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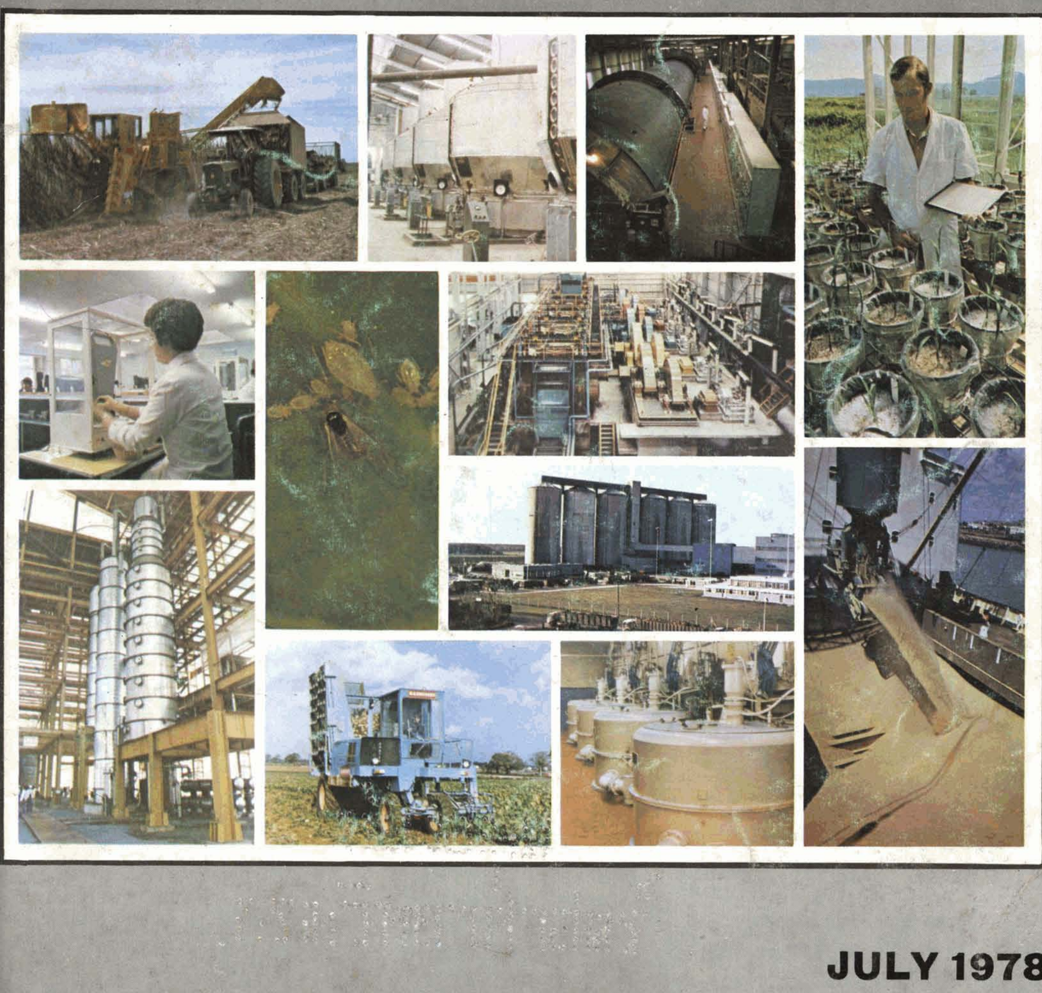

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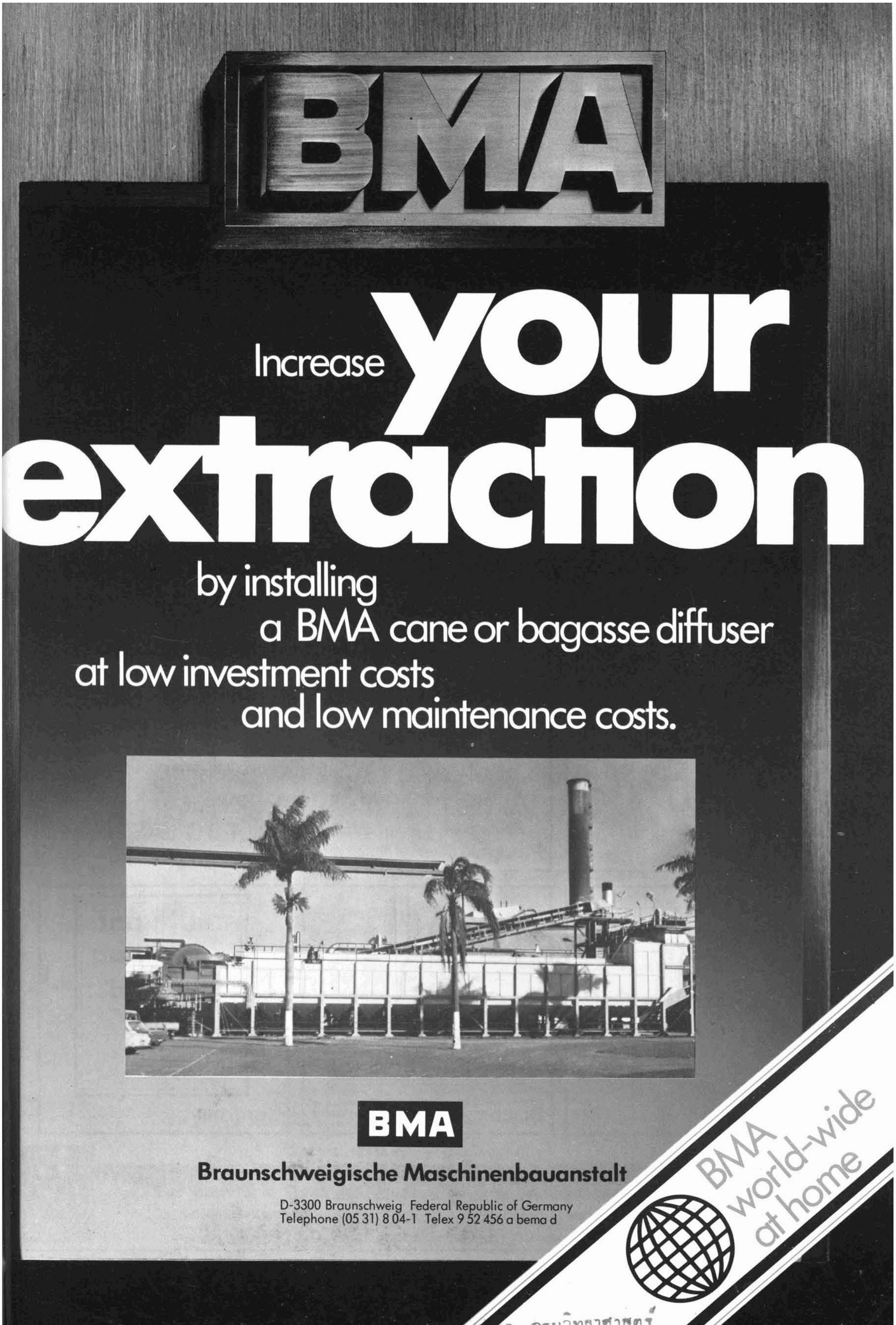
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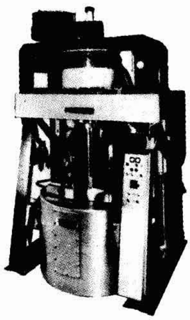

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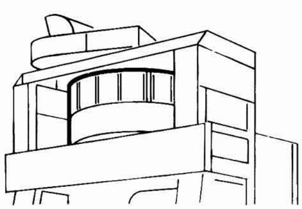

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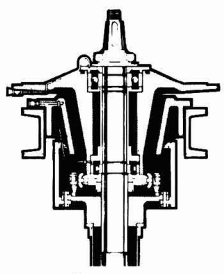

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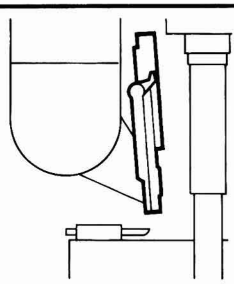

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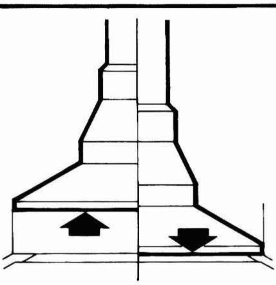

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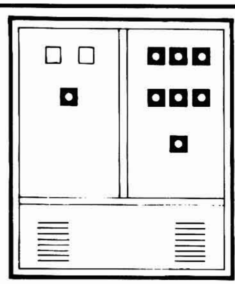

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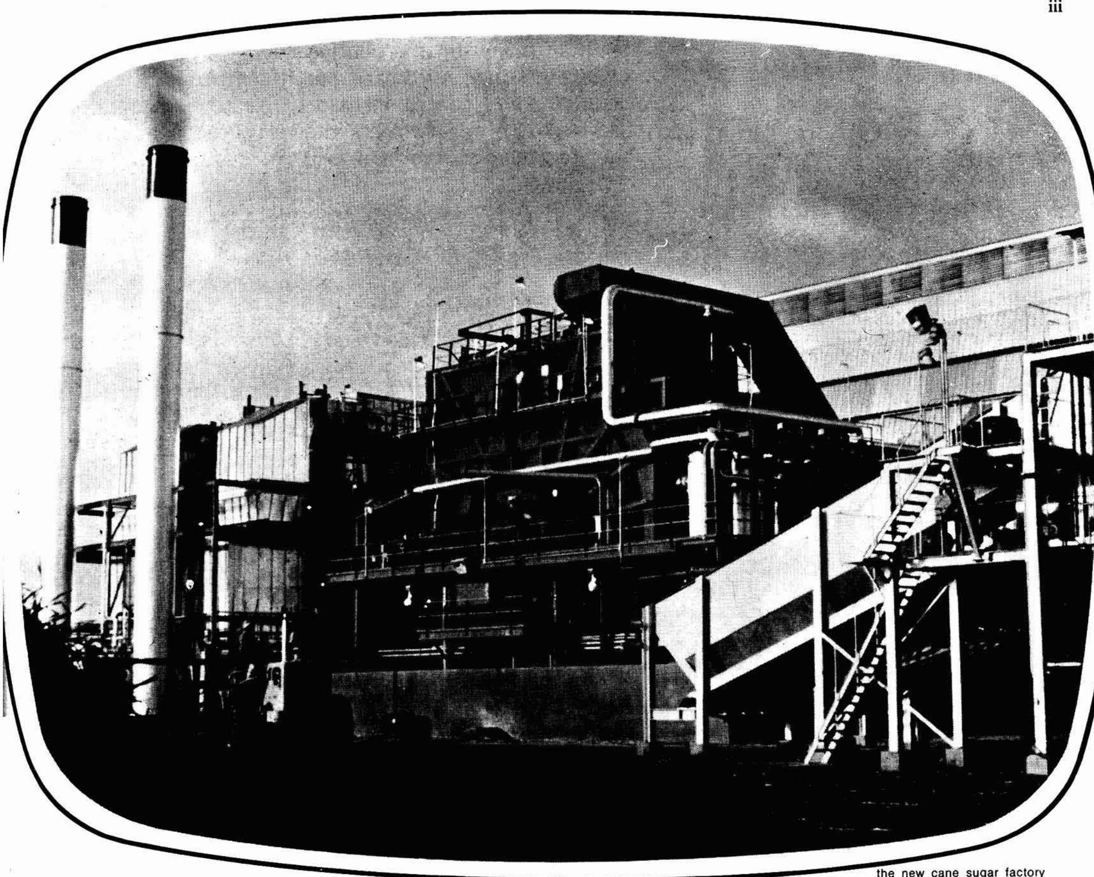

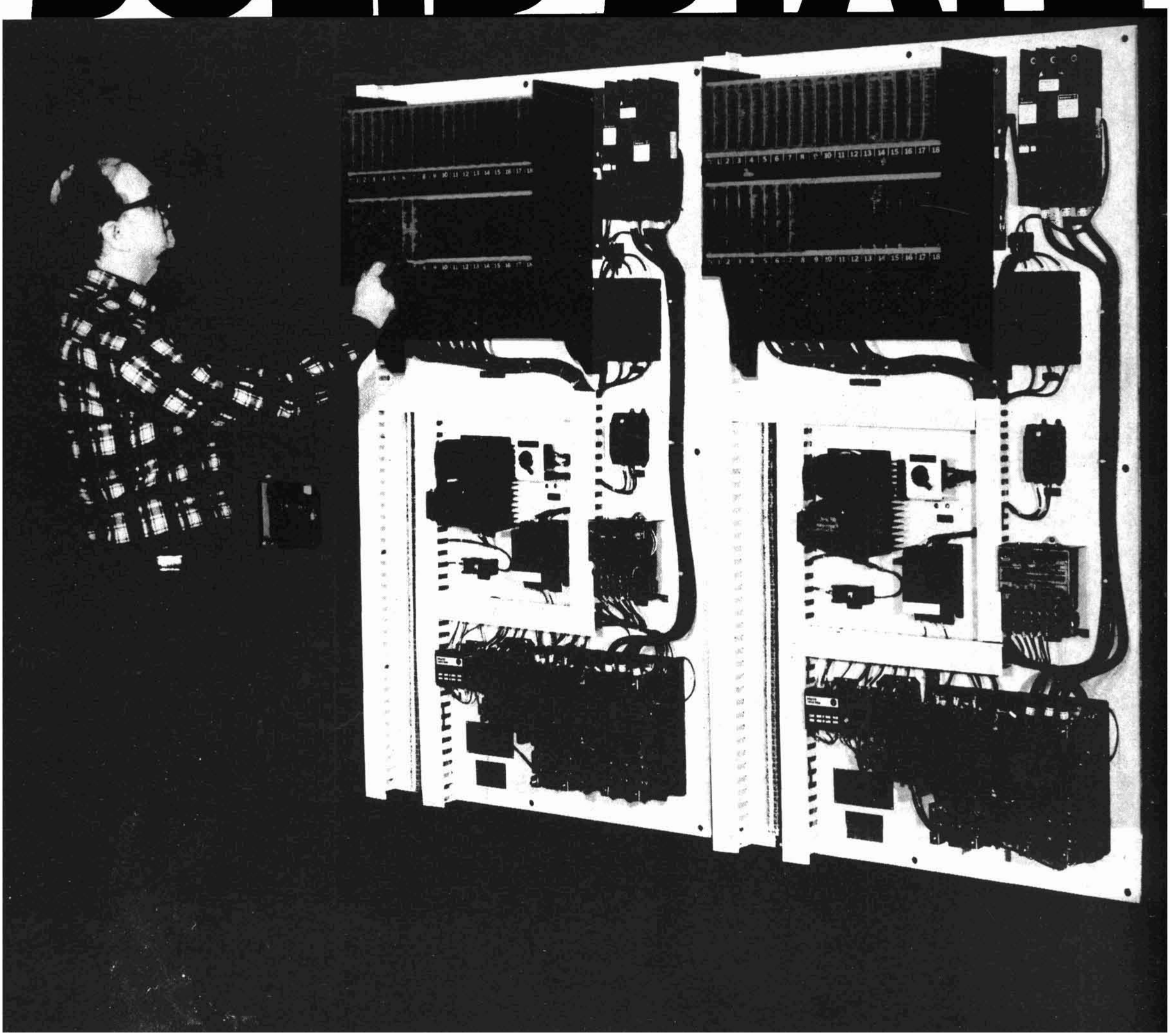

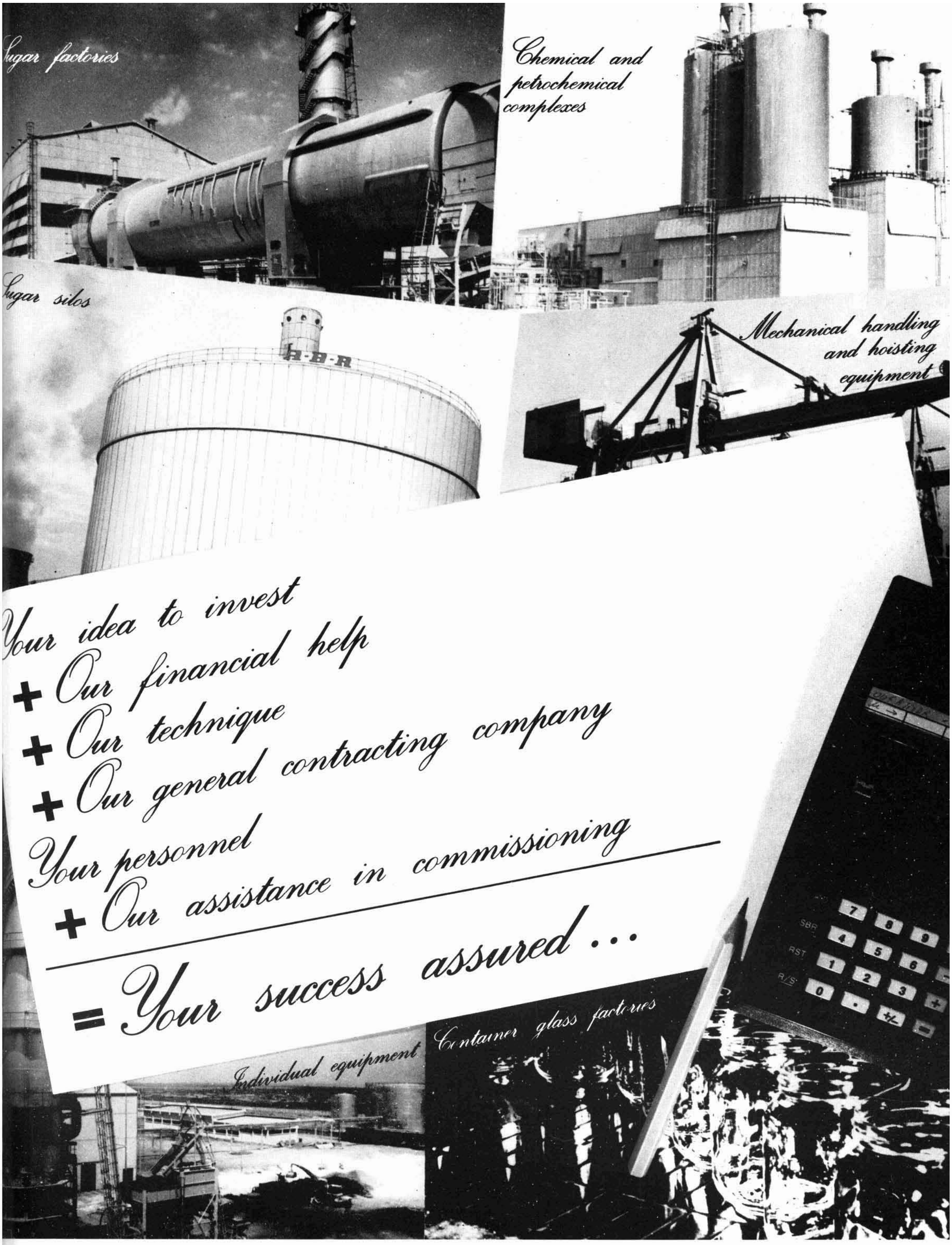
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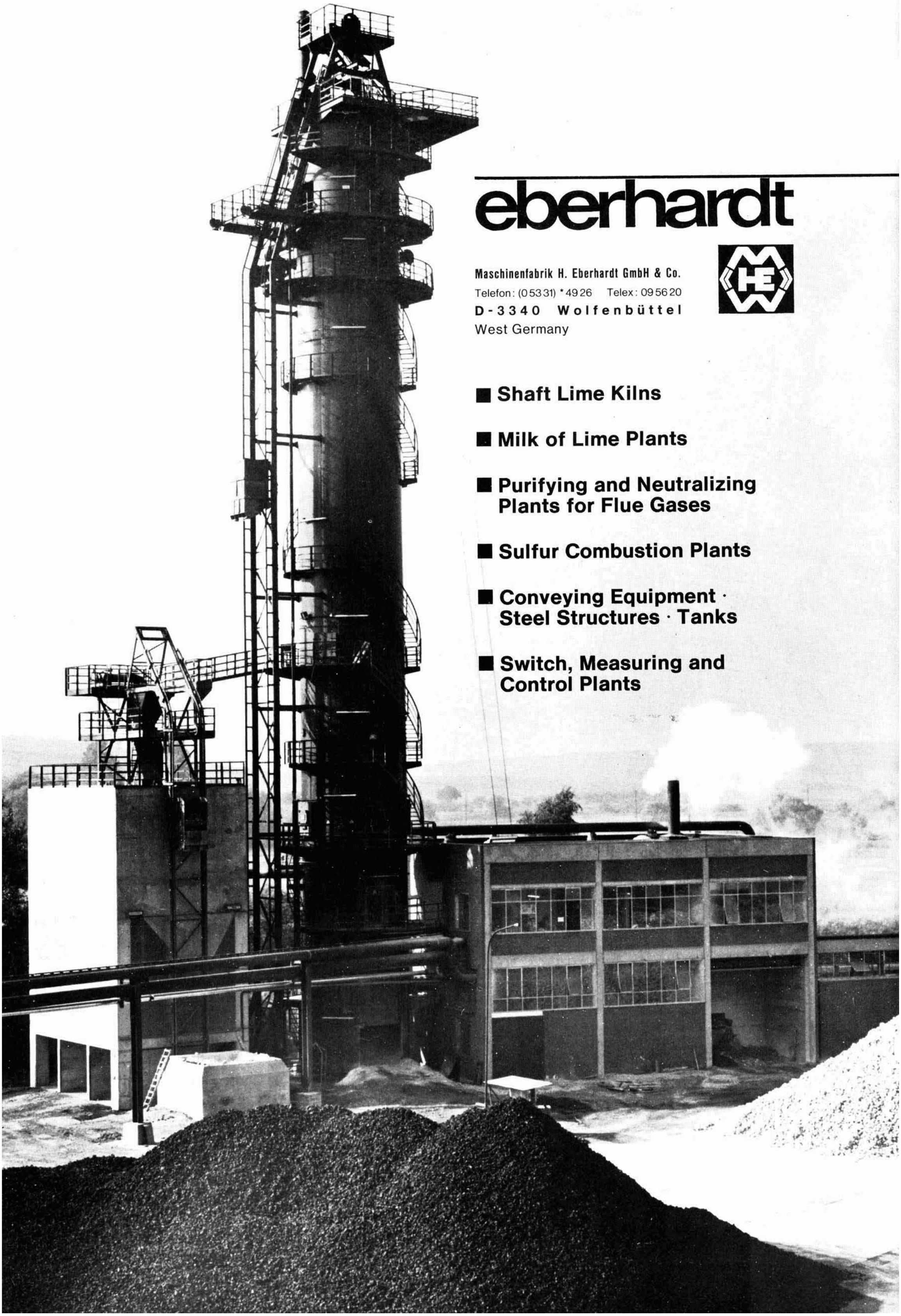

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# NOTES AND COMMENTS

### International Sugar Council

The second Session of the International Sugar Council under the International Sugar Agreement 1977 was held in London on 17th May 1978. The Session was presided over by Mr. S. El-Bous, the Chairman for 1978, and was attended by delegates of 35 exporting and 12 importing Members.

The Council noted that, since its first Session, Bangladesh, Bolivia, the Dominican Republic, Mozambique, Pakistan, Paraguay, on the exporting side, and Bulgaria and Norway on the importing side, had become Members, bringing the total Membership to 38 exporting and 13 importing Members. It also noted that the procedure for Iraq's accession to the Agreement had been carried out by the Organization and that Iraq may soon become an importing Member.

The Council approved the conditions of accession by the German Democratic Republic which, when accepted by that country, will open the way for its membership of the Agreement. With a view to promoting as large a participation in the Agreement as possible, the Council established an informal Working Group under the Chairmanship of the Chairman of the Council to consider all future applications for membership of the Agreement and to provide, as in the case of a possible membership by the EEC, a procedural framework for a dialogue for arriving at the modalities of membership.

The Council noted that the reservations made to the Agreement by India and the USSR were covered by the provisions of article 78, paragraph 2 (in respect of the USSR reservation on stocks, the Council was advised that the reservation was exclusively related to the provision regarding the holding of special stocks and to maximum stocks). The Council accepted, under article 78, paragraph 4, the declarations made by Japan and the USA when depositing their notifications of provisional application of the Agreement that such application was subject to the limitations of their national legislation and budgetary processes.

The Council adopted a revised estimate of the net import requirements of the free market for 1978, amounting to 16·08 million tonnes (as compared with the January estimate of 15·515 million tonnes). In the light of its estimate of the likely exports other than under quotas in effect and of changes in the exporters' Membership of the Agreement, the Council increased the global quota from 10·715 to 11·78 million tonnes. (The aggregate of quotas now in effect, including the first allocations from the Special Hardship Reserve in 1978 amounts to 12,696,275 tonnes.)

The Council also established a special Working Group to consider the difficulties facing the Dominican Republic because of the limitation on its exports to the free market in 1978, and such other similar cases as may be put to the Working Group; and to submit any recommendations in this respect to the Executive Committee for report to the Council at its next Session.

The Council appointed Mr. William K. Miller, of the United States of America, to succeed Mr. E. Jones-Parry as Executive Director upon his retirement on 1st September 1978; and invited Mr. E. Jones-Parry to act as a part-time consultant to the Organization until 31st December 1978. The Council also appointed Mr. Jose Breuil Galligarcia, of Cuba, as the Manager of the Stock Financing Fund under the Agreement.

The Council extended its warmest wishes to Sir Guy Sauzier of Mauritius in his retirement and to Messrs. Gavin Campbell of Australia and George Thigpen of the USA in their new appointments.

The Executive Committee of the I.S.O. was to meet on 15th June to consider any application for an extension of the current deadline of 30th June for ratification of the Agreement. The decision will depend on whether the US and Japan have ratified or are likely to ratify the agreement by this date; in the former case, domestic legislation must be settled before Congress can ratify.

### World sugar prices

The London Daily Prices for raw and white sugar moved in very small ranges during May, the LDP starting at £101·50 and ending at £102 but meantime moving between £98·50 and £103. The LDP(W) slid from its opening level of £109 to £104·50 but recovered to £110 at the end of the month. There has been comparatively little raw sugar business but India has disposed of 484,000 tonnes of white sugar and the EEC has sold about 200,000 tonnes. Venezuela has bought 100,000 tonnes and the ready sales have supported the white sugar price, aided by reports of delays to sowings in European beet fields.

### EEC sugar and beet prices for 1978/79

In mid-May the EEC Farm Ministers decided on the prices which would apply to farm products, including sugar. The decisions, while not as harsh to farmers' interests as the Commission's original proposals[1], were a considerable step towards discouraging a further increase in the Community's surplus production.

White sugar prices were set 2% higher than the 1977/78 level, with a target price of 352·5 U.A. per tonne and an intervention price of 334·9 U.A. The minimum price for beet was set at 25·94 U.A. per tonne. The *B*-quota was set at 27·5% of the basic *A*-quota level, half-way between the previous years' 35% and the 20% proposed by the Commission. The production levy on HFCS was retained and set at the same level of 50 U.A. per tonne as in 1977/78; it is also to be retained in 1979/80.

The Commission had the task of disposing of some 2·8 million tonnes of sugar, white value, from the 1977/78 campaign and by the end of May had successfully sold 2,537,000 tonnes. As C. Czarnikow Ltd.[2] noted, "While congratulating the Commission on the way it has managed to carry out its function in releasing so substantial a tonnage of sugar onto a world market already suffering from a large surplus, it must be recognized that this has only been possible at the expense of substantial and, in general, increasing restitutions. In part these, of course, are met by producers themselves but the

[1] *I.S.J.*, 1978, **80**, 65.
[2] *Sugar Review*, 1978, (1387), 87.

EEC taxpayer has also had to provide enormous sums of money in order to cheapen Community sugar so that it may readily find a home in the world market".

The Ministers have obviously held in mind during their meetings not only the interests of their farming communities but also of their tax-paying constituents so that the new prices reflect increases well below the level of inflation in the EEC, while some relief to farmers has been possible in the countries with weaker economies by adjustment of the "green currency "levels.

**EEC-ACP sugar talks**

Talks between representatives of the EEC and the ACP sugar suppliers were adjourned on 26th May and were expected to resume about the middle of June. The two sides had failed to agree on the ACP demand for a 9% increase, to 297·1 U.A. per tonne, for the 1·3 million tonnes of raw sugar to be imported during the year from 1st July 1978. The EEC had offered an increase of 2%, in line with the increase given to its own sugar producers, to bring the price to 278·1 U.A. per tonne and it is unlikely that an improved offer will be made.

Speaking for the 16 ACP countries, the Fiji Prime Minister said[1] that they objected to the Commission's "take it or leave it" attitude; however, the Commissioner for Development has pointed out that the offered price is well above world market levels and referred to the existing world surplus and the Community's own domestic price levels.

**US sugar legislation**

The Senate Finance Sub-Committee on Sugar and Tourism held hearings on 11th May in connexion with the bill introduced by Senator Church[2]. Among the witnesses testifying, Mr. Julius Katz, Assistant Secretary for Economics and Business Affairs, stated that the International Sugar Agreement remains the foundation of the Administration's sugar policy and, while the part of the Church Bill authorizing the President to carry out the provisions of the Agreement was satisfactory, modification of other provisions was needed.

Mr. Howard Hjort, Director of Economics, Policy Analysis and Budget of the USDA, called the Church Bill inflationary and inconsistent with US support of the Agreement. He outlined Administration proposals which would provide for a target or "established price", beginning with the 1978 crop, which would be set initially at 14·05 cents/lb, raw value, and escalated (by nearly 1 cent/lb per year) using the formula which now applies to wheat, corn and cotton under the Food and Agriculture Act of 1977. The difference between the established price and the minimum market objective of 13·50 cents/lb would be made up by payments to producers (growers), either directly or through processors. The Administration would be authorized to impose fees without the 50% of value limitation currently applying and to adjust these quarterly if necessary. As world prices advanced, the Administration intended to reduce and eventually eliminate the fees. Standby authority would permit imposition of quotas as necessary to cope with unexpected situations.

The House Agriculture Committee began public hearings on pending legislation on 23rd May and Mr. Hjort described the increase in the domestic support price in the de la Garza Bill, to 17 cents/lb, as inflationary and stated that he was quite sure that President Carter would veto such legislation. He referred to the proposed Administration programme, which was later sent formally to Congress.

The programme is unpopular in Congress, however, many legislators feeling that, unlike the Church Bill, it does not assist the domestic cane and beet growers sufficiently. Moreover, while the President may veto the Church Bill, the Administration is anxious to have some sort of Sugar Act passed by Congress so that it has authorization to take part in the International Sugar Agreement which it was due to ratify by 30th June.

**European beet areas, 1978**

F. O. Licht KG have recently issued[3] a second estimate of beet sowings for the 1978/79 campaign which show little change from the first estimates as far as Western Europe is concerned. However, the East European countries are expected to sow 119,000 hectares less, 100,000 ha being the reduction in the crop area of the Soviet Union. Elsewhere changes expected are small, the largest being an increase of 30,000 ha in the beet area forecast for Turkey. The total area is now set at 7,827,378 ha against 7,910,900 earlier and a 1977 area of 7,795,588 ha.

Rainfall, snow and hail have been reported from many areas, and sowings have been delayed. However, the postponement of decisions by the EEC Farm Ministers at their end-April meeting, concerning the prices to be paid for beet in the economic year starting July 1978, has meant that sowings are likely to be completed before the community's farmers know for sure what will be the value of their production.

**US sugar storage[4]**

With the inception of the sugar loan programme effective from 8th November 1977, the US Dept. of Agriculture ended the interim price support payment programme announced in the September before. Under the sugar loan programme, the Commodity Credit Corporation (CCC) offers domestic sugar processors loans of 14·24 cents per pound of refined beet sugar and 13·50 cents per pound of cane raw sugar. Processors must meet grower payment guidelines (which vary in the different beet and cane growing areas) provided the growers have met minimum wage requirements for their employees. The sugar is used as loan collateral and must be in storage facilities owned or leased by the processor and not previously marketed. CCC may take title of the sugar at any time.

On the 12th May the CCC increased the loan rate on refined beet sugar to 15·57 cents/lb to cover fixed marketing costs and to place loan rates for beet and cane sugar more nearly in line with historical market relationships[5].

Up to 5th May the CCC had loaned sugar producers $320,460,000 under the price support provisions of the 1977 Farm Bill. A total of 1,198,582 short tons, raw value, of cane and beet sugar had entered storage under the programme and so is taken off the market to be released when the price reaches 13·5 cents/lb raw value.

1 *Public Ledger*, 27th May 1978.
2 *I.S.J.*, 1978, **80**, 161.
3 *International Sugar Rpt.*, 1978, **110**, (12), 1.
4 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (11), 11; (13), 23.
5 *Lamborn*, 1978, **56**, 79.

# Herbicides for weed control in sugar cane in the Sudan

By M. E. BESHIR

(Guneid Research Station, Agricultural Research Corporation, Guneid, Sudan)

### *Introduction*

THE present method of weed control on the sugar plantations supplying the Guneid sugar factory in the Sudan is hand weeding. It usually is done immediately after the planting irrigation and the overall efficiency of the operation depends, to a very large extent, on the availability of labour, the extent of weed growth at planting time and the time interval between one weeding and the next.

The number of weedings carried out during any one season on a particular plot varies depending on the initiative of the tenant, and the prevailing prices of labour for the season. In an average season, no more than three intermittent weedings are given, after which the developing canopy of the crop tends to control weeds by smothering.

Until recently the method of hand-weeding was satisfactory, mainly because of the availability of labour at relatively low wages. Of late, however, shortages of labour have become not uncommon and wages have begun to escalate. Experiments were therefore begun at this station with a view to replacing hand weeding by efficient and economical herbicide treatments.

The purpose of this paper is two-fold: (1) to describe some aspects of weed ecology at Guneid, and (2) to report the high activity of some soil-applied residual herbicides in the clay soil of Guneid.

### *The environment*

The Guneid sugar cane area (33° 19′–33° 27′ E, 14° 47′–15° 00′ N) is ecologically part of the semidesert grassland zone of the Sudan[1]. The climate is generally hot and semi-arid but the winter months, November to March, are relatively cool and dry. Precipitation is highly seasonal and occurs between June and October.

The vegetation of the area is open grassland (mainly *Aristida adscensionis* L. and *Schoenefeldia gracilis*) dotted occasionally by trees [*Acacia raddiana* Savi, *A. seyal* Del. and *Balanites aegyptiaca* (L.) Del.]. This vegetation cover is of secondary origin since grain sorghum subsistence cultivation was widely practised before the introduction of irrigated cane growing, and at least part of the original vegetation cover must have been interfered with.

Soils of the Guneid area are moderately deep drained, dark brown, alkaline cracking clay of the vertisol order[2]. The dominant clay mineral is montmorillonite, and in general very similar to the soil of the Gezira clay plain on the Western side of the Blue Nile.

### *Weed ecology*

The introduction of irrigated agriculture at Guneid, now in its 22nd season, coupled with the unusual type of clay soil, climate and crop management, has resulted in unique characteristics of the weed flora.

Most weed species are adapted to long summer dormancy and rapid germination at planting time at the onset of the rainy season. The first flush of weed germination typically consists of broadleaved species. The most important, in terms of abundance and early germination, are *Ocimum basilicum* L., *Acalypha indica* L., *Phyllanthus niruri* L., *Heliotropium sudanicum* F. W. Andr., *Ipomoea cordofana* Choisy, *I. belpharosepala* Hochst., *Corchorus fasicularis* Lam., *C. trilocularis* L., *C. olitorius* L., *Digera alternifolia* (L.) Aschers, *Hibiscus ficulneus* L., *Tribulus terresteris L.*, and *Sonchus cornutus* Hochst.

Grass weeds normally start germination four weeks later and completely dominate the weed cover by the end of October. By then most of the broadleaved weeds have flowered and set seed. Five grass species are predominant, viz. *Echinochloa colonum* (L.) Link., *Brachiara eruciformis* (Sm.) Griseb, *Dicanthium annulatum* Forsk. and *Aristida adscensionis* L.

Between-season variation in specific composition and density of individual species is minimal and reflects the uniformity of distribution of these weed species. Another feature of the weed populations is their rapid growth and maturity. The time interval for most species between seedling emergence and flowering is 7–10 weeks, and for the broadleaved weeds this coincides with the length of the rainy season. With the end of the rains and under the effect of irrigation, fresh weed germination occurs but consists mainly of grasses. With time, however, the proportion of broadleaved weeds increases gradually with the advent of the hot temperatures of March to June until they dominate again at the onset of the rains.

### *Materials and methods*

The cane variety used during the herbicide testing was N:Co 310, furrow planted at continuous spacing on 5th August 1976 and irrigated immediately. Alternate rows, 3 metres apart, were sprayed pre-emergence on 8th August.

A Chesterford mini-log sprayer fitted with a single jet and 2 mm ICI "Polijet" nozzle was used. The nozzle was positioned over the centre of the furrow so that the spray pattern extended from ridge top to ridge top. The volume rate was 300 litres.ha$^{-1}$, pressure at the nozzle 0·57 kg.cm$^{-2}$ and the dose range approximately 12:1.

The effectiveness of each formulation in controlling weeds was evaluated by comparing sprayed rows with the adjacent unsprayed controls. The maximum dose rate tolerated by the cane variety was calculated from the distance between the start of the sprayed furrow to the first stool at which the crop bulk was estimated to fall within the range found in adjacent unsprayed areas. The minimum dose giving acceptable weed control was calculated from the distance between the start of the sprayed area to the point visually judged to exceed 25% of the weed cover on the control.

A selectivity factor, derived as the ratio of the maximum dose to the minimum, was calculated for each formulation at six and twelve weeks from planting. An optimum dose for weed control was calculated as the

[1] Jackson & Harrison: *Sudan Forests Bull., New Ser.*, 1958, (2).
[2] Ali: "Soil Survey of Guneid Sugarcane Research Substation", 1968.

geometric mean of the maximum and minimum acceptable doses[3].

*Results and discussion*

With one exception, all herbicide formulations tested had high activity against most weed species as evident from the relatively low dose rates that effected acceptable weed control (Table I) compared with manufacturers' recommendations for clay soils.

**Table I. Screening of herbicides for weed control in sugar cane. Maximum crop tolerance, minimum weed control and optimum dose rates (kg.ha$^{-1}$ a.i.) at six and twelve weeks from planting. Data are means of four replicates.**

| Herbicide | *Maximum crop tolerance* | | *Minimum weed control* | | *Selectivity factor* | | *Optimum dose* | |
|---|---|---|---|---|---|---|---|---|
| | *Weeks after planting* | | | | | | | |
| | 6 | 12 | 6 | 12 | 6 | 12 | 6 | 12 |
| "Flumeturon" | 5·61 | 6·22 | 1·85 | 2·69 | 7·46 | 5·71 | 3·21 | 4·08 |
| "Chlorbromuron" | 6·45 | 6·03 | 1·14 | 1·43 | 13·98 | 10·37 | 2·49 | 2·91 |
| "Ametryne" | 6·84 | 6·03 | 0·62 | 0·94 | 27·37 | 15·86 | 2·05 | 2·35 |
| "Atrazine" | 6·22 | 6·03 | 1·56 | 1·65 | 9·88 | 8·99 | 3·09 | 3·14 |
| "Monuron" | 3·93 | 4·15 | 0·72 | 0·94 | 13·54 | 10·92 | 1·65 | 1·95 |
| "Diuron" | 2·49 | 3·53 | 0·52 | 0·72 | 11·86 | 12·18 | 1·11 | 1·58 |
| "Terbacil" | 2·59 | 2·69 | 0·42 | 0·84 | 15·24 | 7·90 | 1·01 | 1·48 |
| "Dichlobenil" | 8·52 | 10·37 | 4·54 | 9·88 | 4·62 | 2·59 | 6·20 | 10·10 |
| "Bromacil" | 2·59 | 1·88 | 0·42 | 0·62 | 15·24 | 7·51 | 1·01 | 1·06 |
| "Nitralin" | 1·75 | 2·59 | 1·65 | 1·95 | 2·62 | 3·26 | 1·68 | 2·22 |

Good weed control lasting six weeks from planting required a dose range of 0·42–1·85 kg.ha$^{-1}$ and for twelve weeks control an increased dose range of 0·62–2·69 kg.ha$^{-1}$ a.i. These two dose ranges efficiently controlled all the shallow-rooted broadleaved species but only scorched the deep-rooted ones, viz.: *S. cornutus, D. alternifolia, H. ficulneus* and *I. belpharosepala*.

A second feature of the result is the tolerance of the cane variety to the formulations tested. Except for "Nitralin" the variety N:Co 310 tolerated without visible injury the dose range applied for each formulation. This can be seen in the selectivity factors where, with the notable exception of "Ametryne", which exhibits the highest selectivity, all formulations show comparable selectivity figures. This was true both for six and twelve weeks control, with "Nitralin" showing the poorest selectivity.

The optimum dose rates required for weed control, as established on the basis of selectivity, point also to the high activity of the formulations tested. This is again seen in the low rates required which varied from a low of 1·01 kg.ha$^{-1}$ for "Bromacil" and "Terbacil" to the high of 3·21 kg.ha$^{-1}$ for "Flumeturon". With "Ametryne", the most selective of the formulations, a medium dose is indicated. There was however no substantial difference between the optimum dose that was required for six or twelve weeks control, suggesting a continuum of activity of the formulations.

The reasons for this high activity are not readily apparent from the present data. However, it is a property of soil-applied residual herbicides such as those used in the present investigation that they are generally adsorbed by the soil clay and organic matter and then slowly released into the soil water. Three features of the clay soil of Guneid are: high cation exchange capacity (about 50 meq/100 g), low organic carbon (0·30% at the surface) and extreme impermeability when wet.[4,5] It would therefore be possible that these herbicides are adsorbed in the surface layer of the soil and then released into an immobile layer of soil water as a result of extreme soil impermeability. Although depth dilution of the herbicides would take place subsequently, it appears to occur very slowly leaving behind a high concentration at the surface. This would explain the efficient control of the great majority of broadleaved species with pre-emergence application which coincides with the early stage of root development. On the other hand deep-rooted and established weeds would escape the herbicidal effect because their region of nutrient uptake would then be below the toxic layer.

*Summary*

Most weed species of the Guneid sugar cane area are adapted to long summer dormancy and rapid germination at planting time with the onset of the rainy season in early July. Chemical weed control trials have demonstrated high activity of some soil-acting residual herbicides with small dose rates—much lower than manufacturers' recommendations—required for acceptable weed control. The reasons for high activity are thought to be soil conditions, namely, high cation exchange capacity, low organic carbon and extreme impermeability when wet.

**Des herbicides pour la lutte contre les plantes adventices de la canne à sucre au Soudan**

La plupart des espèces de mauvaises herbes de la région à canne de Guneid sont adaptées à une longue période de repos estival et à une germination rapide au moment de la plantation, lorsque début juillet, survient la saison des pluies. Des essais d'herbicides chimiques ont démontré l'activité élevée de certains herbicides résiduaires sur le sol, de faibles doses—nettement inférieures à celles recommandées par les fabricants—étant requises pour obtenir une destruction acceptable des mauvaises herbes. On estime que les raisons de l'activité élevée sont les conditions du sol, notamment une capacité d'échange cationique élevée, peu de carbone organique et une extrême imperméabilité lorsqu'il est humide.

**Herbizide für die Unkraut-Bekämpfung in Zuckerrohr im Sudan**

Die meisten Unkrautarten im Zuckerrohr-Anbaugebiet von Guneid haben eine lange Samenruhe im Sommer und ein schnelles Keimen zur Pflanzzeit bei Beginn der Regenzeit Anfang Juli adaptiert. Chemische Unkrautbekämpfungsversuche zeigten eine hohe Wirksamkeit einiger beständiger Boden-Herbizide. Die für eine ausreichende Unkrautbekämpfung notwendigen Dosen waren klein, viel geringer als die Empfehlungen des Herstellers. Die Gründe für die hohe Wirksamkeit sieht man in den Bodenbedingungen, nämlich der hohen Kationen-Austauschkapazität, dem niedrigen Gehalt an organischem Kohlenstoff und der extremen Undurchlässigkeit bei Nässe.

**Herbicidas para control de malas hierbas en caña de azúcar en el Sudán**

El mayor parte de las especies de mala hierba de la área de caña de azúcar de Guneid son adaptado a durmienza extendida en el verano y a germinación rápida al tiempo de plantear con el comienzo del epoca

[3] Pfeiffer: "A Course on the Principles and Practice of Crop Protection" (Fisons Pest Control), 1960.
[4] Ibrahim: *Ann. Rpt. Guneid Research Station*, 1970/71.
[5] Fadl: *J. Soil Sci.*, 1971, **22**, 129–135.

de lluvia a principios de julio. Ensayos de control de malas hierbas con químicas han demostrado alta actividad de algunas herbicidas residuales que funcionan sobre el suelo con pequeñas dosises—muchos menores que las recomendaciones de los fabricantes—necesario para control aceptable de las malas hierbas. Las causas



de la alta actividad se consideran condiciones del suelo, es decir, alta capacidad para cambio de cationes, bajo contenido de carbón orgànico, y impermeabilidad extrema cuando el suelo es húmeda. □

# Beverage floc and cane sugar

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### *Introduction*

THE production of bottled beverages is a major use for cane sugar in many countries of the world. In the USA, 25% of total sugar deliveries go to bottled beverage manufacturers; figures for various other countries are shown in Table I. In European countries, deliveries to bottlers range between 7% and 20% of total deliveries. Because of the importance of bottlers as sugar consumers, any factor in sugar that affects the quality of a beverage is of great concern to sugar producers and refiners. Indeed, "bottlers standard" is usually one of the highest grades of sugar produced by any refinery.

**Table I. Sugar use in bottled beverages**

| *Country* | *% of total deliveries* |
|---|---|
| Australia | 24 |
| United States | 22 |
| Holland | 18 |
| United Kingdom | 13 |
| Belgium | 12 |
| Germany | 11 |
| South Africa | 8·6 |
| France | 8 |

(Data are for period from October 1975-March 1976, courtesy of the Sugar Information Association and the European Centre for Sugar Documentation)

Cloudiness or precipitation in beverages is unwelcome because it generally means that the beverage must be discarded. There are various origins for these precipitates; although some may be from ingredients other than sugar, all are ascribed to the sugar by the bottlers who find them, so the absence of these cloudy precipitates is of great concern to bottlers, merchandisers, sugar producers and suppliers.

### *Types of floc*

These precipitates, usually fluffy white, occasionally stringy, are referred to by the term "floc". There are several different kinds of floc, which are often confused with one another. Because of the different causes of these various sorts of floc, it is important to specify their nature and origins. Table II lists and briefly describes the major types of flocs. Acid beverage floc has been the subject of much work by the C.S.R.R.P. and will be the main topic of this paper[1–5].

There are flocs of microbiological origin, formed by yeasts, bacteria, or moulds. The non-microbiological flocs resemble these; hence, consumers think, erroneously, that all flocs mean contamination by microorganisms. Yeasts of the *Saccharomyces* and *Torula* (black yeast) species, at quite low concentrations, make a flocculant growth that creates a general haze in sugar solutions[6]. Moulds or their mycelia give a thready fibrous-like fluffy floc; *Aspergillus* and *Penicillium*

**Table II. Types of floc**

| *Type* | *Characteristics* |
|---|---|
| Microbiological—Yeasts | Hazy. |
| Moulds | Thread-like or fluffy. |
| Bacteria | Gelatinous globules. None of these will dissipate upon shaking; none will form if bactericide (formaldehyde or benzoate) is added. |
| Starch | Turbid haze. |
| Dextran | Gelatinous globules or strands. Haze if dried on sugar and redissolved. |
| Alcohol floc | Haze, only appears upon addition of ethanol. |
| Silicate (Inorganic) | Haze or floating precipitate. Often called "water floc". |
| Beet floc | Fluffy flocculant precipitate. Found on top of or at bottom of solution, or floating. Only with beet sugars. Initiated by a saponin from the beet plant. |
| Acid beverage floc | Fluffy balls or granular strands. Only appears at acid pH. Disintegrates on shaking, re-forms on standing. |

species are common in raw sugar[7]. Bacteria such as *Bacillus subtilis* and *B. cereus* synthesize polysaccharide in sugar solutions[8]; these bacteria grow more rapidly than yeasts and produce gelatinous globules, mostly made up of levans (polymers of levulose).

The appearance of starch and/or dextran in high concentration is often, confusingly, called a floc. Starch clouds the solutions and presents a hazy appearance. Dextrans, products of the *Leuconostoc mesenteroides* and *L. dextranicum* bacteria, appear as gelatinous, shiny globules or strands, especially if the organism produces the dextran (polymers of dextrose) in the solution in question. Dextran in granulated sugar that is redissolved may just give a hazy solution.

"Alcohol floc" is the name given to the precipitate or haze that appears upon addition of ethyl alcohol to a sugar syrup. This floc is composed of the alcohol-insoluble constituents of the sugar: starch, dextrans, other polysaccharides, lipids, gums, waxes and proteins (see Appendix on "Floc Tests").

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[1] Godshall & Roberts: *Proc. Tech. Session Cane Sugar Refining Research*, 1977, in press.
[2] Roberts & Carpenter: *ibid.*, 1974, 39–50.
[3] Roberts & Godshall: *ibid.*, 1977, in press.
[4] Roberts *et al.*: *I.S.J.*, 1976, **78**, 163–165.
[5] *Idem: ibid.*, 326–329.
[6] Varley & Moroz: *Proc. Sugar Ind. Technol.*, 1962, **21**, 8–18.
[7] Skole *et al.*: *Proc. Tech. Session Cane Sugar Refining Research*, 1977, in press.
[8] *Idem*: *ibid.*, 1966, 35–44.

The presence of large concentrations of silicate in a sugar solution—sometimes from the sugar, more often from the water—can create a fluffy white precipitate or a general haze. The polymeric silicate anions precipitate with cations in solution and occlude polysaccharides and other large molecules in their network. This is primarily an inorganic floc.

The beet sugar industry had a problem with a beverage floc that was specific to beet sugar. It was discovered[9,10] that a saponin (or sugar beet glycoside), specific to the beet plant, triggered the formation of this floc, which then pulled other acid-insolubles and large molecules down with it. This saponin, a triterpene, can be removed by granular carbon treatment. There does not appear to be an analogous natural product in sugar cane.

A floc caused by water impurities is often mentioned by industrial sugar consumers, but this is usually one of the types discussed above—either a silicate floc, caused by high levels of silicate in the water, or a floc of microbiological origin.

Acid beverage floc of unknown etiology has been of primary concern to sugar manufacturers and bottlers. This floc (ABF) appears as fluffy white bodies in solution; it is known to be generated from something in cane sugar but is not a microbiological formation. It sometimes appears as balls floating in solution, but more often as vague, stranded, granular structures. In the former case, it is called cotton-ball floc in some areas[3].

### *Acid beverage floc*

Acid beverage floc forms in solutions of approximately 15°Brix sugar, at pH 3-4 (below 5), generally after 1 to 10 days' standing. It can be visible within 1 day or, in some sugar samples, not until 30 days have passed. It is also present in more highly concentrated sugar solutions (see Appendix on "Floc Tests") but is sometimes not visible to the eye, probably, it is postulated, because the refractive index is the same as that of the concentrated sugar solution. This fact accounts for some claims that floc disappears if concentration is increased.

If the beverage or test solution that contains ABF is shaken up, the floc will disappear back into suspension as a turbidity, only to re-form again upon several days' standing. It is this ability to reappear upon standing that makes it such a liability to retailers of bottled beverages. Starch and dextran hazes may be soluble at acid pH, so they are not present at pH below 5. Flocs of microbiological origin do not dissipate and re-form upon standing. This property, and its presence at low pH, distinguish the true acid beverage floc.

Until recently, only two studies had been published on the nature and cause of ABF. There was no consistency in analyses performed on samples of ABF—the composition of different samples varied widely. Stansbury & Hoffpauir[11] studied five different floc-forming refined sugars, and found that the isolated floc contained decolorizing carbon, silica, starch, lipids (waxes), and protein. They correlated the appearance of floc with the presence of decolorizing carbon. Cohen, Dionisio & Drescher[12] studied acid beverage floc and alcohol floc; they decided that alcohol floc is mostly a mixture of polysaccharides. They found that ABF arose from sugars that contained protein and concluded that floc was due to protein-ion interaction. They found that addition of the protein albumin caused floc to form in non-floccing sugars. They also observed that all ABF-positive sugars gave alcohol floc but that the reverse was not true. Liuzzo & Hsu[13] studied the alcohol floc from cane sugar and decided that its cause is an amylose-related polysaccharide that forms complexes with other compounds to produce the floc aggregate.

There has been a great deal of controversy about acid beverage floc. Some refiners and technologists say that any sugar will give floc in a beverage, if the beverage is stored long enough. Others claim that if the sugar is stored long enough, it will not floc—or will definitely floc! Some technologists think that $CO_2$ is necessary for floc to form; others give a narrow pH range. The debate has been compounded because of confusion among flocs of various types. The theory of floc formation to be expressed in this paper explains hitherto anomalous data, rather than adding to the contradiction as previous theories have done.

Roberts & Carpenter in 1974 began a study of acid beverage floc[2] and found that floc isolated from refined cane sugar contained starch, lipids or waxes, proteins, silicon compounds, dextrans, and a polysaccharide that probably came from the sugar cane plant. This polysaccharide was isolated from acid beverage floc that had formed in a sugar solution. The floc was washed free of sugar and subjected to acid hydrolysis. Hydrolysis products were analysed by gas-liquid chromatography. The polysaccharide appears to be an arabinogalactan, i.e. a polymer of arabinose and galactose. It is probably a cell wall structural polysaccharide of the cane plant. Similar polysaccharides have been found in rice and other Gramineae. This polysaccharide has been christened indigenous sugar cane polysaccharide, or ISP.

### *Indigenous sugar cane polysaccharide*

Indigenous sugar cane polysaccharide (ISP) was noted to resemble an arabinogalactan that had beeu found in cane by Roberts *et al.*[14] who, in a study of sugar cane polysaccharides, identified the constituent sugars by paper chromatography. It was, therefore, decided to isolate fresh samples of cane polysaccharides and compare their hydrolysis products with those of floc polysaccharide. Sugar cane was crushed within an hour of cutting, and the polysaccharides were precipitated immediately from the juice with ethyl alcohol[4]. In this way, microbial formation of dextran was minimized. The precipitated polysaccharide was redissolved in water, leaving behind the insoluble starch, and then dialysed against toluene-saturated water for 100 hours to remove residual sucrose. The resulting material may be described as alcohol-insoluble, water-soluble, and nondialysable. It was subjected to mild acid hydrolysis; the hydrolysed polysaccharide was analysed for component sugars by gas-liquid chromatography and results are shown in Fig. 1. It was evident that the polysaccharides from the cane and from floccing sugars are the same arabinogalactan. Recently, Miki, Saito & Kamoda[15] reported the isolation of floc from actual beverages;

[9] Eis *et al.*: *Ind. Eng. Chem.*, 1952, **44**, 2844–2888.
[10] McGinnis: "Beet Sugar Technology", 2nd edn. (Beet Sugar Development Foundation, Fort Collins), 1971, pp. 53–55.
[11] *J. Agric. Food Chem.*, 1959, **7**, 353–358.
[12] *Proc. Sugar Ind. Technol.*, 1970, **29**, 123–164.
[13] *Proc. Soc. Soft Drink Technol.*, 1975, 93–102.
[14] *Proc. Tech. Session Cane Sugar Refining Research*, 1964, 76–83.
[15] *I.S.J.*, 1975, **77**, 67–69.

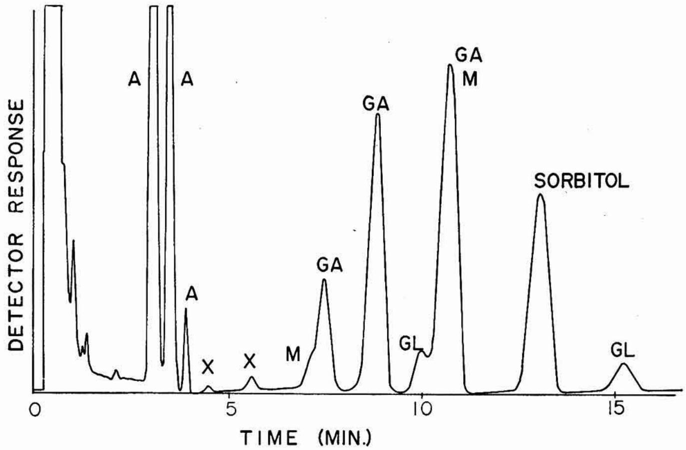


Fig. 1

A = Arabinose
X = Xylose
M = Mannose
GA = Galactose
GL = Glucose
Sorbitol = Internal Standard

subsequent analysis confirmed the findings of Roberts *et al.*[4,14] on the composition of the polysaccharide portion (ISP) of acid beverage floc.

Tests with addition of ISP to various sugars showed that ISP alone was not responsible for floc formation[5], although its addition caused some non-floccing sugars to form floc. It was evident that there is another factor necessary for floc formation. Soluble silicates were suspected[16,17]; there was some correlation observed between high soluble silicate content and floc-positive sugars, and the addition of soluble silicate to some non-floccing sugars caused floc formation. This behaviour was not consistent, however, and this fact, as well as the inability of soluble silicate plus ISP alone to induce floc formation in water, led to the conclusion that soluble silicate was not a necessary factor in ABF formation.

There is evidence that the ABF is colloidal in nature: it can be centrifuged or filtered out of solution. Since the floc-causing polysaccharide comes from cane and since the colloids in cane juice usually carry a negative charge at normal pH, it was of interest to look at the charge on ISP. Solutions of the polysaccharide in phosphate buffer were subjected to moving boundary electrophoresis in a U-tube[3]. It was observed that the ISP migrated toward the positive electrode, indicating a negative charge on ISP at acidic pH. This observation was confirmed when it was observed that the polysaccharide was readily precipitated by dyes with a strong positive charge, such as "Basacryl Orange FL" (see Appendix).

It was then postulated that the other floc factor must be positively charged at acid pH but perhaps negatively charged at higher pH. If this were so, flocculation could only be expected at acid pH, as is the case with ABF. It is well known that many proteins in solution are negatively charged at basic and neutral pH, but positively charged at acid pH, so it was decided to investigate sugar cane protein as an essential factor in ABF formation.

### *Sugar cane protein*

Complete analysis of floc isolated from sugar solutions showed about 4% protein[2] if all nitrogen was taken as protein nitrogen. Strong acid hydrolysis broke down this protein, and subsequent amino-acid analysis gave the constituent amino-acids shown in Table III.

The protein was isolated from samples of sugars by dialysis against toluene-saturated water for 100 hours with subsequent freeze-drying, or by treatment with strong-base ion exchange resins, followed by a sodium chloride wash to remove the adsorbed protein. The sodium chloride was then removed by dialysis for 72 hours and the recovered protein freeze-dried.

When this protein and ISP were mixed either in water or in sugar solution, acid beverage floc was observed to form within 2 days.

**Table III. Amino-acids in hydrolysed protein from acid beverage floc**

| *Amino-acid* | *% of floc* | *Amino-acid* | *% of floc* |
|---|---|---|---|
| Aspartic acid ... | 0·14 | Isoleucine ...... | 0·06 |
| Alanine ............ | 0·11 | Phenylalanine ... | 0·05 |
| Leucine ............ | 0·10 | Proline ............ | 0·04 |
| Glutamic acid ... | 0·09 | Arginine ......... | 0·01 |
| Serine ............... | 0·09 | Lysine ............ | 0·01 |
| Threonine ...... | 0·09 | Tyrosine ......... | 0·01 |
| Valine ............... | 0·09 | Histidine ...... | 0·01 |
| Glycine ............ | 0·09 | | |

In addition to these acids, asparagine, glutamine and amino-butyric acid are found in cane juice. Under the conditions necessary for hydrolysis of ABF protein, these three amino-acids decompose; asparagine and glutamine are hydrolysed to aspartic acid and glutamic acid which are included in the analysis above.

### *Protein analysis by gel electrophoresis*

A method was required to analyse and identify the proteins of sugar cane. A gel electrophoresis method was developed by Godshall & Roberts[1]. In gel electrophoresis, the protein is separated into molecular weight ranges: a sample is dissolved in a buffer solution and applied to a tube of polyacrylamide gel, and a charge is placed across the gel column. By changing the pore size or the concentration of the gel and varying the buffer, a wide range of protein types and sizes can be separated and identified by their position on the gel column. After the proteins are separated (2 to 5 hours), the gel columns are removed from their glass tubes and stained (overnight) with a suitable dye; "Coomassie Brilliant Blue R-250" proved appropriate for sugar cane proteins. The protein bands absorb the dye; the gels are then washed (2 days) to remove the dye from the non-protein parts of the gel, leaving distinct bands of blue-dyed protein. To achieve a quantitative estimate of the proteins in the various bands, the bands are cut out of the gel columns, dissolved in 95:5 v:v dimethylsulphoxide:acetic acid and the colour measured at 590 nm using a spectrophotometer. A calibration curve is made with ribonuclease A.

[16] Clarke: *Proc. Tech. Session Cane Sugar Refining Research,* 1974, 66–75.

[17] Godshall *et al.*: *Proc. Sugar Ind. Technol.,* 1976, **35,** 58–64.

Two bands of protein were observed in all raw sugars tested. The protein of lesser mobility (protein 2) stains as a glycoprotein and is removed in refining, but the other band (protein 1) is observed in all refined sugars examined. When either protein is redissolved and mixed in either water or sugar solution with ISP, flocculation occurs within 2 days, showing that either protein can be the positively charged factor in floc formation.

### *Mechanism of acid beverage floc formation*

The initial factor in floc formation is the positive charge developed on the sugar cane protein at acid pH. This positively-charged protein is then attracted to the negatively-charged polysaccharide (ISP). These two colloidal species form aggregates which coalesce to form floc particles. Other colloidal or solubilized species present are adsorbed onto the aggregates and are included in the floc; thus, starch, silicon compounds, dextrans, etc., may increase the amount of a floc. They may also determine its appearance: a high-starch sugar may form "cotton ball" floc, and a high-silicon sugar, a granular floc. The floc and its constituents are undoubtedly part of the turbidity observed in all sugar solutions.

It has been observed, in attempts to treat floccing sugars with enzymes, that the addition of any protein, e.g. amylase, pectinase, dextranase, to a sugar solution enhanced floc formation when ISP was present either from the sugar or by addition. Even if the enzymes were denatured so that they no longer functioned as catalysts, they were apparently still able to function as positively-charged colloidal proteins and form aggregates with ISP. This behaviour accounts for the observation of Cohen *et al.*[12] that the addition of albumin caused some non-floccing sugars to form floc; in those sugars, ISP must have been present at a level high enough to cause floccing.

### *Critical concentration for floc formation*

The quantities of both proteins and ISP in refined sugar are very small: ISP ranges up to 250 ppm, and protein concentration is well below 1·0 ppm. Amounts in raw sugars are about 10 times these levels. There are apparently critical concentrations for ISP and protein both individually and in relation to one another. Maximum flocculation occurs when the number of positive and negative charges are nearly equal. An excess of one charge may form a layer around bodies of the opposite charge, and thus prevent formation of aggregates. Many sugars, although containing both ISP and protein, do not floc upon acidification; an excess of one component may be the reason. In sugars of very high purity, there may be too low a concentration of either ISP or protein to permit a sufficient number of collisions to form aggregates. It is also possible that manufacturing processes change the structure of ISP or protein so that the electrostatic interaction in acid solution cannot occur.

### *Removal of acid beverage floc*

Surveys have been conducted by the C.S.R.R.P. on the behaviour of protein and polysaccharide in refining processes. Results are shown in Table IV. In protein removal, all refining steps are effective; particularly so are crystallization, bone char filtration, and affination. All protein 2 is removed in refining, but some protein 1 is present in all of the refined sugars examined in this study. About 80% to 90% of total protein is removed in refining. The small remainder—usually less than 1 ppm — is the problem constituent that is a factor in ABF formation.

**Table IV. Behaviour of sugar cane proteins and polysaccharides in refinery processes**

| | *Protein 1* | *Protein 2* | *Total polysaccharides* |
|---|---|---|---|
| *Carbonatation refinery* | | *ppm on solids* | |
| Raw sugar | 0·66 | 0·59 | 930 |
| Washed raw sugar | 0·38 | 0·17 | 450 |
| Melt sweet water | | | 562 |
| Melt liquor | 0·19 | 0·44 | 675 |
| Carbonatated liquor: | | | |
| before filtration | 0·096 | 0·052 | 394 |
| after filtration | 0·083 | 0·13 | 378 |
| No. 1 liquor to pans | | | 244 |
| 1st strike sugar | 0·016 | — | 50 |
| *Phosphatation refinery* | | | |
| Raw sugar | | | 1410 |
| Washed raw sugar | | | 671 |
| Melt sweet water | | | 2669 |
| Washed raw sugar liquor | | | 614 |
| Clarified liquor | | | 588 |
| Liquor off char | | | 350–600 |
| Liquor off resin | | | 550 |
| No. 1 liquor | | | 437 |
| 1st strike sugar | | | 150 |
| 1st syrup | | | 1041 |

The polysaccharide component is also 80% to 90% removed by refining; again, crystallization, char filtration, and affination are the most efficient removal steps. From the data in Table IV, a hazard in using sweet water as melter water should be noted: components removed by affination are added back again in melt sweet water, negating some of the usefulness of affination and recycling impurities.

It is apparent that refinery processes, although effective in removing protein and ISP, do not do so well enough to prevent floc formation. Methods for more complete removal have been studied in the laboratory. The floc-causing factors can be removed by centrifugation at 40,000 *g* for 30 minutes, by filtering thoroughly through a deep bed of filter aid at room temperature (20°C) (filtration above 60°C will not remove floc), or by treatment with weak-base anionic ion exchange resin (basic form) or strong acid cationic resin (acid form). None of these methods are, at present, practical in the refinery, though the ion exchange treatment has possibilities. With high-grade liquor, resins selected for optimum protein and ISP removal could have quite long cycles.

Another approach to floc prevention is under investigation. Rather than to remove the protein and/or ISP, it should be possible to keep one or the other in solution, electrostatically neutralized, so that aggregation and subsequent floc formation will not occur. Reagents for such a process are being investigated.

### *Conclusion*

Acid beverage floc, long a problem to cane sugar producers, refiners, and buyers, has been shown to be caused by the colloidal aggregation of a protein and a polysaccharide, both of which come from the sugar cane plant and remain in sugar in small quantities throughout processing. Floc can be removed by cold filtration, by centrifugation, or by ion exchange treatment, none of which are economically feasible at present.

Now that acid beverage floc and its causes have been identified, research efforts are directed toward finding a practical method either to remove its components or to prevent their formation into beverage floc.

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## APPENDIX

### Floc tests

There has been considerable controversy over the best test for floc or floccing potential in cane sugars. The tests that simulate beverage or syrup conditions are slow and require several days. The dye tests are more rapid, but these ("Alcian Blue" and "Basacryl Orange") are actually tests for polysaccharide; the dyes form complexes with negatively-charged polysaccharide, and show if that is present. These tests do not specifically indicate protein, however; therefore, if there is no protein present, or if the relative concentration of ISP and protein is not such as to permit floc formation, a positive dye test can indicate a floc problem where none exists. The dye tests can be considered tests for floc potential.

Studies in this laboratory have indicated that the "Low-Brix" or "Australian" test is the most reliable.

*Low-Brix Test* (Also called Australian Test or Beverage Test)

This test is essentially the preparation of a beverage, without carbonation or flavourings. 45 g sugar is dissolved in 200 cm³ distilled water, and 1 cm³ 30% w/v sodium benzoate plus 1 cm³ 10% v/v phosphoric acid are added. The solution is made up to 250 cm³ and allowed to stand for 10 days, after which it is examined for floc with a bright light beam. If floc is present, it will probably show up within 5 days.

*High-Brix Test* (Also called Coca-Cola Test)

1000 cm³ of 50°Brix sugar solution is prepared with distilled water, substituting 50 cm³ of formaldehyde for 50 cm³ of the water required, to prevent microbiological growth. Phosphoric acid (85%) is added to adjust to pH 2·0. The solution is examined daily in a bright light beam for 30 days; if floc is present, it will usually show up within 10 days.

*Alcohol Floc Test* (or ICUMSA Test)

There are various quantitative versions of this test, according to the specified procedures of individual alcoholic beverage companies. In all versions, ethanol is added to a high-Brix sugar solution to about 50% alcohol, and the mixture is examined in a light beam (usually 425 nm) for appearance of a floc or turbidity. This floccing or turbid material is the alcohol-insoluble material in the sugar.

*"Basacryl Orange" dye test*

The dye solution is prepared by adding 2 g of "Basacryl Orange FL" dye to 100 cm³ of distilled water. The mixture is stirred at room temperature for 30 min and then filtered or centrifuged to give a clear solution.

For the test, which is really a test for negatively charged polysaccharides, 100 g of sugar is dissolved in 100 cm³ of distilled water at room temperature, and 10 cm³ of the dye solution added. The pH of the combined solutions should be between 4·0 and 8·0. The solution is allowed to stand in a covered beaker for 6 hr (or overnight) at room temperature and the solution examined for floc in a bright light beam.

*"Alcian Blue" dye test*

Procedure A—for sugars with low floc potential.

200 g of sugar is dissolved in 400 cm³ distilled water and brought to a volume of 600 cm³. The polysaccharide is filtered from the sugar solution at room temperature, first through a 0·8 micron Millipore filter, and then through a 0·45 micron Millipore filter, used in series. The filters are washed copiously with water at room temperature, placed in a 250-cm³ beaker containing 25 cm³ water, and boiled, with swirling. The hot water extracts the polysaccharide, and is filtered hot through a 0·45 micron filter. To this filtrate, in a 250-cm³ beaker, is added 3 cm³ of "Alcian Blue" solution (prepared by dissolving 100 mg "Alcian Blue 8-GX" biological stain in 450 cm³ acetic acid and diluting to 500 cm³ with distilled water). The volume of the mixed solutions is reduced by evaporating to about 15 cm³. This solution is cooled, 30 cm³ *iso*-propanol added, and the mixture stirred slowly (magnetic stirrer) for 15 min exactly.

If no precipitate appears, the sugar is floc-negative. If a precipitate appears, it will be composed of the hot water-soluble, alcohol-insoluble, nonfilterable (below 0·45 micron diameter) polysaccharides and proteins in the sugar. "Alcian Blue" is a polysaccharide stain and will react with the polysaccharide(s) in the precipitate. The precipitate should be centrifuged out of solution, washed with *iso*-propanol until the washings are clear, and then dissolved in water and made up to 25 cm³. The absorbance is read at 620 nm, in a 5-cm cell.

Procedure B—for sugars with high floc potential

The procedure is as for A, up to the point where the hot water extract is collected. The extract is cooled, filtered through a 0·45 micron filter, and 2 cm³ of this filtrate mixed with 5 cm³ of anthrone solution in a test tube, and heated in a boiling water bath for 5 min. The anthrone solution is prepared by dissolving 160 mg anthrone in 100 cm³ of 2:1 sulphuric acid, and storing it in the dark. If a dark green or blue colour develops upon addition of the anthrone solution, there is soluble carbohydrate in the water filtrate. This filtrate should be no more highly coloured than a water blank, or the test is not valid.

The material remaining in the 0·45 micron filter is extracted with 20 cm³ of boiling water, mixed with 3 cm³ "Alcian Blue" solution, and treated as in Procedure A. The higher the absorbance reading, the greater the degree of floc.


### Summary

The various types of organic, inorganic, and microbial flocs and hazes that appear in bottled beverages containing cane sugar are defined, differentiated, and discussed.

Acid beverage floc and its properties are considered in detail. Its isolation and analysis are described. The origins of acid beverage floc are reviewed, the discovery of sugar cane polysaccharide and protein components that cause floc formation is presented, and the floc-forming mechanism is explained. Floc tests and potential methods for prevention or removal of floc are discussed.



**Le floc des boissons et le sucre de canne**

Les différents types de flocs et troubles organiques, inorganiques et microbiens qui apparaissent dans les boissons embouteillées contenant du sucre de canne sont définis, différenciés et discutés. Le floc des boissons acides et ses propriétés sont considérés en détail. Sa séparation et son analyse sont décrites. Les origines du floc des boissons acides sont passées en revue, on expose la découverte des polysaccharides de la canne à sucre et des composés protéiques qui provoquent la formation du floc et le mécanisme de la form-

ation du floc est expliqué. Les tests de détermination du floc et les méthodes potentielles de prévention ou d'élimination du floc sont discutés.

**Floc in Erfrischungsgetränken und Rohrzucker**

Die verschiedenen Typen organischer, anorganischer und von Mikroben verursachter Floc-Bildung und Trübungen, die in auf Flaschen abgefüllten Getränken, die Rohrzucker enthalten, auftreten, werden definiert, differenziert und diskutiert.

Floc in sauren Getränken und dessen Eigenschaften werden detailliert betrachtet. Die Isolierung und Analyse werden beschrieben. Es werden die Entstehung von Floc in sauren Getränken besprochen, Polysaccharid- und Protein-Komponenten vorgestellt und der Mechanismus der Floc-Bildung erklärt. Floc-Tests und mögliche Methoden zur Verhütung und Entfernung von Floc werden diskutiert.

**Floc en bebidas y azúcar de caña**

Los varios tipos de floces y calinas orgánicos, inorgánicos y microbianos que aparecen en bebidas embotelladas que contienen azúcar de caña se definen, se diferencian y se discuten. Se considera en detalle el floc de bebidas ácidas y su propriedades. Se describe su aislamiento y análisis. Los origenes de floc de bebidas ácidas se reseña, se presenta el descubrimiento de polisacaridos y componentes protéicos que causan formación de floc, y el mecanismo de esta formación se explica. Ensayos para floc y métodos potenciales para prevención o eliminación de floc se discuten. □

# The maximum economical distance to transport sugar cane

By L. V. GENTIL*, E. S. OMETTO† and H. C. ARRUDA†

*Introduction*

THE fall in the world price of sugar and the continuing low level of prices, in conjunction with the rise in the value of land and increased cost of fertilizers, pesticides, herbicides and fungicides, higher prices of machinery and greater financing costs, have made it imperative to achieve an improved technology. In the specific case of sugar cane, transport of cane accounts for 50% of the total mechanization costs. It is in this area that careful evaluation of technology is needed since there is room for decisions which may have a dominant effect on profitability.

Accordingly, this article constitutes an assessment of the maximum distance over which cane may be transported economically, be it by wagon, trucks, cane containers, bins, etc., using a functional methodology for our particular conditions at São Martinho sugar factory. Several technical papers have been published on this subject but the results may not be applied universally, since they do not particularize the exact conditions which may not exist elsewhere.

Accordingly, in this paper an example has been selected on the transport of cane to São Martinho sugar factory in Brazil using three-axle trucks of 15·5 tonnes net capacity with 130 h.p. engines and double traction in the second and third axles. This system, detailed in Table I, has become popular in Brazil because of its ready acceptance in the mill yard, its manoeuvrability and its good performance on hilly slopes and in muddy soils, and because of its capacity for working a large annual mileage with very low costs of spares and maintenance.

**Table I. Transport system used in the economic analysis**

| *Parameter* | *Specification* |
|---|---|
| Truck | Mercedes Benz 22 13 |
| Gross tonnage | 22 tonnes |
| Net tonnage | 15·5 tonnes |
| Total distance per season | 45,000 km |
| Average journey | 15 km |
| Total price of truck | US$31,467 |
| Topography | Lightly undulating |
| Soil | Clay |
| Usage intensity | 24 hr per day |
| Gross price of cane in the field ready for transport | US$9·2307 per tonne |

It has been found possible to examine factories in Brazil where cane is transported over distances greater than 60 km and where the methodology established by the authors may be applied.

*Materials and methods*

The determination of vehicle cost per kilometre for sugar cane transport was carried out on fleets of trucks engaged in rural activities and included fixed and variable costs. They may be summarized by the equation:

$$CK = \frac{CF}{X} + CVK \qquad (1)$$

where $CK$ is the cost per kilometre, $CF$ is the fixed cost during a period, $CVK$ is the variable cost per kilometre, and $X$ is the number of kilometres run during the period.

Supposing $PT$ is the gross price per tonne of harvested sugar cane in the field and $CT$ the cost of production of one tonne of cane, then the net profit per tonne of cane less transport costs ($LT$) is given by

$$LT = PT - CT \qquad (2)$$

Supposing $TV$ is the net tonnage carried by the transporter in one trip, we may derive in equation (3) below the maximum distance ($MD$) over which the cane may be transported economically. Also, this maximum economical transport distance represents the break-even point between sugar cane net profit and cost of cane transport. Since the transport distance involves an outward and return journey the factor of 2 must be used below the line, i.e.

$$MD = \frac{(PT - CT)\,TV}{2(\frac{CF}{X} + CVK)} \qquad (3)$$

The procedure for determining the maximum economical distance is as follows:

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(*a*) determine the monthly fixed cost per kilometre for the truck (*CF*)

(*b*) determine the variable cost per kilometre (*CVK*)

(*c*) determine the cost per kilometre for each of the following numbers of kilometres per month—2500, 5000, 7500 and 10,000 (*CK*)

(*d*) determine the cost, assuming net profit % of sugar cane ready for transport in the field to be 5%, 10%, 15%, 20% and 25%. The gross price for sugar cane in the field ready for transport is US$9·23 per tonne (*PT*)

(*e*) calculate the value of *MD* for each level of distance covered by the truck per month (2500 to 10,000 km) for each value of percentage net profit on sugar cane ready for transport in the field (5% to 25%).

**Table II. Form for determining costs per km of sugar cane transport**

*General specifications*

| | |
|---|---|
| Cane transporter | Driver's wages |
| Make | Social costs |
| Model | Transporter licensing |
| Manufacturer | Total life |
| Gross tonnage | Fuel consumption |
| Net tonnage | Insurance |
| Price | Washing |
| Interest | Tyres / Air lock |

*Monthly fixed costs:*

Depreciation (Price/Life in months)
Interest (Total interest/term)
Licensing and fees
Insurance
Driver's wages and social costs

*Variable costs per kilometre*

Spare parts and garage materials
Tyres/Air lock and services
Fuel
Crank-case oil
Washing and lubrication

(*f*) plot the data from (*e*) as in Fig. 1.

The amount and cost of servicing, spare parts required, driver's wages, annual distance covered, amount of fuel used, etc. were analysed on adequate samples for every condition of cane transport during the 1977 milling season for São Martinho sugar factory. The samples covered every type of terrain, cane load, distance, new and used engines, various truck adjustments and representative samples of fuel used. Table II indicates the factors investigated and the method used to determine the cost per kilometre for each vehicle, while Table III gives details of the calculations and results for São Martinho in 1977.

**Table III. Determination of costs per kilometre**

| *Monthly fixed costs* | US$ |
|---|---|
| Depreciation ($31,467/60) ............ | 524·44 |
| Interest ($31,467×0·22/12) ............ | 576·89 |
| Licensing and fees ........................ | 154·00 |
| Insurance ($31,467×0·05/12) ......... | 131·11 |
| Driver's wages and social costs...... | 320·00 |
| Total (CF) ................................ | 1706·44 |
| *Kilometre variable costs* | |
| Spare parts and garage materials ... | 0·0472 |
| Garage salaries and social costs ... | 0·0071 |
| Tyres, air lock and services ... ...... | 0·1182 |
| Fuel ............................................ | 0·0960 |
| Crankcase oil .......................... | 0·0024 |
| Washing, lubrication and servicing | 0·0123 |
| Total (*CVK*) .............................. | 0·2832 |

General equation: $CK = 1706{\cdot}44/X + 0{\cdot}2832$
where $X$ is the number of kilometres per month driven by the truck.

## *Results and discussion*

Sugar cane cultivation is associated generally with large plantations which involve long distances between the field and the factory yard. As sugar cane cultivation is extended to more distant areas it becomes necessary to appraise the transport systems employed and their suitability for the longer haulage distances.

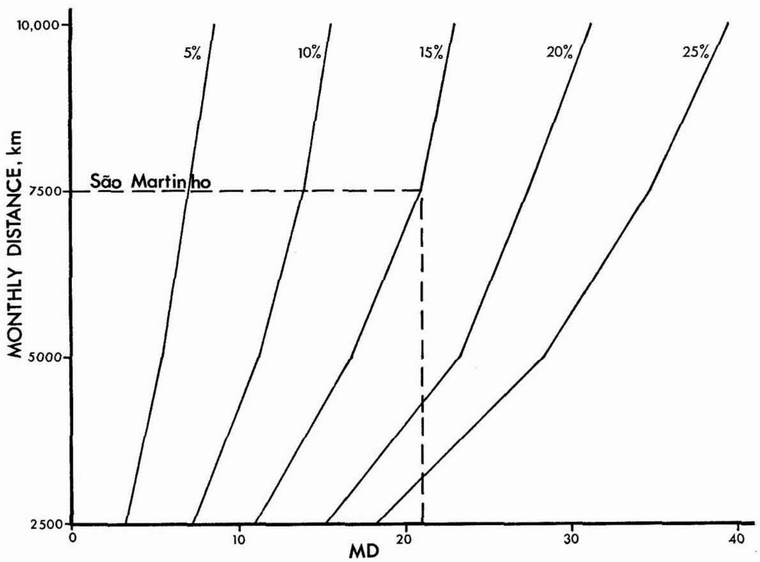


Fig. 1. Maximum economical distance in km (MD) as a function of profit (%) and monthly distance covered (km)

The equation which has been worked out indicates which parameters must be maximized and which must be minimized to achieve the most economical results. Thus, the maximum distance over which the cane has to be transported should be associated with the maximum possible tonnage in each transporter (i.e. the nominal net weight) as given by the manufacturer. Profitability of the transportation system will be maximal when the profit on each ton of sugar cane is also at its highest. In other words, the cane must be net cane, free from trash, soil, roots, etc.

On the other hand, the fixed costs per kilometre must be as small as possible so that the sugar cane transporter vehicle must have the most correct and efficient use. The study of the maximum economical distance will involve such distances as will either never or rarely be used in practice. Accordingly, by the use of equation (3) it is evident that, with improved administration, it is possible to transport cane from progressively further distances.

Fig. 1 shows the variation in the maximum distances of economical cane transportation with the two variables net profit on cane in the field and monthly transporting distance. The nearest and furthest transporting distances are 3·69 km and 39·11 km, respectively (2500 km/month and 5% profit, and 10,000 km/month and 25% profit, respectively). The specific example of São Martinho sugar factory in Brazil shows the maximum economical distance for transporting cane to be 21 km; this means that all cane transported for distances greater than 21 km produces losses in the economic performance of the mill.

## *Conclusions*

(1) From the preliminary data one may conclude that there is justification, in view of the instability of the international sugar market and the cost components of sugar production, for the study of the distance over which cane may be economically transported.

(2) A method is proposed for determining the cost per km of cane transport including fixed costs, viz. depreciation, interest, licences, insurance, and driver's wages, as well as variable costs, viz. spare parts, garage materials, garage wages and social costs, tyres, air lock and services, fuel, crankcase oil, washing, lubrication and servicing.

(3) The basic factors that determine the value of one tonne of sugar cane in the field after harvest are operational costs, administration costs, fixed and variable costs, land rent and the price of harvested sugar cane in the field as fixed by the Brazilian Government.

(4) An equation has been derived from which the maximum economical distance over which cane may be transported can be calculated. The use and application of this equation should be the basis on which management takes decisions with a view to reducing costs and increasing profitability.

(5) For conditions at São Martinho sugar factory the cost per kilometre has been calculated at $CK = 1706.44/X + 0{\cdot}2832$ US dollars per tonne and this has been used for calculation of the maximum economical distance *MD* from equation (3).

(5) The maximum economical distance at São Martinho is 21 km, the local conditions including a distance of 7500 km/month travelled by the truck and a net profit of US$1.3866 per tonne of cane in the field (15% of the official price of $9.2307 a tonne paid to the cane grower).

(7) Distances from field to factory for transporting cane without financial loss varies between 3·69 and 39·11 km, these limits corresponding to 5% profit and 2500 km/month and 25% profit and 10,000 km/month, respectively.

## *Literature*

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## *Summary*

The need for analysis of cane transport costs to determine the maximum distance from which cane may be brought economically to a sugar factory is discussed. The factors governing this distance are tabulated and calculations are given for São Martinho sugar factory in Brazil as an example for application of the method for other cases.

### La distance économique maximale pour le transport de la canne à sucre

La nécessité d'analyser les frais de transport de la canne, en vue de déterminer la distance maximale à partir de laquelle elle peut être amenée économiquement à une sucrerie, est discutée. Les facteurs qui influencent cette distance sont groupés sous forme de tableau et on décrit une méthode pour la déterminer. Des calculs sont donnés pour la sucrerie de São Martinho au Brésil, comme exemple d'application de la méthode à d'autres cas.

### Die maximale wirtschaftliche Entfernung für den Zuckerrohrtransport

Diskutiert wird der Vorteil einer Zuckerrohr-Transportanalyse zur Ermittlung der maximalen Entfernung, bis zu der es wirtschaftlich ist, Zuckerrohr zu einer Zuckerfabrik zu transportieren. Die Faktoren, die diese Entfernung beeinflussen, werden aufgeführt, und es wird eine Methode beschrieben, diese zu bestimmen. Die Berechnungen werden für die Zuckerfabrik São Martinho in Brasilien durchgeführt als Beispiel für die Anwendung der Methode auf andere Fälle.

### La distancia económica máxima para transportar caña de azúcar

Se discute la necesidad de analizar los costos de transporte de caña para determinar la distancia máxima de que es posible transportar ecónominamente caña de azúcar a un ingenio. Los factores gobernando esta distancia se presentan en forma tabular y un método se describe para determinarla. Se incluyen calculaciones para Usina São Martinho, en Brasil, como ejemplo para aplicación del método en otros casos. □


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# SUGAR CANE AGRONOMY

**Uptake and utilization of P and K by the sugar cane crop.** S. V. Parthasarathy and B. Krishnan. *Sugar News* (India), 1977, **8**, (12), 11-14.—The soils of Kattur factory zone are rich in P and K and trials showed that, while extra N increased cane yield, cessation of P and K did not affect it.

**Improved cane cultivation techniques and management of the ratoon crop.** R. S. Kanwar. *Sugar News* (India), 1977, **8**, (12), 15-18.—A survey is made of improved techniques in respect of planting of setts and pre-germinated shoots, use of immature seed cane and application of fungicide to improve germination, hot air treatment of setts for ratoon stunting control, seed cane multiplication, sett size, rate and interrow spacing as well as chemical weed control, use of gamma-BHC for pest control, ratoon management, use of chemical ripeners and autumn planting for higher sugar recovery.

**The feasibility of intercropping of rabi crops in autumn-planted sugar cane.** K. L. Behl and S. S. Narwal. *Indian Sugar,* 1977, **27**, 23-26.—Results of trials in 1973-74 showed that all intercrops reduced cane yield by comparison with cane alone, low-growing crops having less effect than taller crops. There was wide variation in intercrop yields, the highest being sugar beet, followed by onion, after which there was a sharp fall to the third highest yielding crop, garlic. On the other hand, onion and garlic had the smallest effects on cane yield, so that, where good irrigation facilities are available, it is recommended to plant three rows of either onion or garlic between the cane rows, which should be 90 cm apart.

**Cane planting and varieties in US.** L. L. Lauden. *Sugar Bull.*, 1977, **55**, (20), 4.—It is pointed out that frequently farmers make mistakes in cane planting which a little more care could have prevented. Excessive soil cover of cane is particularly to be avoided, care being needed especially on light soils, while cutting of the seed cane also requires care in order that cane is planted and not tops. Success has been achieved by one farmer using double-row planting of cane 18 inches apart in a 6-ft row—research has shown a 15% increase in cane yield by this means, and it is possible to use conventional harvesters in such fields. There is limited choice of cane varieties available to US growers, and of those mentioned some are not recommended by the author.

**Planting in double rows.** G. Collie. *Producers' Rev.*, 1977, **67**, (7), 53-54.—A Queensland cane farmer, Mr. D. Clifford, has adopted double-row planting on 31 ha of his land. Although an increase in yield was expected as one of the major advantages of the changeover, Mr. Clifford considered the system to be of benefit in other ways also, e.g. better utilization of the fertilizer (the amount applied was the same as with single-row planting), a reduction in cultivation time because of 20% fewer rows of cane per unit area, and a fall in the amount of ground to be covered in chopped cane harvesting. It is thought that the system could also be advantageous in wet harvesting; with single rows, the stools tend to get pushed and dislodged by harvesters and transport on wet ground, whereas two rows close together should act as a buffer and help keep the stools in place, while the closeness of the rows to each other should contribute to a reduction in lodging of mature cane. Disadvantages of double-row planting include a 50% increase in the quantity of planting material for the same area, and hence a lower planting rate. Mr. Clifford has had few difficulties in adapting machinery to the new system; apart from buying a new special planter, he has developed his own machine for cultivation and fertilization of the plant crop—it is 180 cm wide and straddles the twin rows. Harvester modifications are planned but will be simple, and harvesting is not expected to present any problems. While the change has been from single rows 145 cm apart to two drills 50 cm apart on 180 cm row centre distances (fertilizer being applied only outside the double row), Mr. Clifford is considering increasing the inter-drill distance to 60 cm to allow one cultivation and fertilizer application in the centre, particularly for ratoon crops. Of his 119 ha assigned to cane, 55 ha was to be devoted to double-row planting by the end of 1977.

**Effect of system of planting and rates of nitrogen on the yield and economics of autumn-planted sugar cane with intercropping of dwarf wheat under Kanpur conditions.** K. S. Rathi and H. N. Tripathi. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India,* 1976, (I), Ag.1-Ag.4.—In a 2-year field trial on sandy loam soil of medium fertility, planting of cane in single rows 90 cm apart gave lower yield but was more profitable than planting in double rows 30 cm apart with a 90-cm skip between the double rows. Three rows of dwarf wheat were grown in the 90-cm space, and both grain and straw yields of the wheat were lower with double-row planting. While 180 kg N per ha proved the most profitable in terms of cane, calculation of net profit using a regression equation showed that maximum profit would be obtained with 137·64 $kg.ha^{-1}$ N. N application rate differences had less effect on the wheat.

**Effect of soil application of gamma-BHC for improving the nitrogen efficiency in sugar cane. II. Yield of sugar cane and sugar, juice quality, nitrogen uptake and efficiency.** S. Thangavelu, E. Lalitha and K. C. Rao. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India,* 1976, (I), Ag.5-Ag.8.—A 3-year replicated field trial was carried out to determine the effect of gamma-BHC pesticide, applied at the rate of 1 kg a.i. per ha, on N uptake and efficiency. While N efficiency was lower in the presence of gamma-BHC and fell with increased application rate (200 and 300 $kg.ha^{-1}$), N uptake was increased by the pesticide which, however, did not cause any appreciable increase in cane yield or quality.

**Effect of different dates of planting on sugar cane.** R. S. Dixit. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India,* 1976, Ag.9-Ag.12.—While the germination percentage rates of three cane varieties in a trial was higher after March planting than after October or January planting, the yields were higher after October planting than after January or March planting. The yield of Co 1148 was significantly higher than that of BO 17 and CoS 510.

**Effect of nitrogen, phosphorus and potassium on yield and juice quality and economics of application in sugar cane in Uttar Pradesh.** M. L. Agarwal, S. P. Dua and M. Dayal. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), Ag.25-Ag.32.—Results obtained with N, P and K application in a permanent trial at Shahjahanpur in the period 1940–62 are tabulated and the effects on cane yield, juice quality and c.c.s. discussed. As regards the economics of cane and sugar production, 112·2 $kg.ha^{-1}$ N was more profitable than no application or 224·4 $kg.ha^{-1}$, while P and K application was generally unprofitable at both rates tested (84 and 168 $kg.ha^{-1}$).

**Higher sugar recovery by maturity-wise cane supplies in sugar factories of Uttar Pradesh during the 1975–76 season.** A. P. Gupta. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India,* 1976, (I), Ag.48–Ag.58.—Pre-harvest maturity testing was introduced in 23 sugar factory areas of Uttar Pradesh in 1975–76, and harvesting scheduled so that factories received only commercially mature cane. While it has been impossible to determine accurately the effect of the scheme on sugar recovery, it is suggested that an increase of at least 0·5% in sugar yield has resulted. The results achieved at the factories are tabulated and discussed by region.

**Soil and foliar diagnosis in sugar factory laboratory for determining macro and micro nutrients required for sugar cane growth.** P. J. M. Rao. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India,* 1976, (I), G.81-G.98. See *I.S.J.*, 1978, **80**, 15.

**Implications of green cane harvesting.** Anon. *Australian Sugar J.*, 1977, **69**, 199, 236.—A study group, formed in accordance with the recommendations of the Sugar Industry Review Committee in Australia, travelled to a number of cane-growing countries in 1977 to observe green cane harvesting practices and evaluate their advantages and disadvantages by comparison with burnt cane harvesting, as well as investigate pest and disease problems associated with green cane harvesting and, with sugar manufacturers, to discuss sugar quality problems that could result. The conclusions of the study group are presented and recommendations listed. It was considered likely that widespread harvesting of green cane in the northern wet zone of Queensland would be accompanied by problems created by the New Guinea beetle borer, which reduces sugar yields and adversely affects juice quality. Since the pest is always present in small numbers in north Queensland fields despite cane burning, it is felt that it will be a constant potential problem. Green cane processing would not present difficulties, provided there was no increase in extraneous matter. The absence of infection by *Leuconostoc mesenteroides* associated with stale burnt cane would permit improvements in processing and raw sugar quality; however, appreciable losses would still occur if excessive delays occurred between harvesting and crushing, although they would not be to the same extent as in burnt cane. (Reducing sugars are the main deterioration products in green cane.) Raw sugar colour should not be any greater with green cane processing, but only if the extraneous matter (particularly leaf trash) was on the low side; otherwise, both sugar colour and filtrability would suffer.

**Factors affecting cane quality and its effect on processing parameters.** A. P. Gupta. *Sugar News* (India), 1977, **9**, (1/2), 35–44.—Factors affecting cane ripening and processing quality are discussed individually, and include: variety; superiority of ratoons over plant cane when crushed early in the season; soil type and moisture content; weather (particularly rainfall and temperature); fertilization; irrigation; drainage; agricultural practices such as earthing-up and "propping" of the cane clumps to prevent lodging, and detrashing to prevent damage by scale insects and mealy bugs; lodging; pests and diseases; crop age; flowering; harvest scheduling on the basis of cane maturity; post-harvest control to reduce cane deterioration, and cane burning. Mill performance and its effect on losses in bagasse, filter cake and final molasses are discussed.

**Manuring of sugar cane in Uttar Pradesh.** K. Kar. *Sugar News* (India), 1977, **9**, (1/2), 57–60.—Studies on N, P and K application to cane in UP are reported. The effects on cane yield and quality as well as sugar content of each nutrient are discussed as well as the economics. Differences found in the effects according to the type of rotation and pre-cane crop are noted.

**Weed control in sugar cane with pre- and post-emergence herbicides.** D. J. C. Singh, K. M. Gupta and S. R. Chari. *Sugar News* (India), 1977, **9**, (1/2), 61–64. A list is given of weeds found in cane fields in India and trials with eleven herbicides carried out in 1976–77 are reported. Best of the pre-emergence herbicides was "Lasso" at 14·2 $litres.ha^{-1}$ (which gave 62% germination and a yield of 76·64 $tonnes.ha^{-1}$ at a sucrose content of 16·96% compared with respective values of 52%, 73·46 $tonnes.ha^{-1}$ and 15·5% in the untreated control). This was followed by "Lasso" at the same dosage rate plus "Atrataf" at 5 $kg.ha^{-1}$, while "Atrataf" on its own came third. Of the post-emergence treatments "Gramoxone" +"Fernoxone" (2·47 $litres.ha^{-1}$+3·75 $kg.ha^{-1}$) in two applications gave the highest yield of all treatments (76·853 $tonnes.ha^{-1}$), while germination was 59% and sucrose content 15·78%. Hand weeding gave 59% germination, 63·49 tonnes of cane per ha, and a sucrose content of 15·38%.

**Why this sheath moisture?** S. V. Parthasarathy. *Sugar News* (India), 1977, **9**, (1/2), 65–70.—The author stresses the importance of determining the cane leaf sheath moisture content as an indication of cane growth and quality; he gives recommended sheath moisture levels for maximum growth rate and harvesting, but emphasizes that regulation of irrigation will not in itself control the level, which is largely governed by internal factors and to only a very limited extent by soil moisture. The question of nitrogen uptake, storage and assimilation is examined, and the point made that generally there is little need for P and K application to cane in India, where tests have shown the soil to contain adequate amounts of these two nutrients. Advice is given on adjustment of N application rate in conjunction with irrigation so as to provide ideal growth and maturation while maintaining juice quality and sucrose content at maximum levels. The need to minimize the quantity of unassimilated N in the leaf blade at harvest time is underlined.

# SUGAR BEET AGRONOMY

**Group harvesting means improved planning and easier decision making.** D. Charlesworth. *British Sugar Beet Rev.*, 1977, **45**, (3), 15-16.—Information is given on a Norfolk harvesting group which operates eight different group schemes with 28 members growing peas, beans and sugar beet (the last on 202 ha). The beet group comprises nine members, all of whom must drill to the same row width of 46 cm, six rows at a time. A harvesting programme is drawn up by early September, the headlands being handled first to allow all members an early start. The group owns a three-stage Moreau lifter-topper-loader type harvester, while tractors and trailers are owned by the individual members. The complete programme is carried out by the same six men—three harvester drivers and three trailer operators—from start to finish. Haulage of the beet is carried out by a contractor. Tops are windrowed into six rows; four dairy farmers in the group utilize their tops as cattle feed, three other members sell their tops to them if required, while the other two plough the tops in as green manure. Harvesting rate is usually between 4 and 6 ha per day, the higher figure being achieved under very good conditions. All machinery repairs are undertaken at the farm workshop of the group's chairman.

**A further development on skid guides for harvesters.** H. T. Breay. *British Sugar Beet Rev.*, 1977, **45**, (3), 24. A 3-row skid guide system of the type previously described[1] was developed for a Standen "Multibeet" harvester of the lifter-loader type. Tests were conducted in mid-summer on a hard and dry soil in which beets had remained unharvested from the previous campaign. Results showed that, provided the tractor stayed between the correct rows and did not cross over to the next row, the skid guides kept the lifting wheels perfectly aligned but did not snap off any beet when guiding the machine down the row. As a result, the harvester manufacturers have decided to build an initial fifty 3-row sets.

**Seedbed preparation and drilling: tackling the problem of Norfolk's lighter soils.** W. Knowles. *British Sugar Beet Rev.*, 1977, **45**, (3), 29.—A Norfolk farmer has developed a hydraulically-operated roll to help acquire a firm, level seedbed where problems have usually arisen because of the lightness of the soil. The roll is attached to the front of a tractor and runs between but slightly forward of the wheels, while a Dutch harrow is pulled behind the tractor. In two passes, the complete outfit provides a seedbed with application of very even pressure to the soil. A modification to a beet drill is also briefly described, which is aimed at eliminating capping by partly covering the seed pellet with a lightweight coverer bar attached directly behind the coulter; the press wheel following the bar pushes soil around the pellet, while a further V-shaped coverer bar at the rear of the drill fills in the remainder of the furrow, leaving the surface slightly rough and unpressed.

**Beating the blow.** M. A. Palmer, J. Armstrong and D. H. E. Rope. *British Sugar Beet Rev.*, 1977, **45**, (3), 30-31. Information is given on the technique adopted to prevent wind erosion in the Peterborough factory area, where rye is drilled across the direction of the beet rows in November with the aim of obtaining optimum growth to coincide with the optimum beet drilling time (in practice, however, beet drilling has to be advanced or postponed). The rye is then killed, the tillers and stems providing adequate crop protection. Disadvantages are that the rye is drilled when beet is being harvested, control of perennial weeds and wild oats is difficult, and there is need for flexibility in farming to manage both the rye and beet. Although the system had proved successful on a farm in Nottinghamshire/Lincolnshire, it was decided to try another method in view of the rising costs of rye seed and chemicals. The method used is application of salt to the soil at the rate of 502 $kg.ha^{-1}$, followed by ploughing and then rolling (preferably on a very wet day, but after a few dry days so that the soil profile is not saturated to the full ploughing depth). The result is the formation of clods on the soil surface. A 17:8:22 N:P:K compound fertilizer is applied at the rate of 700 $kg.ha^{-1}$ at least 3 weeks before beet drilling, and the seedbed is obtained by a single pass with a spring-tine cultivator working slowly at right angles to the intended direction of drilling and to a depth of 15-17 cm so as to avoid excessive ridging and shattering of the clods. After drilling and band spraying with "Pyramin", overall post-emergence herbicide application is necessary, since tractor hoeing is unpractical on such a soil. The beet yield on 10 ha subjected to the treatment was slightly greater, at 50 $tonnes.ha^{-1}$, than the average for the beet area on the farm, and wind damage has been completely prevented, in contrast to headlands where the seedbed was obtained with a Dutch harrow. A number of other methods of preventing wind erosion are also considered; it is pointed out that the requirement is for a method which is simple and needs little special equipment. One new method suggested is sowing of wheat in the winter at 50 cm centres, using a precision drill with all the drilling elements moved over half a row width so as to allow the seed to fall in the tractor wheel marks. In the spring the units would be moved back to the normal drilling position and the rows of winter wheat used as markers. The advantage over winter-sown rye is that winter wheat may be drilled until mid-February and thus provide a greater time span.

**Time-saving: the essential element in 3-row harvesting.** P. Goad. *British Sugar Beet Rev.*, 1977, **45**, (3), 39, 45.—The author discusses operation and advantages of the Standen "Multibeet" two-stage, three-row beet harvester.

**A simple weeder for inter-row control.** B. Farrow and D. S. Parry. *British Sugar Beet Rev.*, 1977, **45**, (3), 44. A weeder is described which is cheap and simple to construct from materials to be found on most farms. The aim is to provide a means of dealing with weeds such as chickweed, mayweed and annual nettles between beet rows in wet springtime. Tines uncover the roots of the weeds and lay them on the surface where they are more easily destroyed. The weeder is mounted on the track eliminator bar behind the rear wheels of a tractor.

[1] Breay: *I.S.J.*, 1977, **79**, 288.

# BEET PESTS AND DISEASES

**Possibility of reducing losses caused by cercosporosis in sugar beet.** A. Codrescu. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 31-34 (*Rumanian*). Tests are reported in which suspensions of *Cercospora beticola* spores were applied to soil, and the extent of infection of beet grown in the same soil determined after application of various fungicides. Further tests conducted during 1971-1976 are reported, in which four fungicides ("Benlate 50", "Topsin M 70", "Derosal 60" and "Brestan 60") all reduced infection and increased beet and sugar yield by comparison with untreated controls. The last-named fungicide varied widely in its effect, but the other three are recommended at 300 $g.ha^{-1}$, application being made in 2-3 stages (1-2 in the case of unirrigated beet) 2-3 weeks apart, the first being made shortly after sowing.

**Aspects of the dynamics of occurence and control of the beet weevil** (*Bothynoderes punctiventris*). V. Ciochi and D. Mustatea. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 35-39 (*Rumanian*).—*B. punctiventris* occurs primarily in a well-defined region of southern Rumania; its existence is favoured by growing of maize after beet and by *Cirsium* sp. (thistle) acting as alternative host. Laboratory tests on chemical control of the pest showed that "Miral EC 500" at 2 $litres.ha^{-1}$ killed more than 96% of the weevils 72 hours after application. Optimum conditions for application in the spring are a temperature of 21°C and 60-65% relative humidity. Also effective was a suspension of *Beauveria bassiana*, which gave 100% mortality 6 days after application (the dosage rate is not quoted) and might, it is considered, prove highly suitable for reducing the biological reserve of the pest in irrigated areas.

**Combating yellows.** Anon. *Le Betteravier Franç.*, 1977, (316), 18 (*French*).—After five years of moderate attacks, in 1974 virus yellows reached severe proportions (40% infection) but since then has been reduced (to 7% in 1976). In 1977 climatic conditions did not favour the disease, although the aphid vectors were found in certain areas of France, and the disease did occur. The recommended treatments where infestation occurs are reprinted as well as precautionary measures.

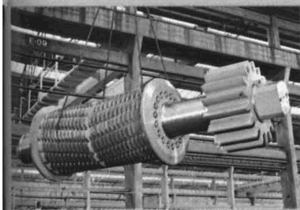
**The occurrence of highly virulent strains of the beet curly top virus in California.** A. C. Magyarosy and J. E. Duffus. *Plant Disease Reporter*, 1977, **61**, 248-251. Tests on isolates of the curly top virus collected during 1974 and 1975 from field beets and weeds in the foothills of the San Joaquin Valley indicated that the isolates have a higher degree of virulence than those found in the 1950's and 1960's. Strains of increased virulence are apparently evolving both in the foothill breeding grounds and in the agricultural areas. The hypothesis that severe isolates tend to be self-eliminating in the breeding grounds does not seem valid.

**Root rot of mature sugar beets by** *Rhizopus arrhizus*. M. E. Stanghellini and W. C. Kronland. *Plant Disease Reporter*, 1977, **61**, 255-256.—In two areas of Arizona in July 1976 about 60% of a 6-month-old beet crop exhibited crown die-back, a foamy exudate from the crowns of these plants and internal decay of the tap root. Isolations were identified as *R. arrhizus*, previously known to cause rotting in stored beet but not field beet, and the isolates produced the same symptoms when inoculated into healthy beet. There had been infestation of a tortricid leaf roller, *Platynota* sp., in the two areas, and the wounds made by its feeding may have permitted penetration of the fungus.

**Sugar beet powdery mildew.** W. J. Byford. *British Sugar Beet Rev.*, 1977, **45**, (2), 43-44.—This disease, more important in hotter countries than the UK, was thought not to be sufficiently damaging to warrant control measures, since it had become prevalent mainly in August and September. However, it has been detected in recent years earlier in the growing season, and experiments indicate that its control could raise the root yield by 3·3 $tonnes.ha^{-1}$. Trials conducted in 1976 showed that sulphur gave the best control when applied at 11·2 $kg.ha^{-1}$; "Benomyl" gave almost as good control, while "Ethirimol" was less effective. If the crop is sprayed in late July or early August, a second sulphur spray after 2-3 weeks may also be profitable.

**Can beet nematodes be controlled in catch crops?** -. Garburg and -. Scherfenberg. *Die Zuckerrübe*, 1977, **26**, (5), 11-12 (*German*).—It is stated that the beet nematode is a typical soil-borne pest which multiplies to a considerable degree only with increased cultivation of host plants in the rotation. Hence, theoretically the simplest and most successful means of control would be a year's break in the rotation after each crop—this would reduce the number of cysts by some 13% and the larvae by about 40%. On the other hand, since even after a 8-10 years' interval between beet crops there would still be a small residual infestation of the soil, resumption of beet growing would be accompanied by a very rapid increase in nematode incidence. The authors suggest a 4-year rotation in preference to a 3-year system, since the latter is considered too restricted, especially where conditions in black earth favour a much shorter development time for the pest, e.g. 25 instead of 57 days. Of catch crops which are suitable for soil improvement, etc. before a beet crop, many are good nematode hosts. Tests on nematode control in summer and winter rapeseed using "Vydate" showed that migration of larvae to plants in the autumn was greatly reduced but by no means completely prevented; in fact, the beet in the subsequent crop were considerably more infested than were plots in which no rapeseed had been grown.

**Conversion reduces chemical wastage on old bandsprayer.** Anon. *British Sugar Beet Rev.*, 1977, **45**, (3), 33.—Details are given of the conversion of a 10-year-old bandsprayer, the cone spray-type nozzles on which were replaced with "TeeJet" spray nozzles and diaphragm check valves installed to improve spray coverage, reduce wastage of chemicals and permit operation of the rig in windy conditions (previously impossible). Now, only wet ground conditions prevent operation of the unit.



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# CANE SUGAR MANUFACTURE

**Developments in steam turbines for the sugar industry.** S. V. Wildman. *Proc.* 51*st Congr. S. African Sugar Tech. Assoc.*, 1977, 137–142.—Demands for higher outputs have been met by careful tailoring of steam turbines for both mechanical and electrical power generation to meet the needs of thermal efficiency and reliability at an economical cost. Major system components and the methods chosen for speed control are described. Important operational requirements are featured.

**Experience with mechanical draft cooling towers in injection water service.** R. Morgan. *Proc.* 51*st Congr. S. African Sugar Tech.*, 1977, 156–163.—Mechanical draft cooling towers should show advantages on economic, space and environmental grounds over spray ponds provided they perform close to specification; this is, however, not always the case. Factors affecting the specification for a cooling installation are discussed, as are the factors affecting water circulation rate and the operation of cooling towers. Methods of evaluating tower performance include a fundamental approach and an empirical approach, both of which are discussed. Biological and corrosion considerations affecting the choice of packing material and design are described, with notes and illustrations of five designs.

**The limitations imposed on crushing rate by tops and trash.** R. P. Scott. *Proc.* 51*st Congr. S. African Sugar Tech. Assoc.*, 1977, 164–166.—The fibre content of clean cane stalks has been found to vary in supplies to Hulett sugar factories from 10·9% to 16·7% and averages 12·8%. The fibre in cane tops varies from 1·07% to 31·2% and averages 16·6%, while that in trash varies from 28·3% to 82·7% and averages 58·6%. Consequently, the presence of tops and trash in cane means a higher fibre in gross cane and, it has been supposed, causes a reduction in cane milling rate as reported in 1949 by a South African committee of investigation. The effects of tops and trash have been investigated under modern conditions, and it has been shown that trash does, in fact, have a highly significant effect in reducing crushing rate and fibre throughput. Tops, on the other hand, appeared to have no influence. From regression equations developed it is concluded that reduction of trash % cane by 1% will permit a 3% greater throughput so that provision of clean cane can reduce the length of the milling season.

**Flangeless top rollers at Tongaat.** J. A. P. Jacquelin. *Proc.* 51*st Congr. S. African Sugar Tech. Assoc.*, 1977, 167–168.—Flanges on the top rollers are a high-maintenance item because of buckling when flange bolts break, and it was decided to fit stationary side plates to an intermediate mill to see if they would serve the purpose of retaining cane between the rollers without excessive wear (as did the side plates surrounding the flangeless rollers of the pressure feeders). The installation was a complete success, with very minor mechanical problems and easily repaired wear at the high-compression area next to the roller gap. Drainage was improved, and the remaining mills in the tandem are also to be modified.

**A study of optimum conditions of raw sugar bulk storage and incorporation of possible changes in its manufacturing technology.** A. F. Zaborsin, N. V. Kostenko, S. A. Brenman and J. Lodos. *Sakhar. Prom.*, 1977, (8), 28–30 (*Russian*).—Among items discussed at a meeting on Soviet-Cuban scientific and technical co-operation in 1969 was raw sugar deterioration in storage —a problem of major interest in view of the large quantities of Cuban raw sugar exported to the USSR. Following the discussion, a programme was set up for investigation of the factors involved in bulk storage, and results of many of the studies have already been published. Particular mention is made of spontaneous heating of stored sugar in an unheated warehouse as a result of bacterial action; the greatest fall in sugar quality has been found to occur in the lower layers of the middle section of a large pile of sugar (greater than 2000 tonnes) stored under such conditions. Low temperatures and high pH values reduce the rate of sucrose degradation and thus diminish losses and colour increase in the sugar. To achieve a pH near to neutral, a modification to sugar curing has been introduced whereby the sugar is washed with alkaline solution, e.g. sodium carbonate, in the centrifugal. This has resulted, in factory tests, in deceleration of sugar deterioration and a colour content two-thirds lower than in stored sugar which had not been treated. Investigations have also continued into conditioning and cooling of raw sugar before storage.

**Empirical formula for estimating $CO_2$ absorption in the continuous carbonatation process.** C. H. Chen, Y. C. Cheng and J. F. Tong. *Rpt. Taiwan Sugar Research Inst.*, 1977, (76), 73–88 (*Chinese*).—On the basis of 110 sets of experimental data, two equivalent formulae were derived, one being $P = 40 \left(\frac{H}{D_o + 0{\cdot}06D}\right)^{0.15} \left(\frac{N_{CaO}}{N_{CO_2}}\right)^{0.5}$ where $P$ is the % $CO_2$ absorbed, $H$ is the height of sugar solution (cm), $D_o$ is the orifice diameter (cm), $D$ is the carbonatation vessel diameter (cm) and $N_{CaO}$ and $N_{CO_2}$ are the numbers of moles of CaO and $CO_2$ consumed in unit time. The second equation is $Q$ (moles of $CO_2$ absorbed in unit time) $= P \times N_{CO_2}/100$. The formulae have pH limits of 9·2 and 11·2, but within this range give values less than 10% outside actual operating data from a sugar factory. They are therefore considered suitable for design work.

**Review of performance of (Mauritius) sugar factories in 1976.** J. Tursan d'Espaignet. *Rev. Agric. Sucr. Maurice*, 1977, **56**, 27–33.—A general account is given of the 1976 season which was abnormal in several respects. Excessive temperatures and rainfall contributed to a record cane production but also to subnormal cane quality. Factories started crushing early in anticipation of the large crop, but supplies were unable to permit continuous crushing, and the industry lost an average of 4·01 hours per day through lack of cane. New and modified systems and equipment at several factories are discussed individually; these include adoption of the Hilo cane handling system at Riche-en-

Eau, introduction of chopper-harvesters for the first time in Mauritius, use of a semi-Kestner evaporator at Union St.-Aubin and rationalization of high-grade boiling at St.-Antoine. Cane preparation in the factories is discussed—it compared unfavourably with that in Australia and South Africa—and reasons for marked improvement in extraction by the "Saturne" diffuser at St.-Antoine are indicated. There were some problems with clarification, particularly where much soil was brought into the factory with mechanically loaded cane. Problems were also encountered in two factories where the "Rapifloc" system of filtration had been adopted. Sugar quality has met required standards except temporarily when factories have had clarification problems. Tests have been made of a heat-stable bacterial enzyme which successfully eliminated starch from mixed juice and could be useful if starch became a problem in the future.

**Report of a delegation from Mauritius Society of Agricultural and Sugar Technology to Réunion.** J. D. de R. de St. Antoine, J. Leclezio and J. Tursan d'Espaignet. *Rev. Agric. Sucr. Maurice*, 1977, **56**, 34–41 (*French*).—The report is presented of a mission by the authors, representing the Mauritius Society, to study the latest developments in the Réunion sugar industry, particularly in the reception and preparation of cane so as to cope with problems arising out of mechanical harvesting and loading, the Langreney continuous pan, and the methods and equipment used to improve mill imbibition efficiency. Other aspects inspected included mud filtration at La Mare, a continuous FCB centrifugal at Quartier Français, a rum depot, an animal feedlot, etc.

**Cut, chopped and loaded sugar cane in the light of industry.** F. O. Brieger. *Brasil Açuc.*, 1977, **89**, 331–336 (*Portuguese*).—To be ideally suitable for sugar extraction, cane supplied to the sugar factory should be mature, fresh and clean, and the meaning of these criteria is discussed. The advent of the chopper harvester with trash separation by blowers has given the opportunity of supplying clean cane of higher density than whole-stalk cane, thus requiring less power to transport and prepare for milling. The problem of wash water disposal is also eliminated. Burnt chopped cane can give a 5% higher industrial yield than burnt and washed whole-stalk cane. Attention must be paid, however, to maintenance of a normal blanket thickness, and use of a shredder is recommended. With normal working conditions, juice quality from chopped cane and whole-stalk cane is identical, but it is important to see that there is no more than 24 hours' delay between harvesting and milling.

**Towards a higher velocity and efficiency in the production of raw sugar.** J. Treto and O. J. Marrero. *ATAC*, 1977, **36**, (2), 20–25 (*Spanish*).—Improvements in factory operation have been brought about in five older factories in the Holguín area of Cuba by modifications to plant which include installation of a deflector to aid condensate extraction from Webre-type juice heaters, semi-sealing of the trays of Pearson clarifiers, improving mud mixing with bagacillo and feeding to the rotary filters, use of ejectors and better incondensables removal from evaporators, use of the Claassen pan feeding system, conversion of crystallizers to continuous flow, and increase in the pH of *A*- and *B*-molasses with alkali to reduce sugar loss.

**The influence of the temperature on the pH of clarified juice and syrup.** I. Díaz, B. Descalzo and R. Caro. *ATAC*, 1977, **36**, (2), 30–34 (*Spanish*).—Samples of juice clarified in the laboratory were studied, the pH being measured at 30° and 100°C. From an initial value between 7·2 and 7·7 the pH fell by 0·4–0·5, corresponding to a value of 0·006–0·007 units.$°C^{-1}$ for $\Delta pH/\Delta T$. With industrial clarified juices, samples of low pH (6·1–6·5) showed increases of 0·2 units in pH over the same range of temperature, whereas juices of higher pH (up to 7·6) showed falls. Similarly, syrup samples of pH 6·6–6·9 showed falls of 0·3–0·4 pH between 30° and 100°C. Measurements at intervals of 5°C showed that the falls were stepwise, indicating that they may be due to chemical changes, which could be the reason for variation of the rate of fall for material of different composition.

***Influence of mechanization of the harvest on the* manufacture of raw sugar.** J. García L., O. Quiñones and M. A. Paneque. *ATAC*, 1977, **36**, (2), 38–43 (*Spanish*). Analysis of data accumulated during 1972–76 demonstrates that mechanical harvesting of cane and pre-harvest burning affect processing, in particular resulting in a higher molasses production. Since mechanization is vital to maintain proper rhythm in the harvest, it is thought necessary to adjust the factory equipment and processes (including the addition of alkali to *A*- and B-molasses to raise the pH) in order to cope with the changed situation. Recommendations for such adjustments and changes are listed.

**Evaluation of methods of cleaning heaters and evaporators.** E. Leon, E. Casanova and M. Morales. *ATAC*, 1977, **36**, (2), 54–65 (*Spanish*).—Tests have been made on the two-stage alkali/acid cleaning and alkali and inhibited acid methods of cleaning of heater and evaporator scale, in respect of both removal and corrosion. Use of alkali alone was least effective for the scales encountered, while the two-stage treatment gave as good results as acid alone. The amount of scale affects the results of the cleaner, and control of clarification to minimize scaling is important. Corrosion by acid of 2–6% concentration is high and use of an inhibitor (distillery must is suitable) is essential, while more work is needed on other materials.

**Using bagasse as fuel.** B. Beyt. *Sugarland* (Philippines), 1977, **14**, (2), 6, 17.—See *I.S.J.*, 1977, **79**, 230.

**A note on the role of phosphates in the sugar industry.** A. Garg. *Sugar News* (India), 1977, **8**, (12), 19–21.—The inorganic and organic forms of phosphate present in cane juice are listed and the formation of insoluble calcium phosphate as the principal reaction in lime clarification referred to; where less than 300 ppm of phosphate is present, addition to give this level is recommended.

**Combating the menace of high mud volume during the peak recovery period in Maharashtra.** H. G. Kulkarni and K. S. Kulkarni. *Maharashtra Sugar*, 1977, **2**, (9), 17–18.—During the middle period of the crop in Maharashtra, juice Brix and purities are higher and settling is more difficult than when lower Brix juices are obtained at the beginning and end. Pre-sulphitation of the middle period juice at 80°C to a pH of 4·8 coagulates proteins and helps rapid settling, giving clear juice which yields good quality sugar. Scaling is heavier and CaO content higher than normal, however, and was not helped by addition of phosphate to the juice.

**Need for modernization in the Indian sugar industry and advantages thereof.** P. J. M. Rao. *Indian Sugar*, 1977, **27**, 11-20.—Of the 260 sugar factories which exist in India, 135 are over 95 years old, and out of this number 95 are in Uttar Pradesh and Bihar (where the Indian sugar industry started). Moreover, of the 260 factories, 135 have a daily crushing capacity below 1250 tonnes of cane, while many which expanded to beyond this figure are still using equipment installed in the 1930's. Modernization and expansion are seen as both necessary and desirable, as is improvement in factory heat efficiency, replacement of steam-operated with electrical equipment, installation of power generators, and improvement in mill performance, boiling house efficiency and sugar quality. A list is given of conventional equipment together with its modern counterpart and advantages of installing the newer machinery.

**Variation in the microbial population in the sugar manufacturing process.** E. Moreno. *La Ind. Azuc.*, 1977, **84**, 182-185 (*Spanish*).—Studies are reported on the variations in microbial populations at various stages of sugar manufacture, the numbers increasing up to clarification (where conditions favour microbial growth) and then decreasing during evaporation and boiling, etc. (where high temperature and osmotic pressures are unfavourable to growth). The individual species identified are surveyed and the variation of populations with time during a season discussed; micro-organisms in mixed juice increased as the season progressed, largely as a function of ambient temperature, while the number in sulphited juice was more constant.

**Continuous centrifugalling of low-grade massecuites.** K. S. Rao, K. B. Rao and P. Ramachandramurthi. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), E.1-E.10 (+ figs.).—Trials were conducted with two FC-1000 continuous centrifugals, one having a basket of 1000 mm inside diameter and used as fore-worker, the other having a basket of 915 mm i.d. and used as after-worker. Both machines showed promise as low-grade centrifugals, the one used as fore-worker giving higher purity sugar and lower purity molasses than a batch machine. While crystal breakage was not determined, it was assumed from the sugar purity that the escape of fine crystals through the screen was on a limited scale. The continuous machines had the major advantage of greater throughput at lower massecuite viscosity (brought about through reheating).

**Capacity of sugar cane mills with respect to the feeding capacity of the first mill.** K. S. M. Rao. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), E.11-E.14.—The effects of cane bulk density, height of feed blanket, mill roller surface friction and cane compressibility on 1st mill feeding are discussed. Calculation of mill capacity (t.c.h.) using the Hugot formula shows that many sugar factories in India are crushing well below the theoretically possible level; other equations derived by Bullock[1] and Murry & Holt[2] for calculation of the mill capacity number indicate how it is possible to achieve the desired crushing rate by increasing the cane bulk density, maintaining a constant feed blanket, installing a shredder and minimizing slippage (through increased coefficient of friction and adoption of suitable pressure feeding).

**Reclamation of an Eimco filter drum.** P. V. G. Rao and N. Murlidhar. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), E.15-E.18 (+ fig.).—After 11 years' operation, the drum of an Eimco filter was badly corroded and had large holes in it. Instead of buying a replacement, the factory decided to repair the drum by covering the surface with stainless steel sheet. The results achieved with arc welding of the stainless steel onto the drum are discussed, and the monetary savings which resulted are indicated.

**Some aspects of cane shredding.** M. N. K. Murthy. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), E.19-E.24 (B) (+fig.).—Shredder performance and design criteria are discussed, as are cane feeding and means of maintaining a constant feed rate. Ways of improving shredder performance by increasing power input are examined, and hammer behaviour is explained.

**Sugar plant maintenance—evolving a maintenance system.** V. Singh. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), E.25-E.35.—The contribution made by effective plant maintenance to the overall profitability of a sugar factory is discussed, and factors to be considered in developing a maintenance system are briefly examined. Stages in setting up a system are then explained.

**Role of design in capacity utilization of a lime kiln.** V. M. Bhalwar and S. K. Gupta. *Proc. 41st Ann. Conv. Sugar Tech. India*, 1976, (I), E.37-E.42.—Factors governing lime kiln performance are briefly indicated, and details given of the kiln at G.B. Pant sugar factory at Kichha (Nainital) which operated at below expectation in 1974-75 after a promising trial run in the previous season. The difficulties encountered are listed, and details given of a number of modifications made for the 1975-76 season, when the performance improved markedly. However, further modifications are considered necessary, although the kiln design is regarded as a limiting factor.

**Some observations on corrosion of brass tubes in preheaters and evaporators in carbonatation sugar factories.** M. U. Ovaisi and K. H. Rao. *Proc. 41st Ann. Conv. Sugar Tech. Assoc. India*, 1976, (I), G.11-G.24. Corrosion of carbonatation juice and thin juice heater tubes (as well as vapour cell tubes where the juice heaters were stopped because of the corrosion) was reported from a number of Indian factories. From comparison of processing conditions at these factories and at others not affected by corrosion, it was concluded that a low pH, particularly below 6·5 (associated with a high $SO_2$ content) and the presence of free $CO_2$ caused the corrosion. It is recommended to maintain strict control of juice pH and use efficient sulphitation and carbonatation equipment to give maximum $SO_2$ and $CO_2$ absorption.

[1] *I.S.J.*, 1959, **61**, 208.
[2] "The mechanics of crushing sugar cane" (Elsevier, Amsterdam) 1967, p. 124.

# BEET SUGAR MANUFACTURE

**Question of purifying 1st carbonatated juice in a centrifugal field.** A. A. Rakhyzhanov, O. R. Rakhyzhanov and A. T. Tishkunov. *Zernopererabat. i Pishchev. Prom.* (Alma-Ata), 1974, **4**, 125–126; through *S.I.A.*, 1977, **39**, Abs. 77-900.—At Dzhambul combine, 1st carbonatation juices were separated in a NOGSh-325 centrifuge. By comparison with clarifiers, centrifuging gave lower colour, since the residence time was 500–600 times shorter; at 85°C and 200 rpm, but not at 90°C and 2500 or 3000 rpm, centrifuging also gave significantly higher juice purity.

**Creation of a centrifugal machine for purifying 1st carbonatated juice.** A. A. Rakhzyhanov, S. F. Zhigalov and O. R. Rakhyzhanov. *Zernopererabat. i Pishchev. Prom.* (Alma-Ata), 1974, **4**, 121–124; through *S.I.A.*, 1977, **39**, Abs. 77-901.—Although the NOGSh-325 centrifuge gave some positive results (see preceding abstract), there was intense foaming and the juice was rather turbid. A filtering centrifuge designed to separate 1st carbonatation juice and mud is outlined with a diagram. In tests it gave mud of 22–25% dry solids.

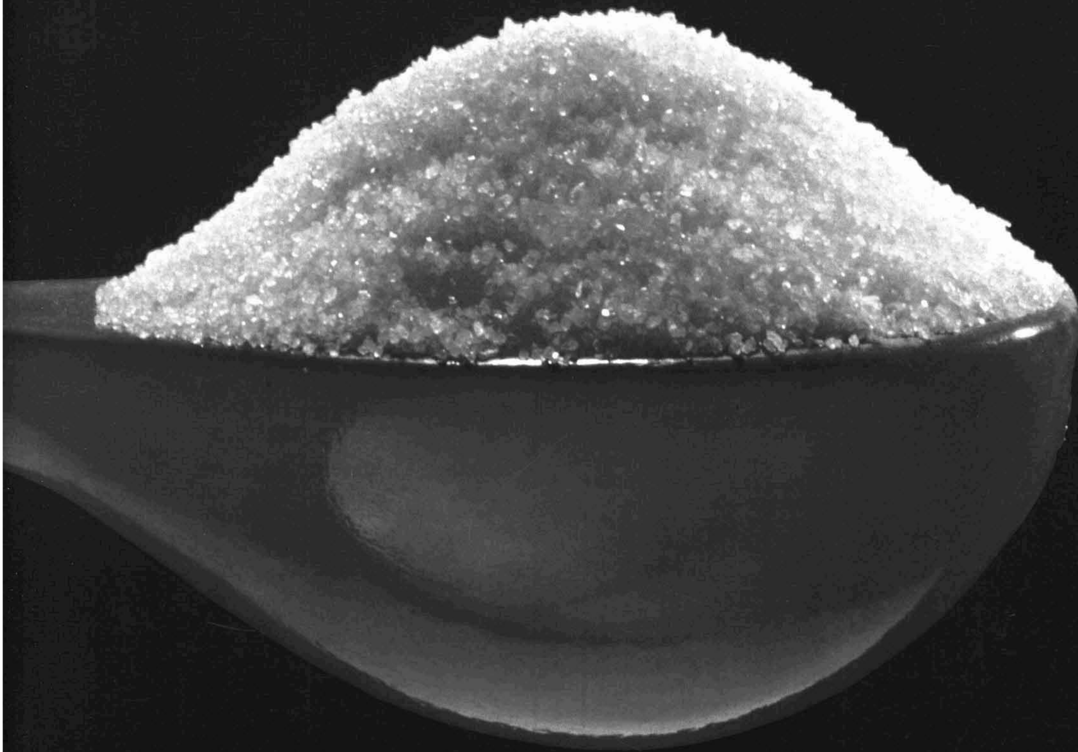
**Obtaining a thickened suspension of 1st carbonatated juice in a mechanical field.** A. A. Rakhyzhanov, S. F. Zhigalov, O. R. Rakhyzhanov and N. A. Kulinich. *Zernopererabat. i Pishchev. Prom.* (Alma-Ata), 1974, **4**, 127–129; through *S.I.A.*, 1977, **39**, Abs. 77-902.—A filtering centrifuge is briefly described (see preceding abstract) and results of tests on it are tabulated, showing that the main quality parameters of juice remained within the permitted range for rotational velocity of 100–400 rpm at 85–90°C.

**"Euroform" entrainment separators for sugar industry evaporator installations.** Anon. *Sucr. Franç.*, 1977, **118**, 262–265 (*French*).—An illustrated description is given of this patented entrainment separator which, available in two types for different degrees of separation, may be constructed of stainless steel, nickel, monel, etc. The vapour passes along zig-zag paths between corrugated plates having pockets to catch the droplets impinging on and running along the outer surfaces of the bends. Separation reaches 99·9% with only a small pressure loss, and the equipment has been installed at three sugar factories in West Germany.

**The applicability of membrane processes in the sugar industry.** G. W. Vane. *Sucr. Belge*, 1977, **96**, 277–282.—Electrodialysis employs membranes which are permeable to either cations or anions but not both. The two types are placed alternately in a stack and a feed liquor and water run between them alternately. By application of a potential difference across the stack, the anions pass from the feed into the adjacent water stream nearer the cathode while the cations pass into the adjacent water stream on the other side, so removing inorganic salts from the feed. The process has been applied to molasses and dextrose solution treatment. Reverse osmosis uses a membrane which retains sugar but permits passage of salts and water, and may thus be used to concentrate dilute sugar streams up to 25–30%, so saving fuel costs in evaporation. Ultrafiltration, which uses a membrane for concentration and removal of ash and colour from dilute impure sugar solutions, is not yet economical but may become so with the development of new membranes.

**A correlation of hydrodynamic and thermodynamic parameters for sucrose inversion in sugar manufacturing plant (thickeners, ion exchangers, evaporators).** V. Maurandi and S. Maurandi. *Sucr. Belge*, 1977, **96**, 283–293.—For small losses, sucrose inverted is given by $K\theta$ where $K$ is the first-order reaction rate constant and $\theta$ the mean residence time. The latter may be determined by tracer studies for specific items of plant, while the value of $K$ may be measured for different conditions of pH, temperature, density and sucrose concentration and the appropriate value applied for the plant conditions. When this was done it was noted that sucrose losses in the first two effects of an evaporator and in a thin juice demineralization plant were of an order greater than the losses in clarifiers which were in turn higher than those in saturators or predefecators. A mathematical model is developed for sucrose inversion in a calandria-type evaporator.

**The optimization of the energy economy in the sugar factory.** P. Christodoulou. *Zeitsch. Zuckerind.*, 1977, **102**, 441–446, 509–515 (*German*).—With the aim of reducing steam consumption in a sugar factory, the author first compares the conventional method with evaporation using vapour compression. The major advantages of vapour compression are a temperature reduction in the 1st effect and a 30–50% increase in water evaporation at the same steam throughput by comparison with conventional evaporation. Mechanical compression is considered better than thermocompression since it allows separation of process steam from compressed vapour; moreover, using a pre-evaporator and a 1st effect made up of two bodies avoids the risk of sugar-contaminated condensate being used as boiler feed. Since the compressor efficiency is higher and the energy consumption lower with increase in temperature and decrease in the temperature gradient, it is recommended to use vapour compression in the 1st effect, where the boiling point elevation is minimal and heat transfer maximum. Since the specific volume of the 1st effect vapour is also lower, there is no need for large-diameter feedlines. For the reasons given, vapour compression in the pan station is not advisable, as demonstrated by data from Aarberg sugar factory/refinery in Switzerland, where an evaporator vapour mass five times that in the pan station required the same energy to drive the compressor as did the pan vapour. Mathematical expressions are given for a multiple-effect evaporator with and without vapour compression, showing the advantages of compression for a factory supplying no current. The role of the evaporator as steam converter and vapour distributor is examined, and optimization of vapour consumption in juice purification discussed, whereby it is established, from observations in Greece and other countries, that an improvement in the steam economy of a carbonatation station is possible. Information is given on the heat systems used at



Platy in the DDS diffusion and carbonatation stations and in the sugar house, and means of optimizing steam consumption in the sugar house are indicated. A model of a white sugar factory having low steam and energy consumption is described, in which variants of quintuple- and sextuple-effect evaporation are examined. A quintuple-effect evaporator with 1st effect vapour compression and pre-evaporator to supplement boiler feedwater is shown to give the lowest steam consumption (24·7 kg/100 kg beet) and lowest fuel oil consumption.

**Some ways in which to improve the scheme for purification of raw juice from beet of low processing quality.** V. A. Kolesnikov, D. M. Leibovich, B. F. Kolesnikov and V. A. Maksyutov. *Sakhar. Prom.*, 1977, (8), 15–20 (*Russian*).—Reference is made to the advantages of a system in which raw juice is subjected to cold preliming followed by fractional cold and hot main liming, with recycling of 1st carbonatation mud to preliming (after alkalinity adjustment with milk-of-lime equivalent to 0·1% CaO). It was found that the milk-of-lime treatment for alkalinity adjustment was better than use of cold limed juice (40% on mixture of predefecation juice plus recycled mud) as regards optical density, lime salts content, settling rate, mud volume and filtration coefficient. Comparison of three schemes showed that system (i) in which predefecation mud was separated in settlers at 62–68°C after cold preliming and fractional cold-hot liming was better than (ii) in which mud was separated at 85–87°C after hot preliming and hot main liming (conducted over the same length of time as the fractional liming) and (iii) in which no mud was separated after cold preliming and fractional cold-hot liming; scheme (i) gave 1st and 2nd carbonatation juices and thick juice of lower optical density and lime salts content than did (ii) and (iii), while it also gave a higher 1st carbonatation juice settling rate and lower filtration coefficient and slightly higher thick juice purity. Clarification of 1st carbonatation juice obtained by scheme (i) at 76–78°C gave only a slightly reduced settling rate than at 82–85°C, so that raising the juice temperature was unnecessary in view of the mud recycling to cold preliming, and steam consumption was thus reduced. The higher temperature in the 1st carbonatation vessel occasioned by the fractional liming system was found to have a positive effect in reducing juice colour, particularly in the temperature range 50–80°C. Vacuum filtration of cold prelimed juice mixed with highly filterable 1st carbonatation mud after the mixture was heated to 90°C gave a suitably low 1st carbonatation juice filtration coefficient of 1·5–2·0. While fine filtration of 1st carbonatation juice was thus obviated, it was still necessary to filter the juice when low-quality beet were being processed, despite the high juice clarification quality. Laboratory tests showed that gassing of limed juice (after predefecation mud separation) directly to optimum 2nd carbonatation alkalinity gave carbonatation juice and thick juice qualities which were lower than obtained by conventional 1st and 2nd carbonatation.

**Raw juice purification.** I. F. Popov, A. F. Popov and Z. N. Lapshova. *Sakhar. Prom.*, 1977, (8), 20–22 (*Russian*). Reference is made to preliming at two Soviet sugar factories, and a detailed description is given of that at Timashevskii where some 1st carbonatation juice is recycled to preliming. Some recycled juice is mixed with raw juice at 40–45°C, whereby the pH is raised to 8–8·5 (0·03–0·05% CaO alkalinity) and partial coagulation of the albumins achieved. The juice mixture is then heated to 85–90°C and fed into the bottom section of the preliming vessel, while further recycled carbonatation juice is fed into the same vessel at four equally separated points up to approximately halfway up the vertical wall of the tank, the lowest feed port being on the opposite side to that where the initial recycled carbonatation juice portion is fed. pH is maintained at the required values by means of control valves on the feed lines to each inlet, viz. 8·5–9·0 at the first two points, 9·0–10·0 at the third and 10·0–11·0 at the fourth. Residence time in the main liming vessel (from 6 to 12 min according to beet quality) is regulated by means of valves and discharge ports at different heights. The multiple carbonatation juice circulation system thus created permits high $CO_2$ utilization and uniform juice treatment despite the absence of a bubbler in the 1st carbonatation vessel, while the dispersed fine particles formed have a high adsorptive surface and present no difficulties in filtration.

**Results of factory trials on the use of deammoniated condensates for the diffusion process.** N. V. Kulinich, Yu. D. Golovnyak, V. G. Yarmilko, L. M. Osadchii, A. P. Zablotskaya, Zh. I. Katrokha, N. A. Arkhipovich and L. D. Bobrovnik. *Sakhar. Prom.*, 1977, (8), 23–28 (*Russian*). Comparative tests were conducted on use of deammoniated condensate (the deammoniation being achieved by electrodialysis with cationic and bipolar membranes) and $SO_2$-treated condenser water for diffusion. The treated condensate increased raw juice purity (through reduction of colloid and pectin contents and decrease in reducing matter) and decreased 2nd carbonatation juice lime salts while also raising thick juice purity and reducing its colour in evaporation, all by comparison with $SO_2$-treated water. In addition, use of deammoniated condensate led to a fall in molasses sugar and hence increased sugar yield, as well as a reduction in microbial infection in diffusion. It also resulted in less corrosion of a steel sample than did $SO_2$-treated water. Details are given of a system for condensate treatment.

**Introduction of thyristor converters at plants in the Cherkassk sugar industry group.** S. I. Podgorny. *Sakhar. Prom.*, 1977, (8), 37–38 (*Russian*).—Advantages of thyristor converters used in conjunction with D.C. motors employed as drives for beet diffusers, slicers, etc. are briefly indicated.

**Operation of vacuum filters with a moving filter cloth.** P. N. Tkachuk and T. S. Taranenko. *Sakhar. Prom.*, 1977, (8), 38–40 (*Russian*).—Details are given of a means of modifying a vacuum filter so as to convert it to a moving belt filter. Operation of such a filter in 1976/77 increased its throughput compared with that of the original model and lengthened cloth life considerably.

**Improvement in the design of a separation unit for pulp-water mixture.** R. N. Katerinich. *Sakhar. Prom.*, 1977, (8), 40–41 (*Russian*).—A brief description is given of a modification to a unit for separation of pulp from water used to convey it to a storage pit. The separator basically comprises a screen mounted at an angle of 40–45° to the horizontal on each side of a tower straddling the pulp pit. The pulp-water mixture falls down a chute over the screens on its way to the pit.

**Rapid method of determining hollow and soft beet roots.** A. Ya. Zagorul'ko, A. K. Kosik and T. F. Burlyai. *Sakhar. Prom.*, 1977, (8), 42-46 (*Russian*).—Descriptions are given of rapid methods for determination of hollow and soft beet at reception in the beet yard. For hollow beet, use of ultrasonics as for flaw detection in industrial samples has proved more suitable than X-ray detection because of the absence of means of determining the intensity of X-rays passed through a hollow beet and a whole beet. The oscillogram waveforms representing whole and hollow samples are indicated. For determination of soft beet, the method of Vukov[1] has been found to be applicable. While this is strictly for measurement of the elasticity modulus, a high correlation coefficient of 0·97 has been found between softness and the modulus, but the correlation coefficient between hardness measurements, as used in the rubber industry, and the degree of softness was only 0·86. Scales of classifications have been drawn up by Vukov and Shevchenko for defining fresh, slightly soft and very soft beet, each category being expressed by range of % moisture loss and elasticity modulus in MPa.

**Bolting of sugar beets and their processing properties.** A. Yu. Gadzhiev, V. I. Kurakov, A. S. Korol'kov and A. G. Dudkina. *Sakhar. Prom.*, 1977, (8), 49-51 (*Russian*).—Half of the bolted beets growing in trial plots were cut at a height of 20-30 cm in the first half of August; all the beets were harvested in the beginning of October and separated into three groups—those with bolted heads intact, those from which the heads had been removed in August, and non-bolted beet. Determination of the sugar content showed that while the non-bolted controls contained 17·9% sugar, the bolted beets contained 17·05% sugar but the beets having their heads removed in August only 15·65% sugar, indicating that removal of the flowering heads did not improve root quality, as expected, but had the opposite effect; this was attributed to an increase in rootlet activity when the heads were removed and hence increased utilization of nutrients including sucrose. Other quality factors were also worse in the bolted than in the non-bolted beet, including reducing matter and nitrogen contents, 2nd carbonatation juice purity and colour, sugar yield and molasses sugar. For most factors, the beets with bolted heads intact were not as bad as those from which the heads had been removed. Early removal of the heads also reduced yield per ha by 40% because of the resultant drastic weight reduction.

**A second line of defence against losses.** G. S. Grind and S. V. Morozov. *Sakhar. Prom.*, 1977, (8), 51-52 (*Russian*).—A 0·5% loss in raw material is allowed for in loading of beets into rail trucks in the Soviet Union. On the basis of 45 million tonnes of beets carried by rail each year, for which I million trucks are required, a considerable saving is possible with just a small reduction in losses. A simple means of reducing the number of beets which fall onto the rail track (and which cannot be recovered because of manpower shortage) is a special shield which is placed at the side of the truck above the side panel by tractor; this helps a prismatic pile of beet to be formed which is higher than without the device, so that the greater load plus reduction in dropped beets help bring about considerable savings.

**Results of mechanical beet harvesting observed at the factory.** J. Wolański and M. Trepka. *Gaz. Cukr.*, 1977, **85**, 135-140 (*Polish*).—With adoption of mechanical harvesting there has been a marked increase in the quantity of mud, stones, sand, etc. received at sugar factories in Poland. The authors indicate the effect of this extraneous matter on storage and beet fluming, and describe the mechanical damage inflicted on a beet pump (clearly shown in photographs). Because of the greater quantities of extraneous matter, the efficiencies of beet yard equipment such as trash catchers have fallen, and losses of sugar have risen as a result of inadequate beet cleaning. Diffuser screens have also been found blocked by sediment and grains of sand.

**Automatic temperature control in a trough-type diffuser.** W. Krupa and A. Korgul. *Gaz. Cukr.*, 1977, **85**, 151-154 (*Polish*).—The authors consider that the present system used in a DDS-type diffuser for automatic control of the temperature of the cossette-juice mixture is not suitable for the counter-current heat exchange process and contributes to considerable fluctuations in temperature in the cossette heating zone. A new automatic system is suggested in which a closed circuit is used for the juice temperature in each of the four heating sections, so that the quantity of steam supplied to a given section depends on the temperature of juice flowing from that section. Advantages of the scheme are listed.

**Optimum series type of hot wells.** J. Kubarski and K. Urbaniec. *Gaz. Cukr.*, 1977, **85**, 154-156 (*Polish*).—The amount of sheet metal of standard thickness used in the construction of typical condensate tanks is discussed. It is calculated that for tanks of 0·5-12·5 $m^3$ capacity the optimum tank diameter is 800, 1200 or 1600 mm. The basic dimensions and water evaporation rate from the free surface of the condensate are calculated and the results graphed.

**Carbonatation mud sweetening-off by water in vacuum filters.** A. Szyszka. *Gaz. Cukr.*, 1977, **85**, 157-158 (*Polish*).—A description is given of the filter cake sweetening-off system introduced for the three vacuum filters used for 1st carbonatation juice at Świdnica sugar factory. The filtrate together with cake washings is recycled to main liming, while the cake is sent to a mixer where ammoniacal water is added to form a secondary mud; this is pumped to a disc filter, the filtrate from which is used for lime slaking. The scheme has resulted in reduced cake losses, and has been introduced in other factories.

**Plant for spraying sugar beet with a disinfectant solution.** T. Bogumil. *Gaz. Cukr.*, 1977, **85**, 158-160 (*Polish*).—Details are given of two variants of a scheme for spraying beets with a disinfectant while they are being transferred from the beet washer to the elevator on an upward sloping screw conveyor. One variant allows for gravity feed of the preparation from a mixer tank to the spray nozzle, while the other involves pumping from the tank on the same floor level as the washer. The preparation ("Kamin") is diluted 1:10,000 with water and the solution applied at the rate of 2% on beet.

[1] "Physics and chemistry of sugar beet in sugar manufacture" (Elsevier, Amsterdam) 1977, pp. 530-531.

**The effect of operational conditions on results achieved with the Quentin process.** E. Gryllus. *Cukoripar,* 1977, **30,** 94-101 (*Hungarian*).—Laboratory investigations of the effect of thin juice composition on the Quentin process (replacement of molasses $Li^+$, $K^+$, $Na^+$ and $Ca^{++}$ cations with $Mg^+$ for increased sugar recovery) are reported. While the K:Na ratio in thin juice had little effect on the amount of sugar extracted from the molasses, e.g. sugar extraction falling from 153·5 to 145·7 g per (K+Na) equivalent exchanged with fall in the K proportion and rise in the Na proportion at a constant molar or weight total of 1·0, increase in the thin juice lime salts content within the range 150–650 mg CaO per 100°Bx caused an appreciable fall in the extra sugar obtainable by the Quentin process. It is stressed that when the thin juice lime salts content is greater than 150 mg/100°Bx, even a 0·4% reduction in molasses sugar can only be achieved by modifying the process, e.g. reducing the quantity of molasses treated per cycle or increasing the regenerant quantity. The quantities involved are calculated.

**Sugar industry microbiology.** K. Magyar, G. K. Proszt and M. Vig. *Cukoripar,* 1977, **29,** 217–220; 1978, **30,** 20–26, 64–72, 112–115 (*Hungarian*).—The development of microbiology in the beet sugar industry over the last 30 years is surveyed, most references being made to work in Hungary with some mention of that in other countries. Methods and techniques used in microbiological studies are briefly described. Results are given of tests to determine the effect of formalin on bacterial populations in raw juice, whereby comparison is made between bacterial populations with and without formalin addition (0·01% and 0·02%) at 55°C. The problems created by micro-organisms in diffusion are discussed, and it is shown that adequate bacteriological control will involve not only formalin addition in the diffuser but also separate disinfection of the raw juice and thorough washing of the beet. The concentrations of formalin found in press water and juice from a Buckau-Wolf tower diffuser have been determined and are shown by tables and graphs. As an aid to determining the optimum amount of formalin to add, the method of Nash (colorimetric measurement of diacetyldihydrolutidine formed by the reaction between formalin and acetylacetone[1] in the presence of excess ammonium salt), is considered best for formalin determination, while a modification of the resazurin method for bacterial counts gives suitably accurate results after 15 minutes.

**Plate filters for the sugar industry.** A. Czuk and O. Ligeza. *Die Lebensmittelind.,* 1977, **24,** 310 (*German*). Information is given on a plate filter of Polish construction which is intended for thin and thick juice and liquor filtration. The circular vertical plates are pre-coated with kieselguhr for thick juice and liquor treatment. The filter is available in two sizes: 45 and 70 $m^2$ filtration surface.

**Simulation of a four-stage evaporator station by means of the "EVAP 1" computer programme.** H. Chame and J. Sáez. *Zucker,* 1977, **30,** 471-484 (*German*). The authors explain how the "EVAP 1" programme (translated into Fortran IV) can be used to simulate conditions in a quadruple-effect evaporator so as to permit evaluation of alternative schemes within a sugar factory. The programme gives a complete heat balance for each effect based on enthalpy and mass balances subjected to iterative processes, whereby the true value of a specific variable is compared with the required value; if there is satisfactory agreement between the values, the programme is applied to the next effect, but if a discrepancy occurs which exceeds permitted limits, the value of the governing factor (e.g. steam input in the case of thick juice Brix) is altered and the calculation process repeated, this being done until satisfactory agreement is reached. Limitations of the programme are briefly indicated, and print-out samples are reproduced.

**Scrubbing of carbonatation gas and defeco-saturation treatment of juices at Ust'-Labinskii sugar factory.** N. K. Polishchuk. *Sakhar. Prom.,* 1977, (9), 15-16 (*Russian*).—Unsatisfactory lime kiln operation at this Soviet factory had caused frequent lime deficiency for juice treatment and inadequate gas $CO_2$ contents. Results included poor juice settling in the Dorr-Oliver clarifiers and difficult filtration, leading to a fall in processing rate. In 1976, hydrocyclones were installed between the lime kiln and scrubber; water is pumped under pressure through three nozzles, located in the hydrocyclones at 120° relative to one another, and thereby washes the incoming gas. Effects of the new system in the latter half of 1976 were a satisfactory milk-of-lime density of 1·19 $g.cm^{-3}$ and a gas $CO_2$ content of 30–32%; kiln operation was highly satisfactory, and sugar colour was only slightly increased when poor-quality beets were processed.

**Experience in the use of sugar factory waste water to irrigate agricultural crops.** V. A. Serkin, D. F. Polyakov, N. S. Gusev, B. P. Devyatkin, A. P. Parkhomets, V. I. Sergienko and S. A. Targanchuk. *Sakhar. Prom.,* 1977, (9), 25–28 (*Russian*).—After application of Class III (heavily polluted) waste water to 70 ha of land in the vicinity of Lenin sugar factory had proved unsuccessful in that the soil (of low permeability) was still wet by the start of the next campaign, it was decided to use the effluent to irrigate crops growing on 262 ha of land belonging to a nearby collective farm. The scheme set up in 1972 involves pumping the water to three settling ponds of 5·2 ha total surface area and 5 m deep, from which the purified water passes to a reservoir divided into two 5·6-ha sections and having a total capacity of 300,000 $m^3$. One of the sections takes not only sugar factory effluent but also waste water from a cattle fattening unit. The combined water is pumped from the reservoir through fixed pipelines totalling about 10,000 m; there is also 3000 m of movable pipeline. The water is sprayed onto annual and perennial grasses such as clover, lucerne, maize, winter rye and barley; it is calculated that 300 $m^3$ of the mixed effluent contains 17·7 kg N, 45·9 kg K and 0·8 kg P. Tabulated data indicate the considerable benefits achieved by effluent spraying —all crops considerably increased their yields by comparison with unirrigated crops. Moreover, much of the land originally used for waste water disposal is to be re-cultivated now that it is no longer required for that purpose.

[1] *Biochem J.,* 1953, **55,** 416.

# SUGAR REFINING

**Packaging in polyethylene—a comprehensive view.** M. A. Muniz. *Paper presented to the 36th Ann. Meeting Sugar Ind. Tech.*, 1977.—The use of polyethylene for packaging of the various forms of granulated sugar is growing, and a survey is presented of the method. Reasons for use of polyethylene are discussed and the properties of the types of film available are described, as are the types of bag, bag closures, printing, use of colour and applications. The equipment used for packaging in polyethylene bags—manual and automatic—is discussed and makes and types suitable for granulated, powdered and brown sugar are briefly surveyed, with a note on costs. Developments which are likely for future applications are referred to, including freezing of brown sugar to facilitate packaging, metallized lamination as a moisture barrier, use of self-standing gusset-bottom bags, total air removal to increase storage life, and the application of micro-processor technology for controlling the operation.

**Continuous sugar detection in refinery waste waters.** M. J. Fowler. *Paper presented to the 36th Ann. Meeting Sugar Ind. Tech.*, 1977.—Two systems are described for the automatic monitoring of refinery waste waters for sugar content. The first, installed at most of the Amstar refineries, employs a device in which a sample is continuously mixed with a metered quantity of a solution of thymol in sulphuric acid. Sucrose or any other carbohydrate in the waste stream produces a red colour which is measured by a light transmitter/filter/photocell system to give a reading corresponding to the sugar content. An upper limit is coupled with an alarm which operates within 5 min of the sample entering the system. At Chalmette refinery, the condenser water from the Mississippi river is too turbid for the system to operate successfully, and a Technicon "Auto-Analyser" is employed which includes a filter (with automatic back-flushing) in the form of a dialysis membrane. The continuous sample is acidified, passes through a 90°C bath to invert sucrose present and passes to the filter. The dialysed invert sugar enters a stream of 0·25N $Na_2CO_3$, a cupric-neocuproine reagent is injected and the stream heated. The reagent is reduced to the highly coloured cuprous form and the colour measured at 460 nm to give a measure of the sugar in the waste water within 15 min of the sample entering the system. A recent development has been the use of a single system connected to two waste streams which it samples and analyses alternately.

**Investigation of the processes of sorption and desorption of syrup colouring matter by TsM-A2 anion exchange resin in sugar refining.** M. Yu. Mazov, Zh. P. Koryakovskaya, M. A. Tyuganova and V. S. Pavlenko. *Sakhar. Prom.*, 1977, (6), 29–32 (*Russian*). Comparative static tests were carried out on decolorization of refinery syrup with TsM-A2 cellulosic resin[1] and AV-16GS and AV-17-2P anion exchange resins. While all three had approximately the same decolorizing capacity, TsM-A2 resin had a considerably higher decolorizing rate than did the other two because of its greater dispersivity and specific surface. However, when regenerated with 10% NaCl solution, it showed a very slow rate of colouring matter desorption; this was found to be due to compression of the cellulose fibres when washed with water and during regeneration. Consequently, further tests were conducted to establish regeneration conditions under which the relative diameter of the fibres was the same during colour matter adsorption and desorption. While addition of small quantities of HCl and NaOH to the NaCl regenerant solution increased the amount of colouring matter removed from the resin, the chemical stability of the ionic groups in the resin is reduced in alkaline medium, so that only HCl was subsequently added. Optimum regeneration conditions were found to be 4% NaCl and 2% HCl, at which the desorption rate was maximum and complete removal of colouring matter achieved. Addition of more than 2% HCl did not increase the desorption rate further.

**A simplified method of calculating refined massecuites.** G. N. Mikhatova. *Sakhar. Prom.*, 1977, (7), 53–58 (*Russian*).—A method of calculating the balances of a 6-product boiling scheme including three refined sugar strikes is explained with the aid of sample calculations.

**C & H sugar refinery.** Anon. *Sugar J.*, 1977, **40**, (1), 17–19.—A brief illustrated description is given of the C & H company and its Crockett refinery. Equipment is described from Hawaiian raw sugar reception to packaged sugar storage.

**Some aspects of flocculant use in the phosphatation process.** F. M. Runggas and G. S. Shephard. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 119–122.—Ten cationic flocculants were examined in studies of their effects on the phosphatation-flotation treatment of raw sugar melt liquor. The additional effect of "Taloflote" added before and after the coagulation reaction in the presence of three of the flocculants was also determined. A further trial examined the effect on elimination of potato starch added to the melt liquor. The experiments showed that addition of flocculant immediately before phosphate precipitation gave the best filtrability, while the "Taloflote" should be added after coagulation of the calcium phosphate. The flocculants did not affect turbidity or conductimetric ash but enhanced removal of colour and starch, and improved liquor filtrability.

**Formulation of manufacturing instructions for white sugar factories processing raw sugar from other sources.** J. Buriánek and M. Kmínek. *Listy Cukr.*, 1977, **93**, 205–214 (*Czech*).—An algorithm and computer programme are presented from which a boiling house balance has been drawn up for white sugar factories (i) processing raw sugar from other factories, (ii) processing their own beet and/or (iii) transferring their own intermediate sugar for processing elsewhere. The programme is intended to provide optimum values from the factory's own input data according to the system being used.

[1] See also Mazov: *I.S.J.*, 1976, **78**, 315.

# LABORATORY STUDIES

**Effect of magnetic field on sucrose crystallization rate.** G. U. Nikabadze, R. Ya. Iashvili and R. M. Kalandadze. *Trudy Gruzinsk. Politekhnich. Inst.*, 1974, **3**, (167), 134–137; through *S.I.A.*, 1977, **39**, Abs. 77-991.—A bipolar electromagnetic apparatus, which could be operated on either D.C. or low-frequency A.C., was used in the study. Sucrose solutions of 82·3 purity and 1·1, 1·06 or 1·05 supersaturation were passed through the magnetic field for 5 or 10 min, then crystallized onto large sucrose crystals of known weight for 90–180 min at 40°C. In some cases, crystallization was considerably faster than that of similar untreated solution; magnetic treatment of static solution was less effective.

**A novel method of maturity testing.** D. Byfield. *J.A.S.T.J.*, 1974, **35**, 46–50.—A new method is described for determining maturity of cane as a function of reducing sugar content, determined colorimetrically by addition of a "Clinitest" tablet to a diluted sample of juice. The tablet has been developed for urine testing of diabetics and gives a colour reaction which can be compared with a standard chart.

**Modified AOAC method for determination of moisture in corn syrups.** C. E. Engel. *J.A.O.A.C.*, 1977, **60**, 165–167.—The AOAC method 31.195 for moisture determination in maize syrups and crude maize sugars has been modified for adaptation to fructose syrups and high dextrose syrups. The main changes are the use of greater quantities of sample and drying medium ("Hyflo Super-Cel") and the disintegration of lumps after drying at 70°C in a vacuum oven for 5 hours before continuation of the drying.

**An improved method for the determination of nitrogen in cane leaves.** J. R. Burrows. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 68–71.—Samples are subjected to a Kjeldahl digestion, and the digests analysed in an automatic instrument system (the LKB 2071 sample processor and LKB 7400 calculating absorptiometer) which measures the ammonium content colorimetrically using a nitroprusside-catalysed indophenol reaction and gives the result as a print-out of N %. The colour complex is relatively stable and unaffected by normal fluctuations in digestate acidity, residual catalyst or mineral content of the samples. A total instrument time of 70 minutes is required for 200 samples, and good agreement is given with results obtained by the distillation method of determination.

**Sampling and analysis of prepared cane for its ash content with reference to estimating soil levels in cane.** M. A. Brokensha and P. Mellet. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 97–100.—Ash in cane is used as a measure of its soil content; the procedure used for determination is to obtain a full elevator width sample of cane which is mixed, shredded, mixed again and subsampled in duplicate for analysis of ash, pol, Brix and moisture. The ash determination involves heating a sample of prepared cane to constant mass in a muffle furnace at 850°C using fused silica basins. Examination of the technique has revealed no bias and the precision of the test has been found to be ±0·32 units of ash % cane, equivalent to a C.V. of 8·8%. Use of a 50-g sample of cane requires only 45 minutes for ashing, as against 120 minutes for 100 g, and there is no significant difference in accuracy, although the smaller sample gives lower precision (±0·43% ash % cane).

**Labour saving conveyors in the cane testing service.** S. King. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 112–115.—Document conveyors, used for carrying an identification such as a weighbridge ticket or bundle tag, related to a particular cane consignment, are described; they include a single and a double air-tube conveyor with a carrier which moves within the 55 mm i.d. tube(s) under the action of low vacuum or air pressure. For samples, a similar double-tube conveyor may be used which has larger carriers and 150 mm i.d. tubing. Another system employs an overhead cable conveyor; in one form, a sample box is suspended on a pulley from a fixed cable and is pulled back and forth between the sampling point and the laboratory, while in another the box is attached to an endless cable moving on pulleys between the two points. Another cane sample conveyor uses a car running on four rubber-tyred wheels on a plastic track picking up 24 V D.C. power from brass rails set in the track and driven by a motor through a gear and worm drive. The various advantages and disadvantages of each system are discussed; their importance depends on the individual circumstances of the factory. Nevertheless, all have shown utility in reducing manual labour required to move documents and samples.

**Exhaustion of molasses. Equipment to determine target purities.** J. Bruijn. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 123–124.—A miniature vacuum pan/crystallizer/nutsch filter is described. It is in the form of a jacketed container which is connected to an upper glass pipe section having a vacuum connexion and a top-mounted stirrer. The latter is chain-driven through a sprocket and bevel gears, and an idler wheel connected to a pointer and scale permits assessment of the stirrer torque and hence mobility of the massecuite. This is built up in the bottom container using sugar crystals and molasses admitted through the cover of the glass pipe section; heating steam is passed into the jacket. At the appropriate mobility, the boiling is stopped and the bottom container transferred to another fitment with a top-mounted stirrer for continued crystallization and exhaustion of the molasses, water of the appropriate temperature being circulated through the jacket. When sufficient time has elapsed, a cover plate is removed from the bottom of the container, which is perforated, and air pressure applied above to expel exhausted molasses through the perforations, after which the molasses is analysed.

**Aspects of thermography as applied to the sugar industry.** L. C. F. Nowicki. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 143–145.—A system recently developed uses a camera to receive infra-red radiation given off by bodies and convert them to signals which are made visible as a cathode ray tube image. The principles of the equipment are described and its use in detection of "hot spots" in electrical circuitry indicated; this minimizes breakdowns and damage to equipment.

**Calorific values of South African bagasse.** C. E. Don, P. E. Mellet, B. D. Ravno and R. Bodger. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 169–173.—It was found that there were no significant differences in gross calorific value (GCV), on a moisture-, Brix- and ash-free basis, for bagasse from different cane varieties, from cane cut at different ages and from different sources, and between fibre, pith, cane stalk and cane tops. The GCV of cane leaves was found to be significantly higher, however. For a sample of cane material excluding leaves, GCV in $kJ.kg^{-1}$ is predicted by the formula 19,605 — 196·05W — 196·05A — 31·14B, where W, A and B are, respectively, water, ash and Brix % sample. Elementary analysis of bagasse for H is used to calculate the net calorific value at 20°C in conjunction with the predicted GCV and the latent heat of evaporation of water.

**Modifications to the Waddell shredder as used in the South African method of direct analysis of cane.** C. D. Crisp. *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 175–177.—The Waddell shredder is used for disintegration of cane samples for analysis in the chemical control system used in South Africa. Problems have arisen in operation, and modifications have been devised to overcome them; they include fitting of hammer bushes of different materials and elimination of the retaining bars which were causing wear, replacement of the "Airchamp" clutch and brake by a more suitable "Wichita" unit and later by a hydraulic drive unit, and redesign of the control equipment with replacement of the timer control with more reliable equipment than the original, and fitting of a proximity switch instead of a press button limit switch as shredder door interlock.

**The residual amounts of polyphenols in beet sugar products when beet treated with these preparations is processed.** M. Z. Khelemskii, M. L. Pel'ts, I. R. Sapozhnikova, A. Z. Usmentseva and N. Yu. Kovaleva. *Sakhar. Prom.*, 1977, (8), 53–54 (*Russian*).—Analysis of beet sugar factory process water, cossettes, diffusion juice, syrup and sugar revealed no pyrocatechol nor hydroquinone, while only traces of these polyphenols were found in beet pulp. Hence, it is recommended to spray beet piles with 3–4 $litres.tonne^{-1}$ of 0·3% solutions of these fungicides, which also act as sprouting inhibitors.

**The filtration behaviour of carbonatation muds.** D. Schliephake and P. Beyer. *Zucker*, 1977, **30**, 405–419 (*German*).—The fundamentals of filtration theory for porous flow in fixed beds are explained and some of the more important equations for calculation of permeability tabulated. The effect of filter pressure on filter cake and filter aid is discussed, and an attempt made to describe cake formation and filtrate flow in the case of compressible precipitates. It is shown that the Brieghel-Müller filtration coefficient used to estimate the filtrability of carbonatation juices is valid only for pre-set test conditions in the case of muds which provide deformable filter cake; in order to expand the estimation criteria, investigations were carried out on the deformation and resistance behaviour of model $CaCO_3$ suspensions and carbonatation muds. A description and diagram are given of the compression-permeability system used for the studies. In the pressure range investigated, results very closely approximated to the exponential function $\alpha_x/\alpha_o = (\varepsilon_x/\varepsilon_o)^{-n}$, where $\alpha_x$ and $\varepsilon_x$ are values of cake resistance and porosity at a given moment, respectively, $\alpha_o$ and $\varepsilon_o$ are initial values of cake resistance and porosity, and $n$ is the compressibility coefficient specific to the substance under study. Comparison of filtration coefficients calculated from static measurements with those determined by the Briegel-Müller micro-method shows that the latter are 1·7 times greater than the former at 0·533 bar pressure. However, when the differences between equipment and methods used are taken into consideration, the discrepancies between the two sets of values are seen to be very small, thus confirming the suitability of the pressure-permeability technique for industrial filtration determinations. The method has the advantage of permitting extension to the range of filtration coefficient measurement and thus allowing resistance to be determined in that pressure range which is of technical interest. The method also gives additional qualitative and quantitative information on carbonatation mud deformation.

**The enzymatic determination of D- and L-lactic acid in sugar factory juices.** N. Kubadinow and G. Rösner. *Zucker*, 1977, **30**, 420–426 (*German*).—Tests are reported on a method of lactic acid determination whereby the acid is oxidized by lactate dehydrogenase (LDH) in the presence of nicotinamide adenine dinucleotide (NAD) to form pyruvate which is then removed by reaction with glutamic acid in the presence of glutamate pyruvate transaminase (GPT) to give L-alanine and $\alpha$-ketoglutarate. The NADH (reduced form of NAD) formed in the first reaction, stoichiometrically equivalent to the lactic acid, is then determined by light absorption measurement at 334, 340 or 365 nm. Light coloured solutions such as thin and thick juice require only microfiltration before analysis, while dark coloured products such as raw juice and molasses require preliminary clarification with e.g. lead acetate. Comparison of results with values given by a second method, in which the pyruvate is removed with hydrazine, showed good agreement for L-lactic acid, whereas the values for D-lactic acid were about 10% (relative) lower for the hydrazine method than for the GPT method; this was attributed to an inadequate reaction time for the hydrazine method, so that conversion from the main to side reactions was not easy to detect and hence no allowance could be made for it.

**The technological value of the sugar beet.** G. Mantovani. *Ind. Sacc. Ital.*, 1977, **70**, 51–64 (*Italian*).—Development of formulae for estimating sucrose loss in molasses on a basis of juice analysis is summarized in a table, the latest work being that of Devillers *et al.*[1], and the influence of non-sugars of various kinds on beet juice and processing are discussed. Beet damage and the effects of pests and diseases cause variations in the non-sugars contents and affect the processing and value of the beets. Much information from the literature

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[1] *I.S.J.*, 1977, **79**, 205-206.

is summarized and discussed, including the influence of harvesting damage, topping level, variety, storage and dirt content in piles.

**The Polish control test for molasses exhaustion.** K. Wagnerowski. *Gaz. Cukr.*, 1977, **85**, 123-126 (*Polish*). At the 16th Session of ICUMSA, Recommendation (3) under Subject 25 was that the test of Wagnerowski *et al.*[1] for molasses exhaustion should be the subject of collaborative studies. Five series of tests were conducted on samples of molasses from three sugar factories with the aim of comparing sugar dissolution with crystallization for molasses saturation, comparing the approximation method with the basic one and comparing the use of massecuites prepared from molasses and white sugar with that of massecuites prepared from molasses and *C*-sugar. Tabulated and graphed results showed that both dissolution of sugar to saturated solution and crystallization of sugar from supersaturated solution were suitable for molasses exhaustion indication, that the shortened method gave results which agreed with those of the full method within experimental error, and that molasses saturation was not affected by the materials used for massecuite preparation. The test was found to be suitable for control of molasses exhaustion under factory conditions.

**Micro-organisms in stored molasses.** L. G. de Souza, J. S. Goldoni and A. F. da Eira. *Brasil Açuc.*, 1977, **89**, 204-207 (*Portuguese*).—The micro-organisms identified in samples of molasses from raw and white sugar production, which had been stored for three years, are tabulated. They are classified by fungi (17 and 25, respectively), yeasts (4 and 10, respectively) and bacteria (31 and 34, respectively). Only small counts occurred and *Leuconostoc* bacteria were not observed, although other micro-organisms recorded in the literature were identified, including *Bacillus subtilis* and *Aspergillus*, *Monilia* and *Penicillium* fungi.

**Kinetic analysis technique for glucose determination in sugar solutions.** D. Kirstein. *Die Lebensmittelind.*, 1977, **24**, 311-312 (*German*).—Details are given of a method in which dextrose in sugar solutions is oxidized by a stream of oxygen in the presence of glucose oxidase to form gluconic acid which is then found by potentiometric titration, using NaOH as titration agent and an oxygen electrode. The maximum titration rate serves as a measure of the dextrose instead of the titration end-point, linearity having been established between titration rate ($cm^3.min^{-1}$) and dextrose concentration up to $10^{-3}$ M, after which the conversion rate is affected by the fall in oxygen concentration caused by the reaction. Since the enzyme catalyses oxidation of β-dextrose (present in glucose solutions in an amount of 64% at 25°C) but not α-dextrose, and the equilibrium between the two forms of dextrose is re-established only very slowly, the titration end-point is reached only after some hours. Addition of mutarotase and invertase to the enzyme permitted the method to be applied to direct titration of sucrose.

**Agglomeration behaviour of freshly milled sugar.** D. Roth. *Zucker*, 1977, **30**, 464-470 (*German*).—As found earlier[2], lumping and caking of icing sugar results when water taken up by the amorphous layer is released by the re-crystallization process. Further investigations of dry-milled and -packed icing sugar have shown that many weeks may elapse before re-crystallization can take place as a result of diffusion of water vapour from the atmosphere through the package material. The water liberated raises the relative humidity of the sugar to 60-80%; at such high levels, the re-crystallized sugar adsorbs so much water that moisture bridges are able to form between the particles and dissolve sugar, finally leading to formation of lumps. Subsequent loss of moisture, e.g. by diffusion of the water vapour from the sugar through the packaging into the atmosphere, causes crystallization and caking. A number of photomicrographs illustrate the above-mentioned processes.

**Definition of the International Sugar Scale and its significance for the sugar industry and sugar trade.** A. Emmerich and K. Zander. *Zucker*, 1977, **30**, 490-492 (*German*).—At the 5th International Conference of OIML (International Organization of Legal Metrology), held in Paris in 1976, a revision of OIML Recommendation No. 14 on polarimetric saccharimeters was adopted. The revised recommendation includes data on construction of the instruments and their calibration with quartz control plates as well as a definition of the International Sugar Scale. Several OIML members rejected the draft revision on the grounds that the scale is not based on an international units system. The authors trace the history of the ISS and explain how the introduction of photoelectric saccharimeters necessitated modifications to the calibration process, since the optical and photoelectric instruments could not be calibrated by a common method. Proposals for a more precise definition of the scale in physical terms were submitted by the Institut für landwirtschaftliche Technologie und Zuckerindustrie to ICUMSA in 1962; however, exact measurements at precisely defined light wavelengths necessitated new basic measurements for establishment of the optical rotation of sucrose in terms of concentration, wavelength and temperature. The difficulties involved in calibration based on the modified method are discussed, and the significance of a stable monochromatic light source for calibration of optical saccharimeters is indicated. However, it was also found that a 0·1 nm change in wavelength caused a noticeable change in the measurements obtained with photoelectric instruments. Measurements of the optical rotation of sucrose at 20°C and various wavelengths showed that there was need for improvement in the method used to determine sucrose moisture content. Application of modified methods[3] showed that the earlier established formula for relative rotary dispersion at 20°C and a wavelength of 546·2271 nm could be applied at other temperatures in the range 18-30°C with sufficient accuracy. However, establishment at 546 nm of the optical rotation as a function of sucrose content and temperature difference (measurement temperature — 293·15°K) showed a difference of up to $1{\cdot}3\times10^{-2}$ degrees between the measured values and the measurements used as basis for the ISS, thus indicating the need for correction to the scale. The optical rotation at 100°S, 20°C and 546·2271 nm was 40·777°±0·001° compared with 40·765°, the value accepted by ICUMSA in 1966, i.e. a difference of 0·013° or 0·03%. The effect of such a difference on the monetary value of 81·5 million tonnes of sugar a year is briefly discussed.

[1] *I.S.J.*, 1960, **62**, 225; 1961, **63**, 352; 1962, **64**, 115, 146.
[2] Roth: *ibid.*, 1978, **80**, 154.
[3] Schneider *et al.*: *ibid.*, 1972, **74**, 120; 1976, **78**, 93, 249.

# BY-PRODUCTS

**Technical details of a process to manufacture industrial alcohol from sugar cane.** O. Maldonado R., E. C. Rolz and A. E. Humphrey. *Annales de Technologie Agricole*, 1975, **24**, (3-4), 335-342; through *S.I.A.*, 1977, **39**, Abs. 77-942.—A proposed integrated system is described with flow diagrams. Cane stalks are passed through a separator where the rind is removed; the pith and fibre undergo diffusion to extract the juice, followed by enzymic hydrolysis with cellulase to produce glucose syrup; the non-digestible residue is converted to pulp for paper. The juice and glucose syrup are together fermented by a 3-stage process: an anaerobic stage to produce alcohol, and two aerobic stages using air-lift fermenters to recover the alcohol and produce single-cell protein.

**Scale-up production of bagasse-plastic combinations by use of gamma radiation.** Ung-Ping Wang. *Ho Tzu K'o Hsueh*, 1975, **12**, (1), 12-22; through *S.I.A.*, 1977, **39**, Abs. 77-943.—Full-scale tests confirmed results obtained previously. Bagasse boards were impregnated with vinyl chloride-vinyl acetate, methyl methacrylate, styrene or methyl methacrylate-unsaturated polymer, and submitted to 1·2 MR gamma radiation to bring about polymerization. The properties of the bagasse-polymer combinations were tested. As the polymer content was increased from 0 to 50%, the tensile strength increased, the hardness increased nearly 6-fold, and the water absorption decreased from about 180% to $<$20%. The boards containing $\not>$40% polymer showed good dimensional stability in a 30-day weathering test, and suffered no insect damage during 10 months outdoors. An economic evaluation of the process is shown.

**Effects of treatment of bagasse with sodium hydroxide under steam pressure on chemical changes and digestibility. I. Effect on sample recovery and proximate composition.** S. Shiroma. *Ryukyu Daigaku Nogakubu Gakujutsu Hokoku* (Okinawa), 1974, (21), 281-303; through *S.I.A.*, 1977, **39**, Abs. 77-944.—Bagasse samples were treated with 0, 5 or 10% NaOH on dry solids at atmospheric pressure or steam pressure of 150 or 300 lb.in$^{-2}$ for 5, 15 or 25 min. All three factors affected the recovery; in particular, recovery decreased with increasing pressure. As the pressure and NaOH concentration increased, the crude protein content and N-free extract in the product decreased, while the ash and crude fibre contents increased. The increase in ash content with NaOH concentration seemed to be mainly due to retention of Na in the treated bagasse.

**Cane bagasse and its growing utilization in the production of cellulose and paper.** J. Zegarra Russo. *Papel*, 1975, (36), 49-55; through *S.I.A.*, 1977, **39**, Abs. 77-947.—The history and prospects of making cellulosic materials from bagasse are examined. Physical and chemical characteristics of bagasse from different countries are indicated, and the storage requirements and methods used in different countries are outlined. World statistics on production of bagasse in 1970 and of different types of bagasse cellulose in 1974 are included.

**Production of alcohol from bagasse.** P. Esmeris, R. Casacop, P. Chua, M. Umali and C. Gayo. *Crystallizer*, 1977, **2**, (2), 11, 20.—A theoretical technique is proposed, based on the literature of wood saccharification (and what little has been reported on bagasse saccharification) and fermentation of the product sugars. Bagasse should be oven-dried at 105°C and may be pre-treated with 1% NaOH or 1M HCl before washing and further drying at 150°C for 40 minutes, and grinding to 48-mesh size. The material may then be acid-saccharified by treatment with dilute HCl or $H_2SO_4$ under unspecified conditions (although 5% $H_2SO_4$, 1:5 cellulose:acid ratio, 30 minutes under 20 psi pressure is later indicated as optimum), and the liquor filtered and neutralized. Details are given of the culturing of *Trichoderma viridae*, a fungus which is a source of an enzyme (extracted with 0·05M sodium citrate buffer of pH 4·8) which is added at the same pH to the cellulose material and incubated at 50°C for 6 hours to effect enzymic saccharification. The sugars may be fermented with a strain of *Saccharomyces cereviseae* after dilution to 3% and addition of required nutrients.

**Utilization of bagasse.** M. C. Tseng, C. R. Phillips and J. W. Smith. *J.A.S.T.J.*, 1974, **35**, 115-120.—A description is given of the use of bagasse as a substrate for the cultivation of mushrooms, as practised in Taiwan and practical in other parts of the world.

**Production of CMC (carboxymethyl cellulose) on a pilot plant scale from the nitric-digestion cellulose of cane bagasse.** Y. A. Kostrov and C. J. Triana F. *Rev. Icidca*, 1975, **9**, (3), 3-8 (*Spanish*).—Cellulose was obtained by digestion of bagasse with nitric acid under three different regimes, and converted to carboxymethyl cellulose in each case. The characteristics of the cellulose and of the CMC were measured and the latter compared with a standard product, before and after purification. The crude CMC was of better quality than that used in the USSR for oil drilling mud, but purification by acidification, neutralization and precipitation gave a product which was of lower quality than a food-grade CMC from France.

**Influence of mass transfer on the kinetics of bagasse treatment with nitric acid.** P. López G. and J. L. González G. *Rev. Icidca*, 1975, **9**, (3), 9-14 (*Spanish*). The kinetics of nitric acid treatment were examined by passage and recirculation of the reaction liquid through a column of bagasse packed in a constant fashion, at constant temperature, using bagasse of the same source and a constant liquid:bagasse proportion such that acid consumption did not appreciably reduce its concentration. The velocity of surface flow was varied between laminar and turbulent, and the effect on the rate of reaction measured in terms of the yield of pulp after a constant time for each experiment. The results are discussed and the mass transfer rate found not to affect the reaction kinetics under the conditions employed, for flows up to 2500 cm$^3$.min$^{-1}$, but to have a significant effect at 4700 cm$^3$.min$^{-1}$. Further work needs to be done to study the region of limiting turbulence.

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**Determination of the optimum energy consumption for pulp dewatering.** H. Huber. *Zucker,* 1977, **30,** 485–489 (*German*).—The need for minimization of energy consumption in beet pulp pressing stems from shortage of fuel and the demand for reduction in environmental pollution, both factors directly or indirectly affecting the costs of the process. The author examines both mechanical and thermal dewatering, and underlines the importance of pressing for optimum dewatering, since the energy costs in pressing amount to only between one-seventh and one-tenth of the total dewatering costs, and even a slight increase in the dry solids content of the pressed pulp will have a considerable reducing effect on thermal processing costs by substantially decreasing the amount of residual moisture to be evaporated. Theoretical calculations confirmed by observations of the drying process over a number of years show that, where boiler flue gas is mixed with combustion gas, pulp drying is affected by three factors: the air factor *n* in combustion, the temperature of the boiler waste gas and the drum load. The air factor has been found not to play a decisive role, and a minimum value of 1·3 is recommended. Increase in the boiler flue gas temperature reduces the fuel consumption in drying, while a larger drum volume is of advantage over a smaller one; a graph demonstrates the effect of drum load on the relationship between inlet and outlet temperatures. Use of the formulae derived for calculation of the various parameters is demonstrated, and coal consumption per 100 kg dry pulp is indicated for pressed pulp solids contents of 18, 19, 20, 21 and 22% and drum loads of 60, 80 and 100%.

**Substituting alcohol for gasoline.** C. Alincastre. *Sugarland* (Philippines), 1977, **14,** (2), 9.—In a brief study of the economics in the Philippines of manufacturing ethyl alcohol as a substitute for gasoline, the author calculates a cost of P3·00 per litre when sugar is used (assuming a sugar price of P76·50 per picul), compared with a gasoline price of only P1·80. While the cost of alcohol manufacture from cane molasses would be much lower, at P0·75, the total molasses yield in the Philippines is sufficient to give only 50 million litres of alcohol per year in contrast to a daily requirement of 1 million litres. However, as a compromise, the author indicates the advantages of using cane juice for alcohol production. Based on a price of P75 paid to the cane farmer for 1 ton of sugar in normal cane, the cost of alcohol manufacture from the juice would be P1·74 per litre. Moreover, past experience has shown that the mash from juice fermented more rapidly and the resultant beer distilled more quickly than when molasses was used—a consequence of the higher purity of the juice.

**Winter feeding of cattle with dry pulp and beet leaves.** E. Thier. *Die Zuckerrübe,* 1977, **26,** (5), 14–15 (*German*).—While the beet crop makes available coniderable quantities of highly digestible fibre, protein and minerals for use as animal fodder, it is pointed out that beet leaves as such or as silage carry a great risk to dairy herds because of the danger of pollution by soil; moreover, no other basic fodder is considered as difficult to ensilage without risk of pollution and losses of energy and feedstuff. Incorporation of straw as a means of reducing the losses (by binding the juice which otherwise would seep away) is not practical, however. Hay or straw should be added to the silage to raise the total fibre content to at least 18% of the dry solids, and the silage should be as clean as possible. Recommended winter feeding of dairy cattle where sugar beet is normally grown or where they are reared on pasture land is indicated in the form of tables. For fattening cattle, the feed requirements are slightly different, and good results have been obtained with 75% dry pulp, 6% molasses, 15% soya flour and 4% mineral. The fibre content may be reduced to 14% of the total dry solids.

**Effect of molasses storage time on alcohol quality.** M. Ya. Savchuk, E. N. Samarskaya and Z. P. Kuz'menko. *Ferment. Spirt. Prom.,* 1975, (7), 28-30; through *S.I.A.,* 1977, **39,** Abs. 77-1070.—At Luzhanskii experimental alcohol distillery, molasses samples from neighbouring beet sugar factories were diluted to 20-21°Bx and fermented by a pure strain of yeast at 31°C for 60-65 hours. Ranges of composition of molasses and fermentation products are tabulated for (*a*) unstored molasses sampled each month from September 1973 to February 1974, and (*b*) molasses sampled in September 1973 and stored for 1-12 months. During storage, the Brix decreased while the purity increased then decreased; long storage caused the ethanol yield to increase, mainly at the expense of glycerol. Molasses from late in the campaign gave still higher ethanol yield and usually less glycerol, but more volatile acids and aldehydes.

**Effect of volatile organic acids of molasses on the alcohol fermentation process, the quality and yield of alcohol and baker's yeast.** V. N. Shvets, A. N. Ogorodnikova, T. P. Slyusarenko and V. I. Kravets. *Ferment. Spirt. Prom.,* 1976, (1), 40-43; through *S.I.A.,* 1977, **39,** Abs. 77-1072.—Synthetic media at pH 5·1-5·4, containing 13-13·5% sucrose plus various concentrations of single organic acids, were fermented at 30°C for 72 hours by four strains of yeast. Ethanol yields from hybrid yeasts were not decreased by the maximum concentrations tested, while yields from pure strains began to decrease at concentrations higher than those normally found in beet molasses. Effects of the limiting concentrations on impurities in distillate and enzyme activities of yeast are shown.

**Fermentation of molasses mash with high formation of alcohol in the wash.** S. T. Oliinichuk, Z. A. Raev, A. D. Kovalenko *et al.* *Ferment. Spirt. Prom.,* 1976, (3), 26–28; through *S.I.A.,* 1977, **39,** Abs. 77-1071. The performances of the alcohol-tolerant yeast strain III-I and the typical strain V were compared; the former fermented (beet) molasses at 26–27°Bx, containing 180-182 g sugar per litre, to give >11 vol. % ethanol in 29 hr, residual sugar being 3% on the initial quantity; the latter gave 8·5–9% ethanol from 21-22°Bx in 25 hr. Impurity contents per litre of ethanol in the final wash were: for the new strain, 2·47 g volatile acids, 0·89 g esters, 0·34 g aldehydes, 57·5 g glycerol and 2·8 mg higher alcohols; for strain V, 4·42 g, 0·6 g, 0·34 g, 56·4 g and 3·5 mg, respectively.

**Prize-winning sheep find beet tops to their liking.** D. Charlesworth. *British Sugar Beet Rev.,* 1977, **45,** (3), 37–38.—The advantages of beet tops as sheep fodder on a farm in Norfolk are discussed.

# TRADE NOTICES

**Continuous liquid sugar production.** Alfa-Laval AB, Box 1008, Lund, Sweden S-221 03.

The Alfa-Laval "Sugar-Flow" type HD system incorporates pumps, piping, control panel, sugar and water feed equipment, mixing unit, plate-type heat exchanger (for sugar dissolution) and Brix control unit (filters and equipment for handling the sugar also being supplied if required). Granulated sugar and water are fed continuously to the mixer by feeding devices adjusted to provide a Brix which is slightly higher than the final Brix. The sugar suspension passes from the mixer to the heat exchanger where the sugar is rapidly dissolved. The resultant solution may be filtered before passing through the Brix control unit which regulates the amount of water added to give the desired Brix. The liquid sugar then returns to the heat exchanger for cooling to a required temperature. The entire process can be supervised from the central control panel.

The "Sugar-Flow" type HD-AC system is the same as the type HD but also provides for decolorization by active carbon. In this system, the hot solution from the heat exchanger is injected with active carbon suspension by means of a special dosing unit and then passes to a holding tank where it remains until the required degree of decolorization has been attained. Filter aid (kieselguhr) suspension is then added by means of another dosing unit, after which it is filtered and fed through the Brix control unit as in the type HD system. Brix control accuracy is $\pm 0{\cdot}5°$. A leaflet obtainable from Alfa-Laval describes the systems and compares costs of liquid sugar production by conventional batch means and by means of the "Sugar-Flow" process, showing considerable savings in steam, water, sugar and manpower requirements to produce a maximum of 6000 litres of liquid sugar per hr at a Brix of about 65° (a maximum Brix of 70° is obtainable).

**Pre-emergence herbicides for use in sugar beet.** Fisons Ltd., Agrochemical Division, Hauxton, Cambridge, England.

Issue No. 1, 1978, of "Agrospray" features, among other items, "Morlex" pre-emergence herbicide for u s in sugar beet. It is a liquid formulation containin "Ethofumesate" ("Nortron"), "Propham", "Chlorproph am" and "Fenuron", and is recommended for both we and dry conditions at dosage rates ranging from 8 litre s $ha^{-1}$ on very light soils to 16 litres.$ha^{-1}$ on very heavy soils. The herbicide can be followed by "Betanal E" to give up to 93% overall weed control. Treatment has been found to have no adverse effect on crop stand or vigour. Application is recommended at or soon after drilling but before crop or weed emergence.

Post-emergence application of "Nortron"+"Betanal E" at a rate of 5+7 litres.$ha^{-1}$ has proved effective against weeds not controlled by "Betanal E" on its own, e.g. knot-grass having 2 true leaves, black bindweed at th 4-leaf stage, many annual grasses and late-germinating weeds. However, the mixture must not be used if t h beet is under stress or until the crop has reached the 2-4 leaf stage. It can be used safely following most pre-emergence treatments and/or "Betanal E", although a slight temporary check to the crop may occur under some conditions, recovery being rapid and complete, however. Split application of "Nortron"+"Betanal E" twice within 7 days at the rate of $2{\cdot}5 + 3{\cdot}5$ litres.$ha^{-1}$ reduces the risk of crop check; the first application should be made at the 2-leaf stage of the beet. All the mixture should be applied within 2 hours of mixing to avoid crystallization and nozzle blockage. ("Isophorone" is a Fisons product available for dissolution of the crystals.) "Betanal E" should not be applied until the crop has recovered from wind damage, where this has occurred, and should not be sprayed on a stress-affected crop under high light intensity conditions, since it may cause a check from which the crop may not fully recover. Another Fisons product, "Tornado", has given satisfactory control of the green peach aphid *Myzus persicae* and hence of virus yellows in tests conducted over a number of years, and is recommended for this purpose. Its active ingredient is "Acephate".

## PUBLICATIONS RECEIVED

**Pressure regulators.** Tescom Corporation, 2600 Niagara Lane North, Minneapolis, MN, USA 55441.

A small folded pamphlet describes and illustrates the range of pressure regulators available from Tescom to cover pressures from 5 to 15,000 psig.

**Chemicals information handbook 1977-78.** Shell International Chemical Co. Ltd., Shell Centre, London, England SE1 7PG.

This is a 96-page booklet giving outline information on the world chemical industry and companies involved. It describes the chemical business of the Royal Dutch/Shell Group of companies and the group's organization, and provides information on chemicals produced, chemical plants and their capacities, and chemicals obtainable from Shell, including pesticides and herbicides.

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**Mini-diffuser.**—Extraction De Smet S.A. has developed a stainless steel mini-diffuser having a screen belt only 40 cm wide. Intended for semi-industrial laboratory tests or for industrial extraction of special products, it has an hourly throughput ranging from 400 to 1000 kg. It is available with or without heating facilities, and both extraction time and material bed thickness are adjustable within ample limits. The unit can be supplied with between 5 and 20 (or even more) extraction stages according to customer requirements.

**Bagging plant for beet pulp nuts.**—W. W. Brown & Partners Ltd. have been given a contract to construct a new pulp nut bagging and outloading plant at the Cantley factory of the British Sugar Corporation. The nuts, used as animal fodder, are conveyed from pelleting machines to four bagging stations via troughed belt conveyors and a belt and bucket elevator at a rate of 60 tonnes.$hr^{-1}$; at the bagging stations, the nuts are automatically weighed and fed into 50-kg bags which are conveyed on a series of flat belt conveyors, and a powered roller conveyor, to four road truck loading stations or to two railway loading bays, where they are discharged by mobile belt-type ploughs. The bagging plant can be by-passed to permit the nuts to be loaded into bulk road vehicles or to a stockpile under cover.

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

# West Germany sugar exports[1]

| | 1977 | 1976 | 1975 |
|---|---|---|---|
| | | *tonnes, tel quel* | |
| *Raw sugar* | | | |
| Portugal | 12,730 | 0 | 0 |
| Rumania | 7,119 | 0 | 0 |
| UK | 3,197 | 0 | 0 |
| Other countries | 55 | 11 | 32 |
| | 23,101 | 11 | 32 |
| *White sugar* | | | |
| Afars & Issas | 3,200 | 0 | 0 |
| Algeria | 0 | 0 | 1,564 |
| Angola | 0 | 3,254 | 0 |
| Austria | 1,233 | 146 | 63 |
| Belgium/Luxembourg | 5,477 | 11,157 | 866 |
| Bulgaria | 0 | 9,999 | 0 |
| Burundi | 1,600 | 0 | 100 |
| Canada | 523 | 0 | 0 |
| Colombia | 8,000 | 0 | 0 |
| Cyprus | 8,886 | 3,713 | 200 |
| Denmark | 9,549 | 29,359 | 661 |
| Egypt | 1,222 | 142 | 82 |
| Finland | 5,275 | 0 | 0 |
| France | 4,389 | 3,561 | 580 |
| French Polynesia | 1,120 | 1,413 | 0 |
| Gambia | 4,922 | 2,069 | 500 |
| Holland | 4,070 | 3,475 | 2,225 |
| Hong Kong | 1,912 | 0 | 0 |
| Hungary | 21,650 | 0 | 1,600 |
| Iceland | 1,690 | 1,979 | 65 |
| Indonesia | 334 | 0 | 0 |
| Iran | 1,446 | 42 | 0 |
| Ireland | 0 | 0 | 2,260 |
| Israel | 31,451 | 9,639 | 2,278 |
| Italy | 182,886 | 89,722 | 97,610 |
| Ivory Coast | 0 | 100 | 150 |
| Jordan | 2,221 | 0 | 0 |
| Kenya | 3,475 | 2,700 | 0 |
| Kuwait | 6,475 | 975 | 0 |
| Lebanon | 7,178 | 150 | 0 |
| Liberia | 3,576 | 905 | 0 |
| Maldives | 3,084 | 600 | 0 |
| Malta | 1,700 | 200 | 0 |
| Mauritania | 1,263 | 0 | 0 |
| Morocco | 1,029 | 0 | 0 |
| New Caledonia | 941 | 210 | 130 |
| Nigeria | 43,700 | 13,313 | 1,735 |
| Norway | 25,444 | 8,337 | 1,660 |
| Oman | 4,776 | 700 | 100 |
| Papua | 2,020 | 822 | 0 |
| Saudi Arabia | 8,259 | 0 | 0 |
| Sierra Leone | 2,908 | 1,050 | 200 |
| Sri Lanka | 2,486 | 0 | 0 |
| Surinam | 600 | 0 | 0 |
| Sweden | 5,566 | 1,507 | 0 |
| Switzerland | 116,980 | 31,143 | 4,150 |
| Syria | 1,150 | 250 | 0 |
| UK | 51,755 | 42,808 | 110,135 |
| United Arab Emirates | 4,451 | 1,782 | 0 |
| USA | 16,496 | 822 | 0 |
| USSR | 14,785 | 1,412 | 0 |
| Yugoslavia | 0 | 12,476 | 0 |
| Other countries | 1,347 | 322 | 247 |
| Total | 634,500 | 292,254 | 229,161 |
| Total, raw value | 689,674 | 317,668 | 249,088 |
| Grand total, raw value | 712,775 | 317,679 | 249,120 |

**Fiji sugar exports 1977**[2].—Exports of sugar by Fiji in 1977 totalled 318,050 tonnes, raw value, of which 182,109 tonnes were to the UK with 44,861 tonnes to New Zealand, 37,291 tonnes to Malaysia, 37,237 tonnes to Singapore and the remaining 16,552 to the USA. In 1976 exports were 256,676 tonnes, of which 178,458 tonnes were to the UK, 42,029 tonnes to New Zealand, 18,095 tonnes to Singapore and 18,094 tonnes to Malaysia.

# Portugal sugar imports[3]

| | 1977 | 1976 | 1975 |
|---|---|---|---|
| | | *tonnes, raw value* | |
| Argentina | 33,774 | 10,742 | 0 |
| Brazil | 56,483 | 13,079 | 34,486 |
| China | 0 | 6,314 | 0 |
| Cuba | 56,254 | 61,409 | 77,379 |
| Dominican Republic | 23,143 | 0 | 13,078 |
| Guatemala | 0 | 0 | 13,053 |
| India | 0 | 11,986 | 0 |
| Jamaica | 11,137 | 0 | 0 |
| Mexico | 0 | 0 | 26,166 |
| Mozambique | 0 | 23,041 | 25,624 |
| Peru | 13,150 | 18,124 | 0 |
| Philippines | 0 | 13,200 | 0 |
| Réunion | 10,348 | 33,692 | 0 |
| Salvador | 0 | 0 | 9,485 |
| South Africa | 11,189 | 0 | 0 |
| Other countries | 48,770 | 25,910 | 75,982 |
| Total | 264,248 | 217,497 | 275,253 |

**Spanish sugar production target, 1978/79**[4].—The Spanish Government has set a production target of 987,000 tonnes of sugar for the 1978/79 crop, comprising 962,000 tonnes of beet sugar and 25,000 tonnes of cane sugar, under a decree announced in Madrid. This compares with a production target in the 1977/78 season of 1,160,000 tonnes and estimated actual production of 1,130,000 tonnes. Spain has a sugar surplus estimated by industry sources at 600,000 tonnes, roughly two-thirds of annual consumption. The sources say, however, that the new target will limit large growers to about 83% of their production target last year, while small growers will be unaffected. Under the decree, the Government announced price increases of 5% for large beet and cane growers for the 1978/79 season but gave small growers an increase of 11%. The decree sets the official price at 3200 pesetas per tonne of beet, but growers producing less than 200 tonnes will obtain Pts. 3550. A tonne of cane will be priced at Pts. 2240 but farmers growing less than 300 tonnes will be paid Pts. 2485.

**New Guatemala sugar factory**[5].—Agro-Industrias Agroinsa S.A. of Guatemala is building a sugar factory in the department of Escuintla. The factory will have a daily cane crushing capacity of 3500 tonnes. The project is based on the relocation of the "Terrebonne" factory from Montegut, Louisiana. The factory will be completely redesigned and modernized. The new factory, to be known as Ingenio Tierra Buena, is scheduled to start-up in late 1978. It will produce raw as well as plantation white sugar.

***Australian Society of Sugar Cane Technologists.***—At their recent 1978 annual meeting, it was decided that the former Queensland Society of Sugar Cane Technologists would henceforth be the Australian Society of Sugar Cane Technologists. While Queensland is by far the largest sugar producing State, there are cane sugar factories in New South Wales and refineries in a number of States, while studies have been made for sugar projects in Tasmania and Western Australia.

**Malawi sugar statistics**[6].—Sugar production in Malawi in 1977 reached 95,273 tonnes, raw value, as against 87,237 tonnes in 1976. During the year domestic consumption fell to 32,332 tonnes from 37,148 tonnes in 1976, while exports totalled 63,006 tonnes of which 18,629 tonnes went to the EEC, 42,823 to the USA and 1554 tonnes to Zambia. In 1976 exports totalled 40,347 tonnes, of which 24,217 tonnes went to the EEC and 16,130 tonnes to the USA.

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (14), S4–S6.
[2] *I.S.O. Stat. Bull.*, 1978, **37**, (3), 44.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (14), S9.
[4] *Public Ledger*, 13th May 1978.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (11), 12.
[6] *I.S.O. Stat. Bull.*, 1978, **37**, (3), 69.

# Canada sugar imports 1977[1]

| | 1977 | 1976 |
|---|---|---|
| *Raw sugar* | —— *tonnes, tel quel* —— | |
| Australia | 512,373 | 391,701 |
| Cuba | 101,390 | 132,942 |
| Guyana | 20,552 | 5,568 |
| Jamaica | 70,108 | 0 |
| Mauritius | 25,788 | 4,101 |
| Peru | 10,668 | 0 |
| South Africa | 301,735 | 319,639 |
| Swaziland | 12,958 | 0 |
| Trinidad & Tobago | 5,314 | 10,717 |
| Other countries | 3 | 31 |
| Total | 1,060,889 | 864,699 |
| *Refined sugar* | | |
| Holland | 419 | 201 |
| USA | 4,603 | 35,132 |
| Other countries | 189 | 71 |
| Total | 5,211 | 35,404 |

# South Africa sugar exports 1977[3]

| | 1977 | 1976 | 1975 |
|---|---|---|---|
| | ——— | *tonnes, raw value* | ——— |
| Canada | 341,338 | 302,453 | 281,894 |
| Hong Kong | 361 | 209 | 0 |
| Israel | 0 | 8,894 | 2,155 |
| Japan | 696,123 | 477,354 | 372,110 |
| Korea, South | 34,619 | 0 | 0 |
| Lebanon | 6,003 | 0 | 0 |
| Portugal | 23,954 | 0 | 0 |
| UK | 22,113 | 0 | 13,222 |
| USA | 252,724 | 65,393 | 129,838 |
| Other countries | 6,632 | 5,552 | 9,141 |
| Total | 1,383,867 | 859,855 | 808,360 |

**Swaziland sugar exports, 1977**[2].—Exports of sugar by Swaziland totalled 213,600 tonnes, raw value, against 209,059 tonnes in 1976. The UK was the destination receiving most (116,347 tonnes in 1977 and 139,012 tonnes in 1976), while 69,871 tonnes went to the USA (42,117 tonnes in 1976) and 27,382 tonnes to Canada (27,930 in 1976).

**World sugar publications.**—During the last two decades there have been tremendous changes in the world sugar industry and market, but economic and statistical information available to those in the industry has largely remained unchanged during this period in both content and presentation. For example, country-by-country estimates were available for production alone. However, the situation has been rectified by two new publications launched in June 1978, which attempt to take account of the continuously changing circumstances. The *World Sugar Journal* and the supplementary background handbook, *World Sugar Statistics,* will be of interest to sugar producers, traders, policy institutions, associations, refiners, academics, researchers, etc. All statistical information contained in these publications are based on national crop years separating new from old crops. This approach facilitates a more accurate assessment of the supply and demand situation in any given year for each individual country, and therefore for the whole world. In order to give a comprehensive picture of development in the sugar world, the *Journal* combines statistics covering production, consumption and stocks for each country, with in-depth comments and analyses of topical matters of importance within the industry, including on-the-spot study of selected sugar industries; interviews with leading sugar personalities; price analysis; etc. Emphasis is given to the clear and precise presentation of information throughout and each issue will contain an Executive Summary in English and Spanish so that vital facts are easily accessible. *World Sugar Statistics* is a handy-sized publication with country-by-country statistics in the form of supply and distribution tables from 1965/66, including estimates for 1977/78. This convenient reference source will be up-dated each month with additional pages distributed with the *World Sugar Journal,* ensuring that the readers' copies are up-to-date at all times. The editor-in-chief of both publications is Mr. N. G. Osman, who has been very closely involved with forecasting and analysis of sugar economics and statistics for many years. Between 1965 and 1976 he was Head of the Economic and Statistics Department of the International Sugar Organization and was later appointed Vice-President with the Connell Rice & Sugar Co. Inc., U.S.A. Further information is available from World Commodity Publishing Inc., c/o PHM (Mailing Services) Ltd., Baker Street, High Wycombe, Buckinghamshire, England.

**Errata.**—In Fig. 1 on p. 165 of our June issue, the formula for diacetone alcohol should read $(CH_3)_2C(OH)CH_2COCH_3$ instead of $(CH_3)_2C(OH)CHCOCH_3$.

**Vietnam sugar study**[4].—A/S De Danske Sukkerfabrikker' together with representatives of the Vietnam sugar industry, have been analysing the possibility of setting up a sugar factory near Ho-Chi-Minh City, formerly Saigon. It is hoped that the contract for the new sugar factory will be signed this year.

## PERSONAL NOTES

We regret to report the death on 3rd June of **Sir Ian Lyle,** until March of this year President of Tate & Lyle Ltd. Born in 1907, he joined the Company in 1931, becoming a director four years later. With a break for war service with the Royal Navy he served on the Board until his retirement this year and played an important role during the fight against nationalization in 1949/50. He was Chairman during the later period of home and overseas expansion by Tate & Lyle, becoming President in 1957. He was knighted in 1959.

**Charles Davis,** Chief Chemist of CSR Ltd., retired in March 1978 after a long and successful career. Born in New Zealand, he joined CSR after graduating from the University of Auckland, and worked under a fellow New Zealander, the then Chief Chemist, Dr. Harman. He became Chief Chemist himself in 1950, in succession to Dr. (later Sir James) Vernon who became General Manager. Work on the development of a chemical industry based on alcohol as a raw material led to the establishment of CSR Chemicals, a division in the formation of which he played a major role. Mr. Davis also played an active part in promoting cane quality control and improvement in Australia and in the work of ICUMSA.

**Clair H. Iverson** has been appointed Chief Engineer of Silver Engineering Works Inc., the sugar machinery manufacturers of Denver, Colorado. Mr. Iverson, a registered Professional Engineer, comes to Silver from the URS Company, prior to which he had spent 25 years with the Great Western Sugar Company. During his years at Great Western, he designed one of the first totally-closed waste water systems in the sugar industry and directed the design and construction of capital improvement projects in GW sugar factories. Mr. Iverson is also an instructor for the Beet Sugar Institute at Colorado State University.

**Sir Guy Sauzier,** C.B.E., General Overseas Representative of the Mauritius Chamber of Agriculture and of the Mauritius Sugar Syndicate, will be on leave from 1st July 1978, prior to retirement. Sur Guy joined the Chamber as its Secretary in 1946 and was appointed to his present position in 1959, subsequently leading his country's delegations to the annual discussions held under the Commonwealth Sugar Agreement and to the several International Sugar Conferences. He has held the offices of Executive Committee Chairman of the I.S.O. and Chairman of the International Sugar Council, and was knighted in 1973. He will be replaced by Mr. Bernard O. Boullé, Deputy General Overseas Representative of the Chamber and Syndicate.

[1] C. Czarnikow Ltd., *Sugar Review,* 1978, (1386), 85.
[2] *I.S.O. Stat. Bull.,* 1978, **37,** (3), 97.
[3] *Lamborn,* 1978, **56,** 80.
[4] F. O. Licht, *International Sugar Rpt.,* 1978, **110,** (12), 13.

# Index to Advertisers



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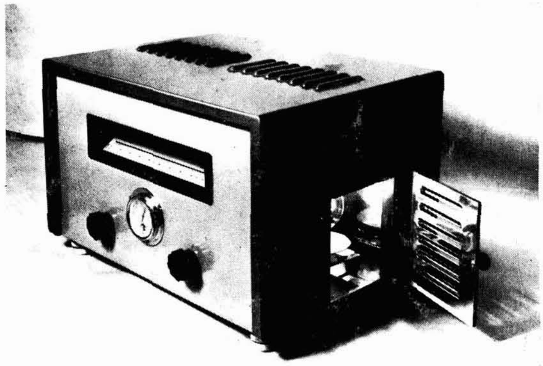

Type CB

### MOISTURE BALANCE

The type CB automatic moisture balance illustrated here, is used for determining rapidly the moisture content of sugar. The *balance is* capable of an accuracy of ±0.05% when 10 grm samples are used.

Heating is by infra-red lamp built into the equipment giving a maximum temperature of 130°C regulated by means of a resistance knob outside the body of the balance.

Aluminous spot projected on to a scale ranged 0/20% gives the moisture content directly at any instant of drying. The balance equipment is magnetically damped and is highly accurate.

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All that is necessary is for the 10 grm sample to be weighed into the aluminium dish which is placed in the oven. The lamp is switched on, temperature adjusted and the spot read from time to time. As soon as two consecutive readings agree, the moisture content can be read directly on the scale.

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The electrode system comprises a copper rod of ⅛ inch (3.18 mm) diameter which is connected to the positive terminal on the instrument panel and a platinum wire electrode connected to the negative terminal, both of sufficient length to permit adjustment so that they are always immersed in the solution under test. These electrodes are held in a rubber bung. Also fitted through the bung are a jet for the admission of the titration solution and a bent glass tube to act as a steam outlet. The bung is then introduced into the neck of a 250 ml flat bottomed flask.

For analytical comparison with the standard Lane & Eynon modified procedure, see *I.S.J.*, June 1966, p. 173.

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