. The costs of the project are listed.

* * *

Loss caused by inversion of sucrose: how to avoid it. C. K. CLONINGER and J. W. APPLING. *Sugarland*, 1965, **11**, (4), 28–31.—The advantages of cane mill disinfection with "Busan 881" in reducing the purity drop between crusher juice and mixed juice are discussed. The bactericide reduces sucrose inversion by inactivating invertase and also eliminates *Leuconostoc* slime.

* * *

The use of Fabcon "Pan-Aid" in "C" strikes. A. ROIG. *Sugar News* (Philippines), 1965, **41**, 314.—Results obtained with the use of "Pan-Aid"[2] are discussed. *C*-massecuite Brix and purity were respectively 97·76° and 59·09 (average of 38 strikes) with "Pan-Aid" compared with 96·82° and 60·66 without (average of 60 strikes). Final molasses purity was slightly reduced, while *B*-molasses purity was 51·99 compared with 54·12 without "Pan-Aid". The boiling time was cut and the refinery return reduced. The *A*- and *B*-massecuites made from the magma produced from the *C*-sugar were lighter in colour and purged more easily, while the *A*-sugar obtained without washing in the centrifugals looked better than previous *A*-sugars. The washing of *B*-sugar was also considerably reduced. A purity drop of 25 units from massecuite to *B*-molasses has been obtained. No harmful effects have been encountered with "Pan-Aid".

* * *

Colour problem of Indian raw sugar. S. C. GUPTA and S. K. D. AGARWAL. *Indian Sugar*, 1965, **15**, 133–140.—Examination of raw sugar from a number of Indian factories has revealed a high colour and low rendement [calculated as pol — (4·5 ash + invert sugar)]. To satisfy the import requirements of various countries, it is proposed that the sugar be selected and grouped according to the rendement. Measures for preventing high colour (related to affinability and rendement) include washing of massecuite with syrup during curing, hot purging of *A*-massecuite, mixing of cold *A*-massecuite before curing with *A* heavy molasses, and steaming of *A*-massecuite where high-speed centrifugals are available.

[1] *I.S.J.*, 1964, **66**, 119.
[2] *I.S.J.*, 1965, **67**, 220.

Two-boiling and 2½-boiling scheme. J. G. MEYER. *Sugar J.* (La.), 1965, **28**, (2), 67–69.—To prevent *C*-massecuite purity exceeding 60 in a 2-boiling scheme, the following measures are considered: recirculation of *A*-molasses, using a 2½-boiling scheme, and cooling of *A*-massecuite. Molasses recycling is not recommended since the volume of *A*-massecuite is increased and maintenance of constant results is difficult. Cooling of *A*-massecuite is expected to raise the crystal content of the massecuite in the system described by about 10%, which will necessitate dilution with molasses, although the final molasses quality is expected to be slightly better than with a 2½-boiling scheme. In the latter, an *A*-1 strike of 85·6 purity is boiled with syrup seeded with *C*-sugar, while an *A*-2 strike of 80 purity is boiled on syrup, *C* seed and *A*-1 molasses. The scheme is called "2½" because of the closeness of the purities of the *A*-1 and A-2 massecuites. The scheme uses 11% less massecuite than with molasses recirculation and gives a lower purity final molasses and higher purity *C*-sugar. The three schemes are compared for a factory with a crushing capacity of 2000 short tons of cane per day.

* * *

Application of "Stearns" magnetic separators in sugar cane milling. W. J. BRONKALA. *Sugar J.* (La.), 1965, **28**, (2), 79–80.—The "LD" type magnetic drum comprises a stationary assembly around which a cylinder is driven at 25–35 r.p.m. In two examples cited the cane (1) passes through a second set of knives just before the magnetic drum, and (2) is fed direct from the end of the carrier. Levelling of the cane before the drum is recommended.

* * *

Efficient processing of cane raw sugar. M. B. YARMOLINSKII. *Sakhar. Prom.*, 1965, **39**, 575–578.—At Odessa refinery 7 crops are boiled (3 refined sugar and 4 intermediate) in the refining of cane raw sugar, granulated sugar being obtained from part of the 1st massecuite (of 99·1 purity) and from the 2nd massecuite (of 98·4 purity). The raw sugar is affined with 1st lump run-off instead of 2nd affination run-off, thereby raising the affined sugar yield and reducing molasses yield and the quantity of intermediate products. The 1st massecuite is boiled from a syrup obtained by treating the carbonatated and sulphited melt liquor with granular active carbon after concentrating it to 68°Bx or saturating with lump sugar. Average sugar yield in 1964 was 93·3% on weight of raws and the daily throughput was increased.

* * *

Fuel and steam economy in (a) double carbonatation sugar factory. B. B. PAUL. *Sugar J.* (La.), 1965, **28**, (2), 81–92.—Measures for increasing heating efficiency and thereby increasing the amount of bagasse available for paper manufacture are described. At the author's factory (Daurala, India) most of the measures described have been applied and the steam consumption thus reduced from 70% to 53% on cane under normal factory conditions. Vapour-line juice heaters have been installed, in which 1st carbonatation juice is heated to 54–55°C. Second carbonatation juice is heated to 78°C in secondary juice heaters using bled 2nd effect vapour. Installation of a preheater using 2nd effect vapour is recommended since it will raise evaporator capacity; the higher the feed temperature the greater will be the capacity. Comparison of the steam consumption in a quadruple-effect evaporator plus vapour cell with that of a quintuple-effect evaporator shows that the vapour cell does not give any great advantage over a straight quadruple-effect, while a quintuple-effect provides better steam consumption. Calandria vacuum pans are preferred to coil pans as regards live steam consumption.

* * *

Light-duty two-roll feeder developed for Queensland sugar mills. D. S. SHANN. *Australian Sugar J.*, 1965, **57**, 315–318.—Details are given of a two-roller feeder developed by the Sugar Research Institute in collaboration with Fairymead sugar factory. The setting of the opening of the rollers governs the setting of the head of the chute, which is fitted with scrapers to engage the grooving of the feeder rollers. Roller diameter is 30–32 in and the average opening is 7 in. Chute length is normally about 4 ft. The feeder rollers are normally driven from the pintle ends of the mill top and feed rollers through a roller chain. The variable-speed feeder drive is governed by the torque in the mill tail-bar. An over-riding control is also provided, based on transverse pressure in the closed feed chute. Approximately 50 feeder units of the type described were expected to be installed in Queensland in 1965.

* * *

Manufacture of white sugar by (a) defeco-melt-crystallization process. S. C. GUPTA, N. A. RAMAIAH and M. SINGH. *Indian Sugar*, 1965, **15**, 195.—Raw sugar produced by a simple defecation process is remelted to give a 65°Bx syrup. This is re-crystallized by boiling with a fine sugar seed and the quality of the resultant sugar is claimed to be much higher than that of conventional sulphitation white sugar.

* * *

Foundry operation in a sugar mill. A. E. BUGAY. *Sugarland*, 1965, **2**, (5), 16–20.—Details are given of the equipment in the foundry section at Victorias Milling Co. Inc. A list is given of the castings available for the milling tandem, steam generating plant, boiling house and refinery sections. The factory's annual demand of cast iron, bronze and aluminium (150, 20 and 2 metric tons, respectively) is met by the foundry.

* * *

Pioneer tries continuous cane ring diffusion. B. T. TOWNSLEY. *Sugar y Azúcar*, 1965, **60**, (10), 27–31. Information is given on the Silver ring diffuser at Pioneer Mill Company[1], Hawaii, and some analytical data are provided.

[1] *See I.S.J.*, 1965, **67**, 169–172.

BEET FACTORY NOTES

Beet unloader (tipping stage). J. ORZESZKO. *Gaz. Cukr.*, 1965, **73**, 139–145.—Details are given of a Polish-designed tipper for unloading beet from road and rail trucks at the rate of 60 tons/hr.

* * *

Evaluation of condensation systems. O. BÖHM. *Listy Cukr.*, 1965, **81**, 128–133.—The importance of efficient steam condensation and complete removal of gases for evaporator and vacuum pan operation is discussed and various condensation systems are described as well as possible means of improving condensation. The use of water jet vacuum pumps, as described by WEBRE[1], is mentioned as being technically and economically justifiable.

* * *

Temperature and moisture conditions with sugar storage in silos. A. F. ZABORSIN. *Sakhar. Prom.*, 1965, **39**, 411–415.—A number of defects with white sugar storage at Timashevskii sugar factory are noted. These include the absence of sugar screening before storage, so that a large amount of highly hygroscopic dust and sugar pieces (the latter of 0·6–1·2% moisture content) entered the silo; the temperature of the sugar being stored was high at 35–39°C (the literature on desirable sugar temperature is briefly reviewed); crystals, already small, were made even smaller by attrition when the silo was frequently over-filled to prevent caking of the whole mass, and consequently air flow in the space between the crystals was lower than required. The aerodynamic resistance of the crystals was greater than with large crystals, which are recommended for storage. Since the R.H. of air from the conditioning plant tended to differ from the sugar moisture, being particularly low during the cold part of the year, it dried the sugar. Recommendations for overcoming the difficulties are discussed.

* * *

Electromagnetic processing of sugar solutions. S. N. PODOL'SKII. *Sakhar. Prom.*, 1965, **39**, 415–418.—The effects of electromagnetic treatment of juice on scale formation were investigated. While treatment by a unit placed before the heaters preceding the evaporator reduced scaling in the heater and 1st and 2nd evaporator effects, the layer of scale in the 3rd effect was still considerable and required boiling out with sodium carbonate. Installation of a second electromagnetic unit between the 2nd and 3rd effects reduced scaling still further, so there there was no need for evaporator boiling-out during the three campaigns up to and including 1963/64, all the scale-forming salts being removed by mechanical filters after the evaporator.

* * *

Effect of the CO_2 content in carbonatation gas on the work of the carbonatation station. V. A. DANIL'TSEV. *Sakhar. Prom.*, 1965, **39**, 418–420.—The adverse effect of low CO_2 content in carbonatation gas on the efficiency of the carbonatation station is discussed with the support of tabulated data showing the factory throughput, carbonatation time, 1st carbonatation juice colour, 1st carbonatation juice purification efficiency and lime salts content for a carbonatation gas CO_2 content of 12–32%. A CO_2 content of at least 32–34% is recommended, and the causes of low CO_2 contents are discussed. The practices in soda plants, where the gas CO_2 content is maintained at 35–37% (a 1% drop resulting in a 2% drop in sodium carbonate yield), are referred to. The improved results following increase in carbonatation gas CO_2 content at a number of Soviet sugar factories are tabulated.

* * *

Experience in rearing carp in waste water ponds. O. A. YAROVENKO, V. S. PROSYANYI and Z. A. MAKINA, *Sakhar. Prom.*, 1965, **39**, 422–425.—Experiments at Krasnyansk sugar factory have shown that the rearing of young carp during the off-season in waste water ponds in which the water has been treated by lime is feasible at a maximum BOD_5 of 200 mg/litre and a free oxygen content of 2 mg/litre. Ponds in which the water is still undergoing purification are suitable for young carp only in June-July. The economics are discussed.

* * *

Waste water purification and its use for rearing of fish. P. A. BROVKO and L. A. CHERNYI. *Sakhar. Prom.*, 1965, **39**, 425–427.—At Kordelevsk sugar factory waste water treated by ammonium nitrate and superphosphate has proved suitable for rearing various types of carp. The average weight increases are discussed and future plans are outlined.

* * *

Automatic control of beet fluming at Falesht sugar factory. N. R. FREPON and B. A. EREMENKO. *Sakhar. Prom.*, 1965, **39**, 428–435.—The power demand of the beet washer motor, dependent on the amount of beet in the washer, determines the rate at which beet are fed from the pile. Signals are transmitted to each of three gates located equidistant from one another in the main flume. When the amount of beet in the washer is greater than required, the gates start to close, reducing the beet flow, until the rate falls below the normal requirement. Then they open in sequence, that nearest the washer opening first to ensure more regular distribution of the beets in the flume. A system of light signals at the pile end is used to regulate the feeding of the beets into the flume and when the gate closes a siren also sounds. A separate light signal system is used for the central flume gate to supervise the level of beet and water in the tunnel before the gate. The signal system is used in cunjunction with the unloading of beets from rail trucks using water or unloading into the emergency pit. The overall system may also be controlled from the panel at the washer or each gate may be operated manually. Advantages of the system are discussed.

[1] *Sugar J.* (La.), 1961, **23**, (8), 23–26; *I.S.J.*, 1961, **63**, 245.

A system of automatic beet feeding. V. A. Borisovich. *Sakhar. Prom.*, 1965, **39**, 436–437.—At Gindesht sugar factory one flume supplies two lines, which include beet washers, weighers and feed hoppers. When one of the hoppers is full a signal is transmitted to stop the beet from the corresponding washer. After 7 sec a reversible gate before the washer stops beet flow and the two-speed beet wheel in the flume slows to its lower speed. When both feed hoppers or both washers are overloaded, a fork gate before the reversible gate closes and 10 sec later a second fork gate before the stone catcher also closes. A time lag of about 2 min between opening of the second fork gate and resumption of beet wheel operation ensures that residual beets are discharged from the flume. All components of the system may be remotely controlled individually. In the event of a stoppage, the beet pump delivers only a small quantity of water.

* * *

Experience in converting lime kilns to natural gas. A. S. Krendel'. *Sakhar. Prom.*, 1965, **39**, 441–448. At Korenovsk sugar factory the CO_2 content of the gas from the lime kiln converted from anthracite- to gas-firing was only approx. 23–25% compared with 28–31% using anthracite as fuel. The lower efficiency with incomplete burning of the gas is attributed to feeding of air and gas through separate tuyères so that the air entered the kiln some distances above the gas burners. Results obtained elsewhere with gas-fired kilns, giving CO_2 contents up to 30%, are cited. The need for more suitable gas burner arrangements is emphasized.

* * *

Some ways of modernizing beet washers. A. P. Parkhod'ko. *Sakhar. Prom.*, 1965, **39**, 449–451.—The modifications described include two arrangements for trapping and removing impurities floating in the water (1) by a system of grids over which the water is discharged from the washer, and (2) by a screw conveyor onto which the impurities are directed by water from nozzles. A method of removing sand from a washer is also described.

* * *

Arrangement for feeding formalin into rotary diffusers. L. S. Pokutnev. *Sakhar. Prom.*, 1965, **39**, 452. Formalin is continuously pumped to the 5th and 18th compartments of an RT-type diffuser along a pipeline passing through a connecting head at the front end of the diffuser.

* * *

Diffusers aid Michigan expansion. Anon. *Sugar y Azúcar*, 1965, **60**, (8), 32–33.—An illustrated account is given of the installation of an RT beet diffuser at the Carrollton factory and a BMA tower at the Caro factory of Michigan Sugar Company.

Crystallization schemes. Z. I. Lutai and I. N Kaganov. *Sakhar. Prom.*, 1965, **39**, 492–493.—The graph method devised by Brieghel-Muller[1], in which the quantities in crystallization (massecuite Brix, sugar Brix, number of crystallizations, Brix of molasses in massecuite and sugar yield) are denoted by rectangles, is described. While it is considered simple and useful for comparison of different crystallization schemes, the Sankey diagram is preferred. Intermediate curing of final massecuite, as proposed by Brieghel-Müller, is discussed, although with the aim of reducing the massecuite Brix and viscosity (and hence molasses purity rather) than raising final massecuite purity.

* * *

Use of formalin in diffusers. E. T. Koval', V. Z. Nakhodkina and V. G. Yarmilko. *Sakhar. Prom.*, 1965, **39**, 493–498.—The chemical properties of formaldehyde are briefly discussed and depolymerization of solid paraformaldehyde is described. A method for calculating the formaldehyde content in formalin is given. The question of temperature in diffusers (this should be at least 70°C to avoid bacterial infection) is discussed and the techniques used to feed formalin to various types of diffuser are described. Tests with a KDA-58 and Buckau-Wolf tower diffuser showed that addition of 0·015% of formalin on weight of beet once an hour will inhibit microbial activity sufficiently, the original degree of infection being regained only after 1 hr. A universal scheme for formalin dosing is described.

* * *

The effect of vacuum on the massecuite boiling process. S. I. Sokolov. *Sakhar. Prom.*, 1965, **39**, 498–501. The adverse effect of vacuum fluctuations during boiling on temperature and supersaturation is discussed. Particular criticism is made of the Soviet practice of providing a central condenser for a number of pans, and in some cases only one condenser for both pan and evaporator stations. Recorder charts demonstrate the effect of the pan:condenser ratio. The effect of syrup feed on vacuum change is considered, especially where the syrup is taken in to dissolve false grain, since the vacuum fluctuations are sufficiently great to make the boiling process uncontrollable.

* * *

Briquetting dry pulp. Z. D. Zhuravleva and A. M. Zhuravlev. *Sakhar. Prom.*, 1965, **39**, 501–505.—The operational characteristics of drop and rotary briquetting presses are described. Technical data are given of two Soviet presses (one of each type) used in other industries and recommended for sugar factories. Tests with these are briefly discussed. The ability of the rotary press to produce small granules of mixed composition is emphasized.

[1] *Zeitsch. Zuckerind.*, 1963, **88**, 613–622, 679–684; *I.S.J.*, 1964, **66**, 234.

Mechanization of lime kiln charging. V. A. SEREBRINSKII. *Sakhar. Prom.*, 1965, **39**, 511–515.—Details are given of an automatic scheme for charging lime kiln skip hoists with limestone and, where applicable, coal. Originally one difficulty was encountered in the absence of means of sorting the limestone, but this has been largely overcome and over- and under-sized limestone is eliminated.

* * *

Production automation—more attention. A. G. LOZBENEV. *Sakhar. Prom.*, 1965, **39**, 515–516.—Difficulties with some of the controls at Tul'skii refinery and Tovarkovskii sugar factory are discussed.

* * *

Streamline methods—means of reducing the time taken to build sugar factories. O. B. BELOSTOTSKII and T. G. TIMOFEEVA. *Sakhar. Prom.*, 1965, **39**, 517–524. The methods used to build Soviet sugar factories and the organization of the building programme are described.

* * *

The use of beet pumps instead of elevators. V. P. NIKITIN. *Sakhar. Prom.*, 1965, **39**, 532–533.—Experience at Buinskii sugar factory has shown that the transference of beet from the washer to the weigher before the slicer by pump reduces losses and the amount of water entering the slicer when a beet elevator is used.

* * *

Improving the performance of a tray clarifier for flume-wash waters. I. P. OROBINSKII. *Sakhar. Prom.*, 1965, **39**, 535–536.—Modifications to a waste water clarifier are described. These were made to prevent losses of hot condenser water (fed to the clarifier to increase purification), reduce foaming and raise the temperature of the waste water.

* * *

Softening of thin juice and the heat economy of a sugar factory. J. VLASÁK and K. ČÍŽ. *Listy Cukr.*, 1965, **81**, 165–169.—Practical experience in Czechoslovak sugar factories with thin juice softening with cation exchangers is discussed. During the 1964/65 campaign the average Brix of the thick juice was higher and heat consumption in steam lower than during the corresponding period of the 1963/64 campaign when the juice was not softened. Data are presented in tabular and graph form.

* * *

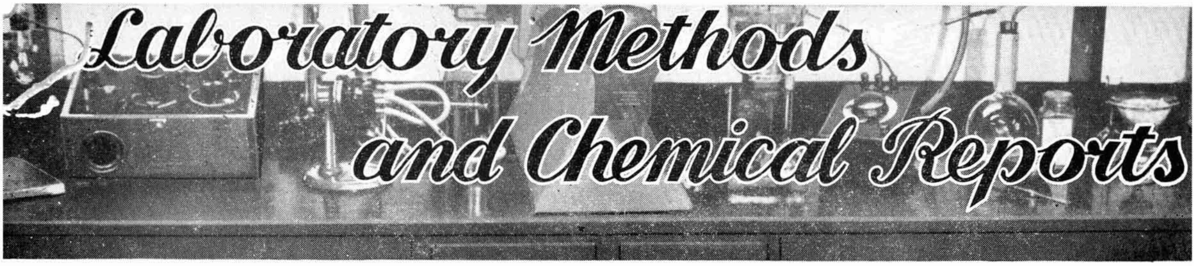
The use of hydrocyclones in juice purification. M. ATHENSTEDT. *Zeitsch. Zuckerind.*, 1965, **90**, 456–458. At the Lage factory of Lippe-Weser Zucker A.G. raw juice is limed and gassed simultaneously (la carbonatation), limed, reheated, limed, gassed (1b carbonatation), clarified, filtered, heated, carbonatated (2nd carbonatation), filtered, sulphited, filtered and treated by ion exchangers. Tests were conducted on treatment of 1b juice by a T 404 40 Dorr-Oliver hydrocyclone with a juice throughput of 40 cu.m./hr at a feed pressure of 2 atm. The over-flow was returned with some of the under-flow from the 2nd carbonatation hydrocyclones to the clarifier. The 2nd carbonatation juice was treated by a battery of five T 204 P IIa ceramic cyclones with a throughput of about 10 cu.m./hr at 2 atm feed pressure. Up to 50% of the mud was separated from the 1b carbonatation juice and the over-flow could still be filtered after mixing in the clarifier. The under-flow had good filtration properties; these were enhanced by the addition of a flocculating agent. The use of the ceramic hydrocyclones obviated the need for manual operation of the filter presses and achieved 60% solids separation. Return of the under-flow to the raw juice is recommended, as this is almost pure $CaCO_3$. A parallel scheme is described in which carbonatation juice is passed through a hydrocyclone, the over-flow clarified and the under-flow filtered, and the clarified juice and filtrate from the under-flow filter mixed before further filtration and carbonatation.

* * *

Damage to horizontal boiler tubes caused by laminar flow. H. ANDERS. *Zucker*, 1965, **18**, 460–461.—The adverse effect of laminar flow on boiler tubes under certain circumstances has been investigated. Intensive heating of the boiling tubes at a relatively low steam content is to be avoided, since laminar flow occurs at high pressures in boilers with natural circulation, even at very high circulation rates. At moderate pressures heating may be intensive only at a high steam content. With increase in pressure the critical zone occurs in the region of low steam content. With forced circulation intensive heating of the horizontal tubes should be avoided in the zone where steam forms first, although with higher circulation rates and smaller diameters the temperature difference across the tubes remains small. While the steam rate affects the tube wall temperature, the water rate is insignificant.

* * *

Errors in the determination of the sugar content of beet and pulp as a consequence of discrete checking of these parameters. L. L. ROTKOP and E. M. TRAKHTENBERG. *Sakhar. Prom.*, 1965, **39**, 583–587.—A method is described for determining the error arising from the time intervals between measurement of the parameters. The statistical data (fixed random functions of time) concerning cossette sugar content and sugar losses are fed into the components of a simulator (two blocks connected in series), each block receiving one function. The functions are multiplied together and an answer obtained in the form of an "autocorrelation function". For a tower diffuser from which samples were taken once an hour, the error due to the time lag was $\pm$ 1·5% in the case of cossette sugar and $\pm$ 0·18% for sugar in pulp.



Laboratory Methods and Chemical Reports

Organic analysis. 49. Colour reaction of 3,4-, 4,5-, or 3,5-dinitrophthalic acid with reducing sugars. T. Momose, A. Inaba, K. Inoue, K. Miyahara and T. Mori. *Chem. Pharm. Bull.* (Tokyo), 1964, **12**, (1), 14–18; through *S.I.A.*, 1965, **27**, Abs. 355.—Solutions containing 0·1% of a dinitrophthalic acid in 5% Na_2CO_3 were heated with a drop of glucose solution for 2 min. A transient violet colour was formed with 3,4- and 4,5-dinitrophthalic acid, which was stabilized by adding $NaPO_3$. The absorption maximum was 550–552 mμ. The limit of detection of glucose was 5μg in 5 ml, compared with 0·2 μg with 3,6-dinitrophthalic acid. The colour was shown to be due to 3-nitro-4-hydroxylaminophthalic acid and 4-hydroxylamino-5-nitrophthalic acid respectively, which form quinoidal ions in alkaline solution. 3,5-Dinitrophthalic acid gave only a yellow colour (glucose detection limit 15 μg/ml) due to the completely reduced 3-nitro-5-aminophthalic acid.

* * *

Methods of determining optimum alkalinity of 2nd carbonatation juice. M. S. Zhigalov and P. M. Silin. *Sakhar. Prom.*, 1965, **39**, 437–439.—Three methods of determining 2nd carbonatation optimal alkalinity (alkalinity due exclusively to alkali carbonates) were compared. The simplified method of Silin, in which filtered 1st carbonatation juice is gradually saturated at 80°C until neutral against phenolphthalein, and 0·5–1·0% powdered $CaCO_3$ added before boiling for 10 min under reflux, gave results very similar to those obtained by the standard, complex, method for optimal alkalinity (maximum deviation 0·003%), residual lime salts (maximum deviation 0·005%) and optimal pH (maximum deviation 0·1 unit). The results obtained with the method of Barabanov[1] deviated to a far greater extent from those given by the standard method. The Silin method takes only 15–20 min and is recommended in place of the standard method.

* * *

Molasses quantity and purity in relation to its degree of exhaustion. A. Pasetti. *Ind. Sacc. Ital.*, 1965, **58**, 160–165.—The yield of molasses on beet and its purity depend on the amounts of sugar and non-sugars in the beet, characteristics which result from factors affecting the beet during its growth, particularly climate. Mathematical relationships are deduced and illustrated in graph form. Equations used to determine the degree of exhaustion of a molasses are surveyed. The importance of the effect of non-sugars in sugar crystals on its solubility is discussed, as are the concepts of saturated, under-saturated and supersaturated molasses.

Chelatometric titration of sulphate as barium sulphate using EBT (Eriochrome Black T) as indicator. W. Chen and P. Wang. *Rpt. Taiwan Sugar Expt. Sta.*, 1965, (37), 131–139.—The sulphate content in cane sugar was determined as barium sulphate by back-titrating barium with EDTA in the presence of magnesium, using Eriochrome Black T as indicator. Since the colour change at the initial end-point takes place very slowly and may pass unnoticed, $MgCl_2$ is added to restore the original wine colour, permitting more rapid change from red to blue. Cations in concentrations normally present in sugar have practically no effect on the accuracy, which is ± 1%. The sulphate contents of 32 raw and white sugar samples ranged from 24 to 168 mg/100 g.

* * *

Quantitative determination of carbohydrates by titration with KCN. K. R. Manolov. *Nauch. Trudy. Vissh. Inst. Khranit. Vkus. Prom. Plovdiv*, 1963, **10**, 259–263; through *S.I.A.*, 1965, **27**, 353.—The method is described[2] and its application for the determination of sucrose (after inversion) and glucose is reported. The maximum error is within ± 1% for solutions containing 0·5–0·8% of sugar.

* * *

Problems in the determination of sugar quality. F. Schneider and A. Emmerich. *Zucker*, 1965, **18**, 397–406.—Analytical methods used for white sugar quality evaluation are discussed in detail with 22 references to the literature. Direct evaluation of white sugar by measurement of the pol is considered impossible, since the accuracy of even the most modern photoelectric instruments is insufficient. The indirect methods are divided into three groups: trace analysis (water, ash, SO_2, reducing sugars, oligosaccharides and bacteria), effect of impurities (colour, turbidity, buffering capacity, coloration on heating, floc and foaming) and sieve analysis. Each of these is considered, with particular importance being attached to colour and turbidity measurement. While there is need for accurate work, it is also essential that the methods be suitable for routine use. Comparison of three methods of quality evaluation (the proposed methods of the Codex Alimentarius Commission, the Paris White Sugar Terminal conditions and the Braunschweig points system) showed that the first is too time-consuming, the second gives insufficient indication of sugar quality, while the third can be reduced to three tests without any reduction in its value[3] and is therefore recommended.

[1] *I.S.J.*, 1962, **64**, 305.
[2] *See I.S.J.*, 1963, **65**, 277.
[3] *See* Schneider *et al.*: *I.S.J.*, 1965, **67**, 91.

The use of membrane filters in sugar microbiology. M. MERGL. *Listy Cukr.*, 1965, **81**, 170–173.—The use of membrane filters for determination of sugar bacteria is discussed with particular mention of the "Filtra 50" apparatus made in Czechoslovakia. Comparison of the membrane filter technique with the classic plate method is made for various bacteria using results obtained by a number of authors. From the viewpoint of economy and accuracy the membrane filter method is preferred.

* * *

Studies on the determination of some thermodynamic properties of crystallization of sucrose. N. A. RAMAIAH, R. C. GUPTA and S. K. SANYAL. *Sharkara*, 1964, **6**, 8–19.—An aqueous sucrose solution of known supersaturation was fed to a laboratory crystallizer and a small quantity withdrawn by pipette at the test temperature for refractometric measurement. A weighed amount of seed crystals (5 g/100 g of syrup) of known size was added and the mother liquor withdrawn and analysed at various time intervals. The crystallization velocity constants were then calculated from the kinetic data. The occurrence of an induction period in crystallization prevented application of kinetic equations. However, by using crystals measuring 0·28 mm it was possible to eliminate the induction period, which is shown to be associated with crystal size and not impurities. At 35, 40 and 50°C the calculated velocity constant (k) in the equation for first order reactions was fairly constant in the initial 10–15 min period, after which it decreased with time up to 40 min and then remained fairly constant up to 70 min. Hence it is concluded that kinetic studies should not be made during the time when dissolution and crystallization occur simultaneously. Although the value of k was surprisingly low at approx. 10^{-5} sec^{-1}, the energy of activation was also very low (approx. 4 kcal/mole), whereas chemical reactions having low velocity constants generally have high activation energies (at 27°C the energy of activation corresponding to $k = 10^{-5}$ sec^{-1} is calculated as 20 kcal/mole). However, it is shown that the energy required by the solvated sucrose molecule to crystallize is very low. Positive values of ΔF and ΔH (change in free energy and in heat content, respectively) demonstrate the slow nature of the crystallization process, while negative values of ΔS (change in entropy) suggest a loss of freedom of movement of the sucrose molecules in "activated" condition; this is presumed to be due to behaviour of unsolvated molecules as non-polar molecules in a polar solvent.

* * *

The significance of aerobic and anaerobic thermophilic spore-forming bacteria as sources of infection in beet sugar factories. I. ***Clostridium thermohydrosulfuricum*, a new type of sucrose-destroying, thermophilic, sulphide-forming *Clostridium*.** H. KLAUSHOFER and E. PARKKINEN. *Zeitsch. Zuckerind.*, 1965, **90**, 445–449. The thermophile has been isolated from factory juices and its morphology and physiology studied. Its properties differ so from the type described in the literature that it is regarded as a new species and the name *Clostridium thermohydrosulfuricum* Klaushofer et Parkkinen is suggested.

* * *

Determination of sucrose in beet molasses by means of glucoseoxidase. K. TÄUFEL, U. BEHNKE and H. WERSUHN. *Zeitsch. Zuckerind.*, 1965, **90**, 462–465. A method is described in which sucrose is inverted by invertase and the glucose component determined by glucoseoxidase. The molasses sample (0·5 g) is diluted with water, and 0·5 ml of invertase added before making up to 100 ml. After 30 minutes' incubation at 35°C in a thermostatically-controlled oven and subsequent cooling to 20°C, 5 ml of the sample is removed and diluted to 100 ml. Of this, 1 ml is treated with 4 ml of glucose reagent (made by mixing 1 vol of 0·007% w/v aqueous *o*-dianisidine hydrochloride with 100 vol of a solution of 50 ml of glucoseoxidase and 8 mg of peroxidase dissolved in 100 ml of 0·12M phosphate buffer of pH 7·0 and containing 0·3 ml of chloroform). After 35 min at room temperature and diluting to 10 ml, the extinction is measured at 455 mμ using a 1-cm cell. The molasses sucrose content is given by $\frac{0 \cdot 2A}{G}$, where A = μg of sucrose (obtained from a standard curve of sucrose *vs.* extinction) and G = molasses weight (g). Comparison was made between the oxidase method, direct measurement of rotation and the double-acid polarimetric method of OSBORN & ZISCH[1]. These gave average sucrose contents (the mean of 12 molasses samples representing raw and white sugar factories and refineries) of 48·6%, 50·4% and 49·7%. The advantages of the method described over polarimetric ones lie in the simplicity (no clarification is needed) and high specificity. While the method excludes raffinose, it does have the disadvantage of including the small amount of invert sugar already present in molasses with the glucose. The invert sugar content can be determined by iodometric titration using the Berlin Institut für Zuckerindustrie method.

* * *

Raffinose determination in molasses. C. REICHEL and N. SENDÖKMEN. *Zucker*, 1965, **18**, 458–460. The paper chromatographic method developed by SCHNEIDER *et al.*[2] for raffinose determination in molasses has been combined with a technique for preliminary ion-exchange purification[3] to give a method which is claimed to be suitable as a reference method but not for routine work. Details are given of the method, which involves the use of "Amberlite IRA-401" and "Amberlite IRA-400" anion exchangers in OH^- form and "Amberlite IR-120" cation exchanger in H^+ form.

[1] *Ind. Eng. Chem.*, 1934, **6**, 193.
[2] *I.S.J.*, 1959, **61**, 317.
[3] WEIDENHAGEN & SCHIWEK: *I.S.J.*, 1960, **62**, 106.

BY-PRODUCTS

The composition of Czechoslovak molasses as regards its use in the fermentation industry. F. ŠTROS and V. SYHOROVÁ. *Listy Cukr.*, 1965, **81**, 133–138.—The effect of the composition of molasses from the 1962/63 and 1963/64 campaigns in various beet regions of Czechoslovakia on the yield of bakers' yeast was studied and the results of the analyses tabulated. The molasses contained small quantities of SO_2 and volatile acids and was characterized by a relatively low bacterial count. High yields of fermentate were obtained with molasses having high total N and α-amino acid N; a low purity was also advantageous. Fluctuations in the contents of biotin and pyridoxine used as growth substances did not affect the yield.

* * *

Vinasse and its use in pulp drying. M. A. KOKHAN. *Sakhar. Prom.*, 1965, **39**, 421.—Vinasse from the molasses alcohol plant at Khodorovsk sugar factory mixed with pressed pulp, followed by drying, has application as a supplementary feed for cattle. The composition of the mixed fodder and the treatment required before it is fed to cattle are discussed.

* * *

Influence of certain factors on the fermentation of substrates of molasses and of sucrose by bacteria ***Lactobacillus Delbruckii-70.*** V. KRUMPHANZL and J. DYR. *Sborn. Praz. Vys. Skoly Chem. Technol. Potravin. Technol.*, 1963 (1964), **7**, ii, 15–55; through *J. Sci. Food Agric. Abs.*, 1965, **16**, ii–31.—The influence of bacterial cells, of yeast autolysate, of K_2HPO_4 and the initial concentration of sugar on the rate of fermentation of the substrate of molasses and of sucrose by the above-named bacteria is discussed. The quantity of nutritive matter necessary to give precise results of fermentation was examined. Increase in the initial concentration of sugar prolonged considerably the duration of fermentation. With molasses having an initial concentration of sugar of 15·05%, 18·25% was fermented in six days; the corresponding quantity was 84·80% (same number of bacteria) with 10·03% initial sugar concentration. With sucrose of 2·5–10% initial concentration, conversion of sucrose to lactic acid increases with lowering of the initial concentration of sugar. Details are given of the effects of K_2HPO_4 and of favourable conditions for use of bacteria and yeast autolysate.

* * *

Studies on the growth of food yeast in bagasse (hydrolysate) and cane molasses media. P. N. AGARWAL, T. N. RAWAL, G. M. VERMA and O. P. VERMA. *Indian J. Technol.*, 1964, **2**, 172–174; through *S.I.A.*, 1965, **27**, Abs. 436.—Bagasse was hydrolysed by refluxing with 7% H_2SO_4 for 8 hr. The yield of reducing sugars (as glucose) in the neutralized liquor was 8% on dry bagasse. A yield of 14% of reducing sugars was obtained by refluxing with 7% HCl for 1 hr. *Candida utilis* was grown on sterile media containing 0·62–1·57% of reducing sugars from bagasse; *C. tropicalis*, *C. lipolytica* and *Hansenula suaveolens* were also grown. The yields of yeast (81–98% on reducing sugars fermented) were higher than on a medium prepared from cane molasses clarified by refluxing with H_2SO_4 and neutralization (57–88%). The hydrolysate reducing sugars contained 70% of xylose, 10% of arabinose, 14% of glucose, and 6% of an unidentified sugar.

* * *

Effect of adding dried molasses to the grain mix of lactating dairy cows. L. D. BROWN, R. S. EMERY and E. J. BENNE. *J. Animal Sci.*, 1963, **22**, 1118; through *S.I.A.*, 1965, **27**, Abs. 439.—Grain mixes containing 0·0, 2·5, 5·0 or 7·5% dried molasses, together with hay and corn silage, were fed *ad libitum* for 63 days. The 2·5% molasses content appeared to be the optimum for appetite and milk production. Molasses content did not significantly affect apparent digestibility.

* * *

Obtaining protein concentrate from vinasse and (spent) alkali. V. I. CHOPIK. *Sakhar. Prom.*, 1965, **39**, 509–510.—Protein concentrate was prepared from vinasse and spent alkali (from the Steffen process) by adding H_2SO_4 and gypsum and mixing for 1 hr at 80°C. The precipitated double salt, $K_2SO_4,CaSO_4$, was filtered off under vacuum and the filtrate concentrated. The protein content of vinasse and spent alkali was thereby increased on average from 30·0% to 35·2% on Brix and the ash reduced from 29·7% to 14·9%, which included a reduction of K_2O content from 13·7% to 4·4% on Brix.

* * *

Sugar-beet by-products in the production of beef. E. CORDIEZ. *Sucr. Belge*, 1965, **85**, 1–11.—Tests are reported in which young bulls were fed with rations containing beet pulp silage. The results showed that while a concentration of 1% on live weight gave a daily weight increase of 1·205 g compared with 1·188 g with 0·75% concentration and that more of the lower concentration feed was consumed per day than of the higher concentration feed, the consumption per kg weight increase was higher for the 1% concentration. This fact and the difference between the feeding and selling price of the bulls favour the 0·75% concentration ration.

* * *

The potentialities of sugar by-products. A. R. APACIBLE. *Sugar News* (Philippines), 1965, **41**, 367–378. A survey is presented of the by-products obtainable from sucrose and cane products, with 18 references to the literature.

* * *

Venezuela's new bagasse board plant. ANON. *Sugar y Azúcar*, 1965, **60**, (10), 34–35.—Details are given of the Tablopan de Venezuela S.A. new plant at San Mateo, Aragua, which produces high-density board (although the process used is suitable for low- and medium-density board) under the name of "Durotab". The bagasse is provided by Central El Palmar. Properties of "Durotab" and two other boards to be produced in the near future ("Multitab" and "Sonotab") are discussed. Annual production for 1965 was scheduled at 9000 tons, but 14,000 tons is the aim for 1966.

THE LATE J. CAMPBELL MACDONALD

WE regret to announce the sudden death at his home on the 22nd January of Mr. J. CAMPBELL MACDONALD, O.B.E., B.Sc., C.Eng., A.R.C.S.T., M.I.Chem.E. He was 66.

Born in Gourock, Scotland, in 1899, he served in the Royal Navy from 1916 to 1918, and afterwards sudied chemistry at the Royal Technical College, Glasgow. In 1921 he joined John Walker & Sons Ltd., the Greenock sugar refiners. He went to Brazil in 1922 and after three years in the cane sugar industry returned to Britain where he became chemist at the Ely beet sugar factory.

Some years after the sugar factories of the U.K. had been acquired by the British Sugar Corporation under the Act of 1936, he joined the industry's "general staff", later becoming Chief Technical Officer, from which post he retired in October 1964. He joined the Board of the Corporation as Technical Director in 1957.

"Mac", as he was known throughout the industry, gathered round him a team of technologists who successfully carried through the post-war capital re-equipment of the British sugar factories. This led to the introduction of many new techniques; his contributions to the development of sugar machinery, particularly the extraction plant, were notable. He had particular interest in and encouraged development of automatic process control and reduction of sugar losses in pulp, etc.

He initiated a series of annual technical conferences which has attained international status among sugar men and has promoted a welcome interchange of views and information which has been of great value to all who have participated. He was frequently consulted by sugar interests in other countries; in this connexion he had travelled to New Zealand, Greece, Israel, Chile, East Africa, Iran, Russia and Afghanistan.

He was an honorary member of the American Society of Sugar Beet Technologists, and had several times visited the United States for the exchange of information. He was also a member of the British sugar industry's delegation to the Comité Européen des Fabricants de Sucre.

Mac, a big man in several senses of the word, consented to become one of our Panel of Referees on its formation in 1955, and generously applied his great knowledge and experience to the assessment of contributed papers, a kindness which we remember with gratitude. He had a host of friends all over the world who will be shocked and saddened by his sudden death so soon after retirement.

St. Kitts (Basse Terre) Sugar Factory Ltd. 1965 report.—Crop started on the 26th March and finished on the 29th August with an outturn of 38,450 tons of commercial sugar equivalent to 38,921 tons on 96° pol basis. Of the 34,150 tons of sugar for export, 33,723 tons was sold at the negotiated price under the Commonwealth Sugar Agreement. The cane crop totalled 342,171 tons while more than 20,000 tons had to be left to stand over to the 1966 crop. Heavy rains in May and July affected the juice quality and resulted in considerable dirt and trash being brought in from the fields with a consequently disappointing yield (11·37% as against 11·56% in 1964). A Commission of Inquiry into the St. Kitts sugar industry has taken evidence and its report is awaited. The year saw a break in the long period of drought which has affected the industry and it is hoped to achieve a more satisfactory result in 1966.

Mexico sugar crop, 1965.[1]—Production of sugar in Mexico in the 1965 season reached a record level of 1,982,969 metric tons, produced from 22,430,983 tons of cane grown on 369,412 hectares. The prospects for the 1966 crop are good and the initial estimate is for an output of 2,200,000 tons.

* * *

U.S. sugar cane area[1].—The U.S. Dept. of Agriculture has recently established the cane area for Florida and Louisiana for the year 1966. Of the total of 512,500 acres, 315,000 acres are allotted to Louisiana and 197,500 acres to Florida. Compared with 1965 the sugar cane acreage has been reduced.

[1] *Sugar y Azúcar*, 1965, **60**, (12), 45–46.
[1] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (36), 16.

BREVITIES

The late C. W. Murray.—The death occurred on the 23rd November of CECIL WALTER MURRAY, President of Fletcher & Stewart Ltd. He came from a family long established in the sugar industry; a direct ancestor of his was active in Antigua in 1747 and his father was manager of Port Mourant Sugar Estate in British Guiana where Mr. MURRAY was born. His career began at the age of 17 when he became a laboratory assistant at Usine Ste. Madeleine in Trinidad. There he obtained certificates both as a pan boiler and as an operator of a continuous still. He put in 18 months working under the Chief Engineer, and then returned to the U.K. where he trained at The Mirrlees Watson Co. Ltd. as an engineer. MURRAY was working as a junior engineer on the erection of a sugar factory in Angola when the 1914–18 War broke out. He quickly joined the Forces and served with the Queen's Own Royal Glasgow Yeomanry, later being transferred to the Royal Flying Corps. It was with the R.F.C. that as Captain MURRAY he was awarded the Distinguished Flying Cross. He returned to Mirrlees Watson to continue his training and took a refresher course in Engineering at the West of Scotland Technical College. In 1923 he was invited to join George Fletcher & Co. Ltd. as their resident engineer in the West Indies and was in the Caribbean area for about 7 years. He came to the Derby works in 1930 and was appointed Director and General Manager in 1931, becoming successively Managing Director (1934) and Chairman and Managing Director in 1956 when George Fletcher & Co. Ltd. joined the Booker Group of Companies in that year. In 1958 Duncan Stewart & Co. Ltd. also became a member of the Group and Mr. MURRAY was appointed Chairman of that company. On the integration of the two companies under the present name, Fletcher & Stewart Limited, he became President. He was also a director of both Bookers Engineering and Industrial Holdings Ltd., and Vickers & Bookers Ltd. MURRAY did not allow administrative duties to eliminate contact with technical matters; he was responsible both for design and production at the Derby works and much of his time was spent discussing the details of equipment with the technical staff. The well-known Fletcher "Centre-Flow" vacuum pan is an example of his design ability. In 1953 he was appointed Deputy-Lieutenant of the County of Derbyshire. This is an honorary position conferred on a few highly respected citizens who have given exceptional service to the county.

* * *

Jamaica sugar and rum production, 1965[1].—Production of sugar in Jamaica in 1965 amounted to 506,348 tons, compared with 474,278 tons in 1964. The 1966 crop is estimated at 533,800 tons. Production of rum in 1965 is estimated at 6 million proof gallons, compared with 3,700,000 gallons in 1964.

* * *

Indian interest in the Nigerian sugar industry[2].—An Indian goodwill mission in Lagos has mentioned that the Indian Government is interested in setting up a sugar factory in Nigeria.

* * *

Trinidad sugar production, 1965[3].—Production of sugar in 1965 amounted to 250,586 tons, compared with 226,531 tons in 1964.

* * *

British Guiana 1965 sugar crop[4].—Crushing of the 1965 cane crop in British Guiana has been completed and sugar production has reached 309,445 tons, an increase of 50,000 tons above the level attained in 1964. The 1966 crop is scheduled to start in mid-February.

* * *

West Germanysugar campaign, 1965[5].—The 1965/66 campaign in West Germany ended before the beginning of the new year. Beets delivered to the factories totalled 10,290,182 metric tons, as compared with 13,471,006 tons in the previous campaign, a decrease of 3,180,824 tons or 23·62%. The decrease is due to the reduced beet acreage and also to the unfavourable weather conditions during the growing period and early wintry weather in November. Sugar content as well as extraction were substantially lower than in the two preceding years; sugar content amounted to 15·78% as against 16·82% and 16·68% in 1964/65 and 1963/64. Extraction reached 15·14%, raw value, as against 15·77% and 15·96% in the two previous years. From the total beet tonnage 1,555,701 metric tons of sugar, raw value, was produced, nearly 600,000 tons less than in the previous campaign. Sugar production will not be sufficient to cover domestic requirements; however, the balance between consumption requirements and production will be covered by existing surplus stocks, and the high sugar stocks which were on hand at the beginning of the sugar year 1965/66 will be substantially reduced during the current year. In spite of this reduction, however, turnover stocks at the end of the year 1965/66 will still exceed the usual level.

* * *

Cattle feed from sugar cane by-products in Cuba[6].—Cane harvesters imported into Cuba from the U.S.S.R. and Czechoslovakia are designed to separate the tops which can themselves be harvested mechanically. These can be used for cattle feed as can be Torula yeast grown on molasses. A plant is being built at Morón, Camagüey, for the production of this fodder yeast.

* * *

Hawaii sugar production record[7].—The 1965 sugar campaign in Hawaii closed on the 25th December, production having reached a record level of 1,217,646 short tons, which compares with 1,178,796 tons in 1964. Milling of the 1966 crop started on the 4th January 1966.

* * *

Spanish sugar crop, 1964/65[8].—With the conclusion of the cane crop in Spain, sugar output from the beet and cane sugar industries totalled 480,574 tons, approx. 105,000 tons more than in the previous campaign year. The beet crop in the 1965/66 campaign is expected to be greater because of the higher acreage planted, although dry growing conditions make it unlikely that there will be a greater yield per acre.

* * *

Bagasse board in Jamaica[9].—A subsidiary company has been formed by one of the large oil concerns to make building materials from bagasse. The new factory is expected to have a capacity of 2000 tons of particle board, the equivalent of 25 million square feet, and approximately half of this output would be available for export. Construction of the plant was scheduled to start in November 1965 but it will be about a further year before production gets under way.

* * *

Bulk sugar reception in France[10].—The port of Le Havre has become the first in France to be able to receive sugar in bulk, the first to be so handled arriving on the 25th August last. A store for bulk sugar has been built which holds nearly 25,000 tons and handling equipment will deal with 600 tons per hour.

* * *

Chinese sugar factories for Pakistan[11].—Under the terms of a trade agreement signed recently between China and Pakistan, the former is to help set up an industrial complex in West Pakistan, according to news agency reports[1]. The work will include the construction of cement and sugar factories together with the production of low-pressure boilers and other factory equipment.

---

1 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 1156.
2 *Overseas Review* (Barclays D.C.O.), January 1966, p. 67.
3 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 1157.
4 *Public Ledger*, 1st January 1966.
5 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (1), 6.
6 *Cuban Foreign Trade*, 1965, (4), 21.
7 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (1), 16.
8 *Bol. Inf. Sind. Nac. Azúcar*, 1965, (190), 34.
9 *Overseas Review* (Barclays D.C.O.), November 1965, p. 74.
10 *Le Sucre et ses Dérivés*, 1965, (37–38), 7; through *Sucr. Belge*, 1965, **85**, 130.
11 C. Czarnikow Ltd., *Sugar Review*, 1965, (739), 202.

BREVITIES

New U.S.S.R. sugar factory.—A new factory is reported to have commenced operations in Vinnitsa in the Ukraine, according to *die Wirtschaft des Ostblocks*.[1] The factory has a daily capacity of 5000 tons of beets.

* * *

Cuban crop reduction forecast[2]. According to reports from Havana the long drought earlier in 1965 in Eastern Cuba is threatening the country's sugar harvest goal of 6,500,000 tons. Observers feel that the 1966 yield will not be more than last season's 6,000,000 tons and perhaps considerably less since the lack of rain has reduced the sugar content of the cane.

* * *

Volta Republic sugar plans[3].—The Government of this West African state has stated that it is to sign an agreement for the establishment of a cane sugar factory in the neighbourhood of Banfora.

* * *

Sugar factory proposal for Angola[4].—Authorization has been requested to install a sugar mill in Angola at a cost of some 300 million escudos (£3,750,000).

* * *

Citric acid manufacture in Poland.—A citric acid plant at Zgierz, near Lodz, is undergoing trial operation. Using molasses as raw material, the plant is designed to produce 120 tons of citric acid per year for the food and pharmaceutical industries. The equipment is Polish and the plant includes chemical, microbiological and biological laboratories.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th January*, 1966)	s d
Anglo-Ceylon (5s)	5/9
Antigua Sugar Factory (£1)	10/3
Booker Bros. (10s)	19/10½
British Sugar Corp. Ltd. (£1)	24/3
Caroni Ord. (2s)	2/3
Caroni 6% Cum. Pref. (£1)	16/6
Demerara Co. (Holdings) Ltd.	3/4½
Distillers Co. Ltd. (10s units)	20/6
Gledhow Chaka's Kraal (R1)	15/–
Hulett & Sons (R1)	16/6
Jamaica Sugar Estates Ltd. (5s units)	3/4½
Leach's Argentine (10s units)	12/–
Manbré & Garton Ltd. (10s)	32/3
Reynolds Bros. (R1)	17/–
St. Kitts (London) Ltd. (£1)	11/3
Sena Sugar Estates Ltd. (5s)	8/–
Tate & Lyle Ltd. (£1)	31/–
Trinidad Sugar (5s stock units)	2/8¼
West Indies Sugar Co. Ltd. (£1)	8/9

CLOSING MIDDLE

New York Stocks (*at 15th January*, 1966)	$
American Crystal ($5)	20
Amer. Sugar Ref. Co. ($12.50)	32¾
Central Aguirre ($5)	30⅞
Great Western Sugar Co.	42⅝
North American Ind. ($10)	15
South P.R. Sugar Co.	23¾
United Fruit Co.	32½

Portuguese Government control of the sugar industry[5].—The manufacture and refining of sugar in Portugal have been placed under Government control from the 1st January 1966. These industries are included in a decree issued by the economy and overseas ministries bringing under control food, chemical, metallurgical and some other industries. It was pointed out that the measure was not nationalization but simply one of a number of measures aimed at co-ordination and uniformity of industries both in Portugal's mainland and overseas territories, as part of plans to intensify industrialization of the country.

* * *

Chile sugar production, 1964/65[6].—Industria Azucarera Nacional S.A. has reported that its output of refined sugar from the 1964/65 harvest amounted to 95,259 tons, compared with 99,460 tons in 1963/64.

* * *

Brazil sugar production, exports and stocks[7].—Brazilian sugar exports by the end of 1965 were not expected to reach earlier expectations owing to a scarcity of shipping space, according to the *Boletim Cambial*. Exports in 1965 will probably have totalled some 13 million bags (780,000 metric tons) instead of the earlier estimates of 15·5 million bags (930,000 tons). Total supplies, at 95·2 million bags (5,712,000 tons), will comprise 1965 production of 72 million bags (4,320,000 tons) plus a 23·2 million-bag (1,392,000 tons) carry-over from 1964. Only some 60 million bags (3,600,000 tons) will have been disposed of by the end of the year, leaving stocks of 35 million bags (2,100,000 tons) including both whites for domestic consumption and raws for export. These stocks will pose a storage problem which will be further aggravated by a heavy carry-over expected at the end of March when the crop year ends. When new sugar legislation has been sanctioned the Instituto do Açucar e do Alcool will have the power to adjust production quotas to obtain an overall balance in the producing zones and in the quantity of sugar produced, but it seems inevitable that the Institute will also have to create a retention stock out of part of the carry-over, to be absorbed in two or three subsequent crop years.

* * *

New sugar factory for Czechoslovakia[8].—A large sugar factory at Rimavska Sobota has been opened. It is one of the largest and most modern plants in the country and is scheduled to slice 50,000 tons of beets and to produce 6500 tons of sugar during the current season.

* * *

U.S. beet area[9].—On the 10th December 1965 the U.S. Dept. of Agriculture announced the establishment of a national sugar beet acreage requirement of 1,435,000 acres for the 1966 crop. This compares with a 1965 requirement of 1,375,000, the increase providing acreage for two new localities in Maine and Arizona. For other areas proportionate shares are about the same level as in 1965.

* * *

U.S. reallocation of Rhodesian 1965 sugar quota[10].—The Rhodesian sugar quota for 1965 has been reallocated by the U.S. authorities. Of the total of 9542 tons, 2175 has been reallocated to Mexico, 2149 to the Dominican Republic, 1341 to Peru, 1233 to Brazil, 681 to the B.W.I., 356 to Argentina, 276 to Ecuador, 239 to the French West Indies, 226 to Nicaragua, 196 to Guatemala, 195 to Costa Rica, 157 to Colombia, 103 to Haiti, 96 to El Salvador, 81 to Panama, 23 to British Honduras and 15 tons to Venezuela.

[1] C. Czarnikow Ltd., *Sugar Review*, 1965, (739), 202.
[2] *Public Ledger*, 20th November 1965.
[3] *Zeitsch. Zuckerind.*, 1965, **90**, 655.
[4] *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 926.
[5] *Public Ledger*, 20th November 1965.
[6] *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 1050.
[7] *Public Ledger*, 27th November 1965.
[8] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (33), 9.
[9] *Lamborn*, 1965, **43**, 207.
[10] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (34), 17.