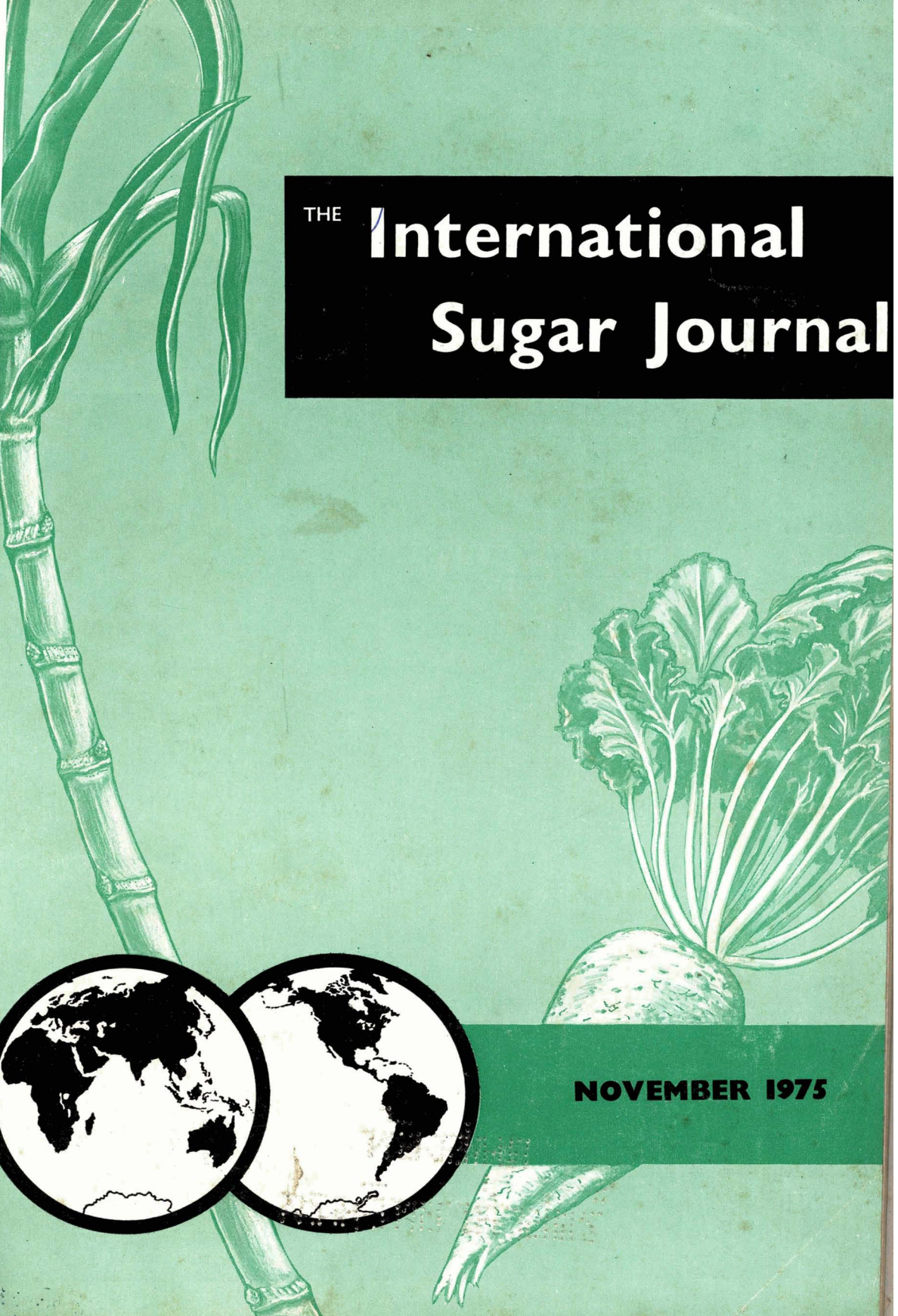
# THE International Sugar Journal



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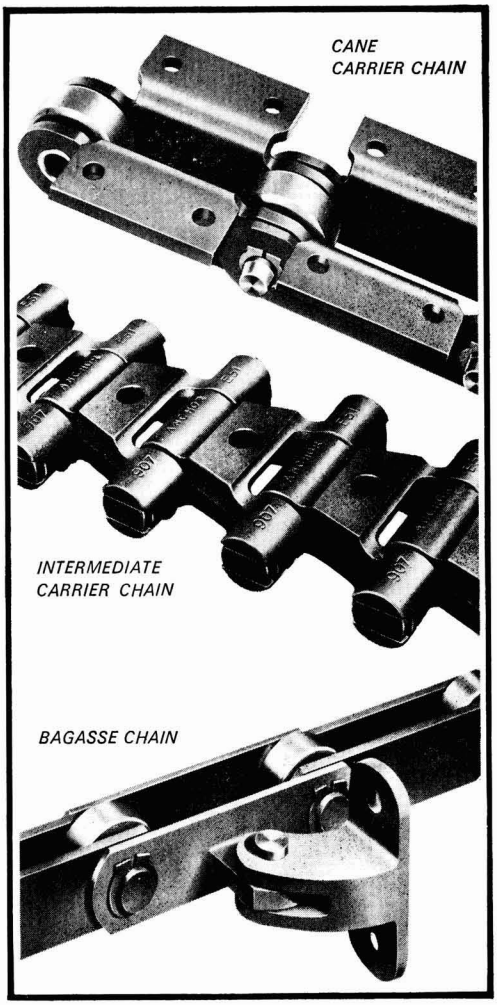

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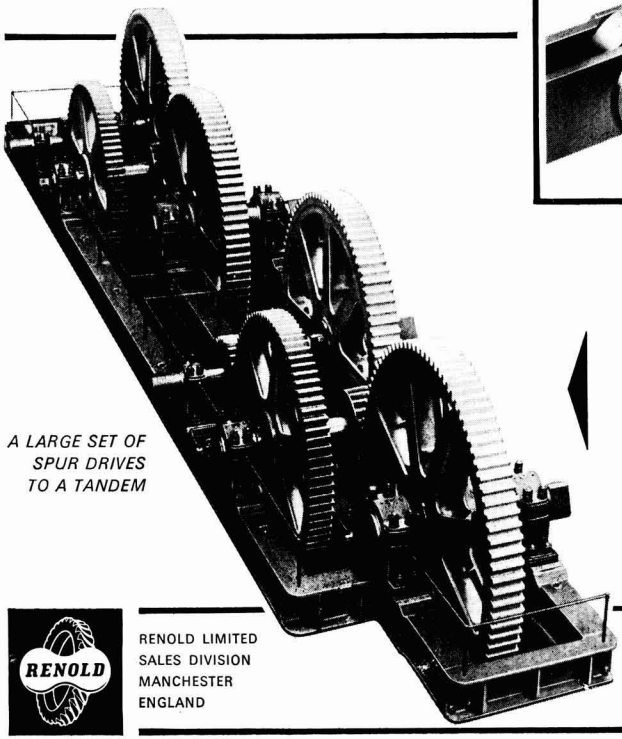

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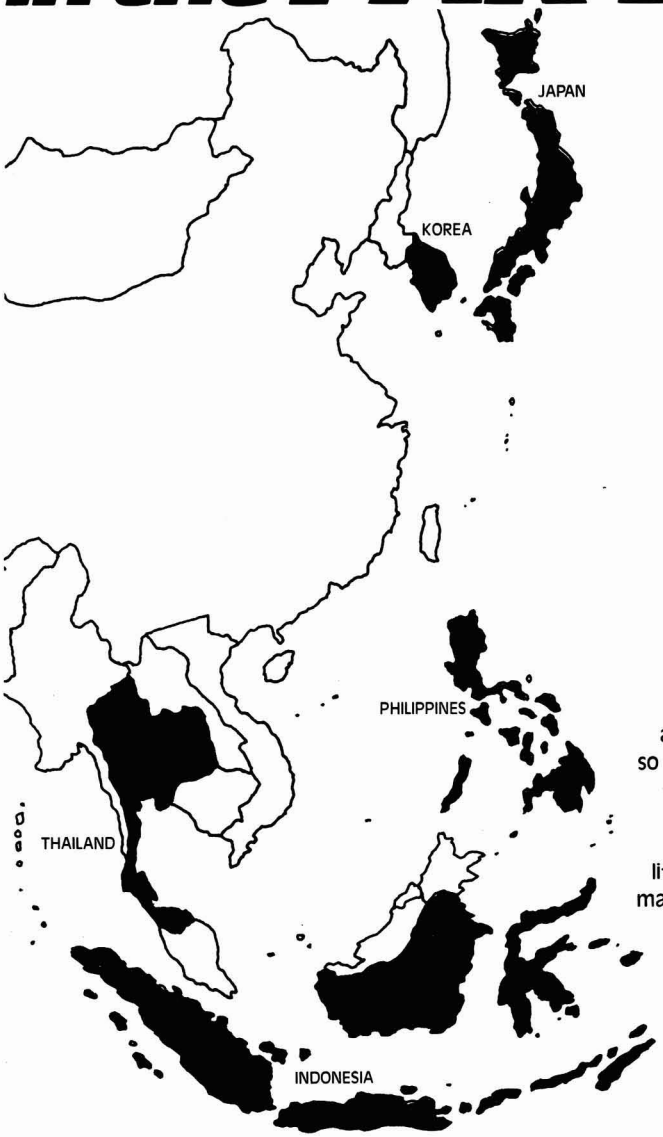


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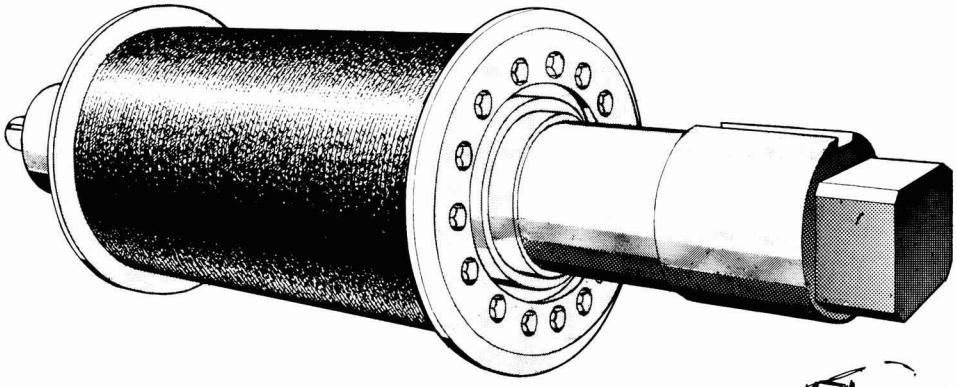

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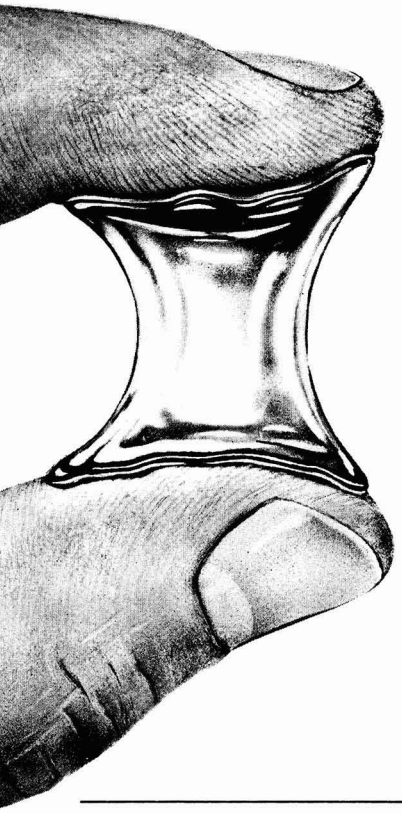

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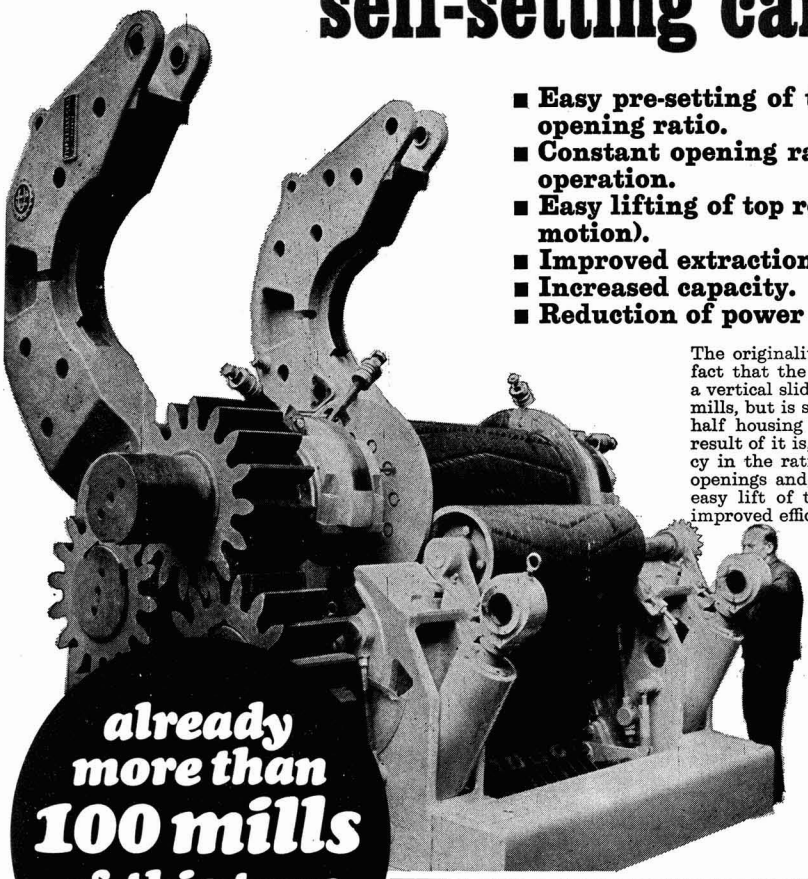

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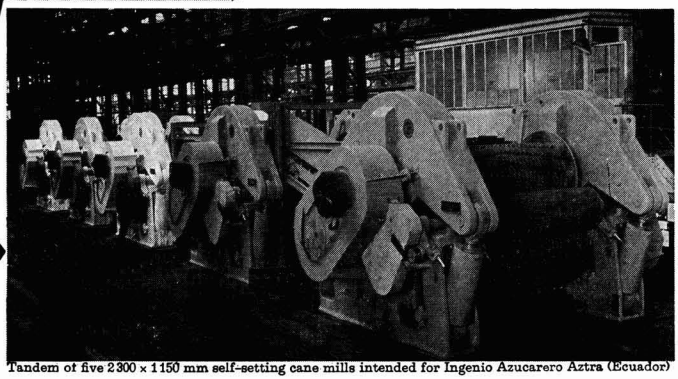

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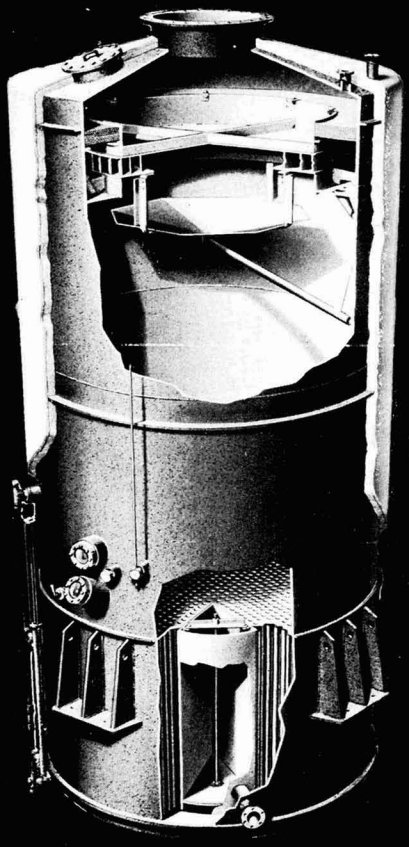

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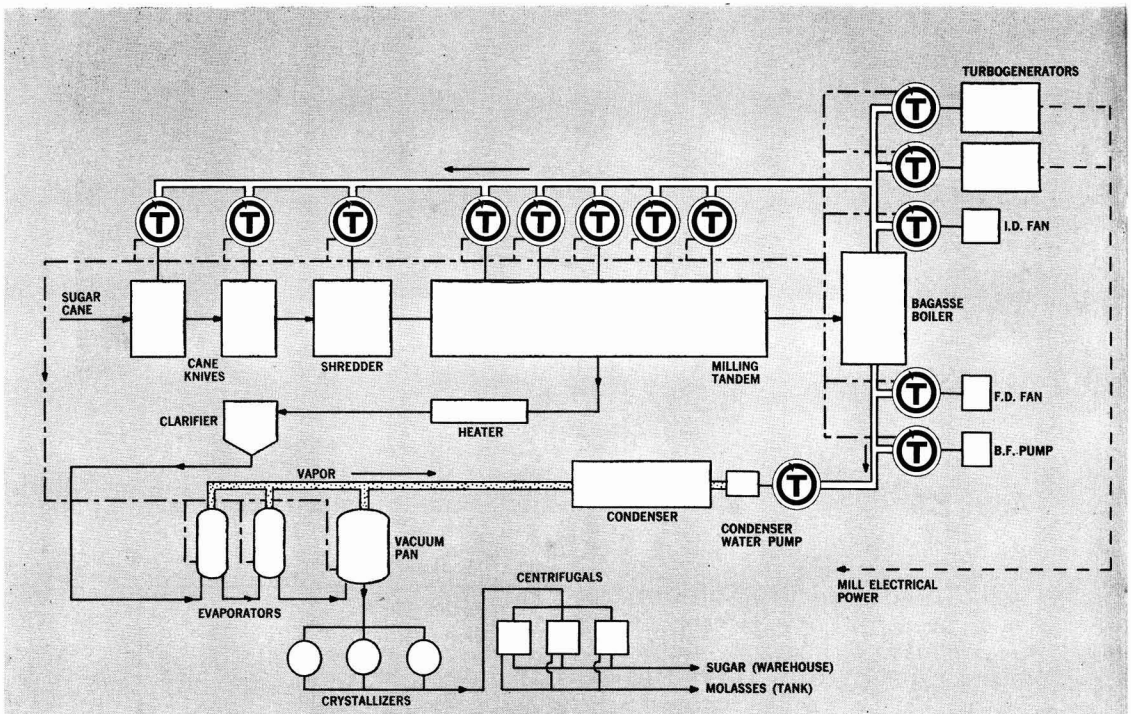


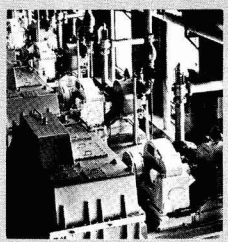

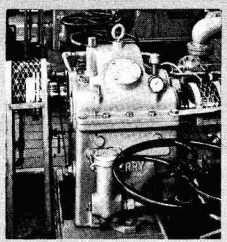

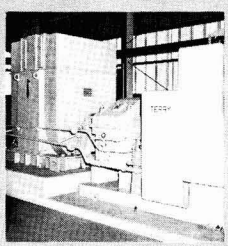

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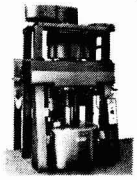


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**The International Sugar Journal Ltd.,**
23a Easton Street, High Wycombe,
Bucks., England.
*Telephone:* High Wycombe 29408
*Cable:* Sugaphilos, High Wycombe
*Telex:* 21792 REF 869

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*UK ISSN 0020–8841*

# International Sugar Journal

## November 1975

### *Contents*

# SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

**Utilisations industrielles du saccharose.** A. J. VLITOS. *p.* 323–326

On discute du saccharose en tant que matériau de départ potentiel pour la synthèse de produits chimiques. Tandis que les produits issus de la dégradation du saccharose sont de faible poids moléculaire et peuvent, par conséquent, être produits avantageusement à partir de sources de carbone moins chères que le saccharose, de nombreux dérivés du saccharose peuvent être fabriqués par synthèse avec ou sans utilisation de solvants. On examine les divers types de réactions ainsi que les dérivés formés, en incluant les réactions au cours desquelles la molecule de saccharose est modifiée par l'action de microorganismes pour l'obtention de matériaux valables.

* * *

**Protection de la recolte de canne à sucre contre le gel.** D. P. GOWING. *p.* 326–329

On discute des causes de gel et des principes de la protection de la récolte, et l'on décrit les méthodes utilisées en agriculture de canne sur base de l'expérience accumulée par l'auteur à Haft Tappeh en Iran. On en conclut de l'insuffisance des moyens mis en oeuvre pour combattre le gel dans les contrées de culture de canne et l'on présente un certain nombre de mesures à prendre allant de pair avec une diminution des pertes.

* * *

**Diffusion en Afrique du Sud. IIe Partie.** J. FITZGERALD et J. P. LAMUSSE. *p.* 329–332

On décrit les installations de diffusion de canne en Afrique du Sud et l'on fait ressortir le fait que les opérateurs ne se sont pas encore mis d'accord sur les valeurs optimales de température et de pH, tandis que la différence majeure se situe au niveau du traitement de l'eau de presse. On examine aussi la préparation de la canne ainsi que l'élimination de l'eau de la bagasse, tandis que la majeure partie de l'article est consacrée à la qualité du jus brut et de son effet sur la marche de la station d'évaporation. Dans l'appendice, on donne des details sur la méthode utilisée pour la détermination de l'Index de Préparation de la canne.

---

**Industrielle Verwendung von Saccharose.** A. J. VLITOS. *S.* 323–326

Der Anwendungsbereich von Saccharose als Ausgangsmaterial für Chemikalien wird diskutiert. Während die Abbauprodukte der Saccharose ein niedriges Molekulargewicht besitzen und daher ohne weiteres aus Kohlenstoffverbindungen hergestellt werden können, die billiger als Saccharose sind, gibt es eine Reihe von Saccharosederivaten, die auf dem Wege der Synthese mit oder ohne Lösungsmittel gewonnen werden können. Der Verfasser untersucht die verschiedenen Reaktionsmöglichkeiten und die dabei entstehenden Derivate. In diese Betrachtung sind die Reaktionen eingeschlossen, bei denen das Saccharosemolekül durch Mikroorganismen modifiziert wird und auf diese Weise wertvolle Stoffe entstehen.

* * *

**Schutz der Zuckerrohrernte vor Frost.** D. P. GOWING. *S.* 326–329

Die Frostschäden und die Grundlagen des Ernteschutzes werden diskutiert. Ferner werden die auf Grund Erfahrungen des Verfassers in Haft Tappeh im Iran im Zuckerrohranbau verwendeten Methoden beschrieben. Es wird der Schluss gezogen, dass nicht genügend getan wird, um den Frost in zuckerrohranbauenden Ländern zu bekämpfen. Zum Schluss wird eine Anzahl von empfehlenswerten Massnahmen zur Verringerung der Verluste vorgestellt.

* * *

**Die Diffusion in Südafrika. Teil II.** J. FITZGERALD und J. P. LAMUSSE. *S.* 329–332

Die Verfasser beschreiben die Arbeitsbedingungen für Rohrdiffuseure in Südafrika. Es wird darauf hingewiesen, dass sich das technische Personal noch nicht auf eine optimale Temperatur und einen optimalen pH-Wert geeinigt hat; die grössten Unterschiede finden sich jedoch bei der Presswasserbehandlung. Ferner werden die Vorbereitung des Zuckerrohrs und die Entwässerung der Bagasse behandelt. Der grössere Teil der Arbeit beschäftigt sich jedoch mit der Beschaffenheit des Rohsaftes und ihrem Einfluss auf die Leistung im Zuckerhaus. In einem Anhang sind Einzelheiten über die Methode angegeben, die zur Bestimmung des "Preparation Index" des Zuckerrohrs benutzt wird.

---

**Empleos industriales de sacarosa.** A. J. VLITOS. *Pág.* 323–326

El potencial de sacarosa como materia de partida en la producción de sustancias químicas se discute; mientras produtos de la degradación de sacarosa son de bajo peso molecular y por eso pueden producirse facilmente de fuentes de carbón más barato que sacarosa, hay muchos derivados que pueden producirse por síntesis con o sin el uso de disolventes. Los varios tipos de reacción y los derivados resultantes se examinan, incluyendo reacciones en que la molécula de sacarosa es modificado por micro-organismos para rendir materias de valor.

* * *

**Protección de la cosecha de caña de azúcar contra helada.** D. P. GOWING. *Pág.* 326–329

Las causas de helada y principios de la protección de cosechas se discuten, y se describen métodos usado en la agricultura de caña sobre el base del experiencia del autor a Haft Tappeh en Irán. Concluye que medidas para combatir contra helada en paises cañeros estan insuficiente y algunas recomendaciones se presentan para reducir al mínimo las pérdidas.

* * *

**Difusión en Sud-Africa. Parte II.** J. FITZGERALD y J. P. LAMUSSE. *Pág.* 329–332

Procedimientos de operación de difusores de caña en Sud-Africa se describen y se nota que operadores aun no estan en acuerdo en respecto a la pH y temperatura óptima, mientras la diferencia mayor reside en el tratamiento de la agua de prensa. Preparación de caña y desagüe de bagazo se examinan también, mientras mucho del artículo se dedica a la calidad de jugo crudo y su efecto sobre operación en la casa de calderas. En un apendice se presentan detalles del método usado para determinar el Indice de Preparación de Caña.

THE

# INTERNATIONAL SUGAR JOURNAL

VOL. LXXVII NOVEMBER 1975 No. 923

## Notes & Comments

### World sugar prices

During September there was a gradual lowering of both raw and white sugar prices on the London Market, raw values falling from £195 to £159 and whites from £205 to £173. No dramatic events caused the slide, which was a continuation but at a gentler rate of that experienced in the previous month, but all requirements met more than adequate availabilities. White sugar on offer from India and the Far East permitted the LDP(W) to continue its fall to £165 in the first few days of October after which it started to improve as had the raw sugar LDP from the 1st October, following news of substantial damage to the Brazilian sugar crop by the frosts reported earlier.

Discussing prospects for the future, E. D. & F. Man[1] comment: "The probability is that there will be a surplus of sugar in the world over the next months. Despite European weather conditions, innumerable European beet tests and several travelling cyclones, the world will probably produce between 83 and 84½ million tons of sugar. Consumption on the other hand is more difficult to guess, and the extent of the effect on consumption of higher prices will take time to show up. In our opinion the consumption will be something between 79 and 81 million tons. Consequently we are envisaging a surplus of 2 to 5 million tons. With such a statistical outlook one would expect buyers to hold back from any restocking programme until prices fall. Sellers on the other hand would presumably prefer to sell while prices are still above production costs with the depressing prospect ahead of some people having unsold sugar at the end of the year. There are still people in the market who expect that Russia will buy and we must say that, if that were to happen, it would have a dramatic short-term effect on prices. In the long run it would not change the balance from surplus to deficit and, therefore, the lower prices could still be expected later. Sentiment which is still a major factor in the market does not yet seem to agree with logic. Our conclusion, therefore, is that prices will ease a little, but slowly, and the only chance of a real jump up would be Russian buying".

* * *

### UNCTAD Commodities Committee meeting

A meeting of the 87-member committee was held in Geneva during the 21st–25th July to consider the proposal for establishment of a $6000 million fund for financing stockpiles of ten commodities, including sugar. The aim of such a programme is to regulate prices and ensure supplies of the commodities but in an integrated scheme instead of on an individual basis as at present and in the past. The scheme envisages that finance would be provided by importing and exporting countries, the oil-producing states, the International Monetary Fund and the World Bank as well as by borrowing on the capital market with such loans protected by a levy on the commodities.

The main trading nations represented at the Committee were circumspect in their reactions to the proposal but the Secretary-General of UNCTAD was instructed to consult with individual governments, prior to the fourth UNCTAD General Conference, to be held in Nairobi early next summer.

A warning about agreements was given in a talk to the Royal Institute of International Affairs by R. A. PERLMAN, Director of the Commodities Research Unit[2], who pointed out that only if consuming countries can be persuaded that commodity agreements are in their own interests will they accede to them. Indexation of prices could not be forced on importing countries without the requisite discipline on the part of producers and, if that discipline was present, there was little need for consumer cooperation.

A multi-commodity stockpile as proposed by UNCTAD would both add to the prospects of success and detract from them. Funding should be easier as widening of the commodity package reduced the risk of the operation, since there was less exposure on any one commodity. So long as it was likely that prices for different commodities would move in different directions, the multi scheme would also tend to reduce day-to-day financing costs, as sales of one commodity would contribute to the fund's liquidity as purchases of another mopped it up.

But administrative arguments, disputes about management price ranges and so on would be multiplied in a multi-commodity scheme and, although the risk on each component might be reduced, the total sum involved would be vastly greater than for a single commodity buffer stock.

* * *

### Metrication of London Terminal Market[3]

It has been decided that the price and quantity units of the No. 2 Raw Sugar and No. 2A White Sugar Conversions Contracts shall be changed from a long

[1] *The Sugar Situation*, 1975, (292).
[2] *The Times*, 28th July 1975.
[3] C. Czarnikow Ltd. *Sugar Review*, 1975, (1250), 158.

ton to a metric ton basis for all contracts for delivery from March 1977 onwards. Quotations in March 1977 commenced on 29th September for the No. 2A Contract and on 1st October for the No. 2 Contract.

The LDP and LDP(W) will be quoted on a metric ton basis with effect from 3rd January 1977.

* * *

**Brazilian crop damage**[1]

Market observers are well aware that there is a tendency for intitial reports of crop damage occasioned by adverse weather conditions to be exaggerated. Consequently when it was reported in July of this year that the cane crop in the southern states of Brazil had suffered severely from frost damage there was an impression that losses might eventually be found to be less than at first suggested.

In fact, nothing could have been further from the truth. As the weeks have gone by it has become increasingly clear that the Brazilian 1975/76 crop has sustained disastrous damage, which will lead to a substantial reduction in exports.

At the beginning of the campaign a sugar target of 7,740,000 metric tons, tel quel, was set, out of which some 2·6 million tons were earmarked for export, while reserves set aside of more than 400,000 tons could no doubt have been drawn upon either for domestic consumption or exports, should the need have arisen.

It soon became apparent, however, that the crop in São Paulo, the largest producing state, would not come up to expectations and the quantity earmarked for export had to be reduced by more than 400,000 tons.

Within a few weeks came the reports of crop damage from frost with first indications being that the total output would be down by something of the order of a further 400,000 tons.

It now seems that this was very much a conservative estimate. Some reports suggest the crop will amount to not more than 6·3 million tons while others speak of even lower figures. Certainly exports will have to be severely curtailed and it is probable that they will not exceed 1·4 million tons. Most of this sugar must already be earmarked for shipment under long term arrangements and to the United States. Consequently Brazilian sugar is unlikely to feature largely in the world market for some months to come.

* * *

**US sugar prices and consumption**[2]

US raw sugar prices were expected to average between $17 and $22 per 100 lb during the autumn of 1975 as against $20 in July and a peak of $64.50 in November 1974. The average price for the calendar year 1975 is expected to be between $20 and $25, down from the $29.50 per 100 lb average for 1974. Crop prospects indicate an increase of 25–30% in sugar beet production over the 22·1 million short tons harvested in 1974 despite flooding in the Red River Valley in July which caused extensive damage and reduced potential output by 50,000 tons of sugar. An increase of 6% in cane area and good growing conditions suggest a cane yield up to 12–16% over that of 1974.

Total domestic sugar stocks of 1·15 million tons as at 1st August were down more than 300,000 tons, raw value, from a year ago. Both beet sugar firms and cane sugar refiners are maintaining substantially smaller stocks than in past years.

With sharply higher prices for sugar and sugar-containing products, per caput US refined sugar consumption declined in 1974 and is declining further this year. Per caput use may total less than 90 pounds, down from 97 pounds in 1974 and a recent high of 103 pounds in 1972. Not since the sugar-short years during and following World War II has US per caput consumption dropped below 90 pounds.

Because of reduced US demand, sugar imports will be down sharply from the 5·8 million short tons (raw value) imported last year. Up to the 12th July, total imports were running about a third below a year earlier. It now appears that imports will total less than 4 million tons, the lowest level since the 3·63 million tons imported in 1964.

* * *

**South African sugar production and consumption**

According to unofficial sources quoted by F. O. Licht K.G.[3], sugar production in South Africa in 1975/76 is presently estimated at 1,920,000 metric tons, tel quel, compared with 1,883,000 tons in 1974/75 and 1,732,000 tons in 1973/74. To reach the production goal of 2,700,000 tons, tel quel, by 1980, it will be necessary to make new plantings of sugar cane. If no new plantings are effected it will be difficult to maintain the export potential of the country in view of the steep rise in sugar consumption.

South Africa's local market has been showing a steady growth pattern over the past few years. The average annual increase in consumption over the past five years has been around 5·90%; sugar consumption rose from 835,405 tons in 1970/71 to 980,802 tons in 1973/74 and the estimated level for 1974/75 is 1,050,000 tons. One of the reasons for the steep increase in sugar consumption is the higher income of the black population. A recent study has shown, moreover, that at present 14% of the urban black population are at times out of sugar because they cannot afford to buy as much as they want, and rural blacks are even worse off. Consequently, this means that a vast potential market for sugar exists within South Africa since the black population is 70% of the total.

The average price of sugar on the domestic market is R106.54 per ton, however, as against production costs of R170 a ton[4], so that if a higher proportion of output is allocated to home sales an increase in the domestic price will be needed to maintain the industry's economic soundness and this will tend to check consumption growth.

To maintain production requirements will require a capital investment of R700 million over the next 10–20 years, according to Mr. ANSON LLOYD in his Chairman's address to the South African Sugar Millers' Association. Even at today's prices the cost of land preparation, crop production, plant and machinery would be R350 million and the present rate of inflation could double this over the next 20 years. It will be impossible to undertake any major expansion of the industry until important decisions have been taken on the method of financing.

[1] C C zarnikow Ltd., *Sugar Review*, 1975, (1251), 161–162.
[2] *G D A News*, 19th August 1975.
[3] *Int' ational Sugar Rpt.*, 1975, **107**, (19), 8.
[4] *S Af rican Sugar J.*, 1975, **59**, 269–272.

# Industrial uses for sucrose

By A. J. VLITOS

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IT may appear pointless to speculate about industrial uses for sugar when there is current worldwide concern about shortages of food and of calories, and the world price of sugar is so high. There are, however, at least two good reasons for carrying out research on possible alternative markets, irrespective of shortages and high prices.

Firstly, it is a historical fact that as additional uses are discovered for an agricultural commodity, demand increases and growers are given an incentive to produce more of it. This trend is perhaps best exemplified by maize, which began as an American Indian garden crop and now occupies several million acres in the USA alone. The crop is grown for starch, maize oil and for its primary use as an animal feed. Even its stalks are used to produce furfural. Sophisticated breeding programmes have led to varieties containing a ligh level of a specific amino-acid (lysine), to sweet varieties lacking the enzymes which convert sucrose to starch during storage and, more important, to varieties with a wide adaptability to climate. The point is that as new uses are discovered for a crop it *attracts* more advanced genetic and breeding techniques, eventually resulting in varieties which grow, for example, as well in Northern France as in mid-western USA.

Additionally, there is an incentive to seek new uses for any excess starch—for example to produce starch derivatives with applications in the textile industry, in food, etc., not to mention the production of glucose and glucose-fructose mixtures (i.e. "isomeroses"). Each step in the evolution of a multi-purpose crop leads to new applications and to additional markets. I believe similar opportunities may be open to us in the cases of sugar cane and sugar beet.

Although the price of a multi-purpose crop, such as maize, does vary from year to year, the variations are due mostly to shortages brought about by adverse weather conditions, rather than to deliberate under- or over-production.

Perhaps a more timely reason for seeking alternative uses for sugar is that the product can be produced year after year. It represents a replenishable energy source. As petrochemicals become scarcer and more expensive we will have to depend less on the fossil fuels and more on sugars, starches, cellulose and lignin to supplement or replace petroleum-derived chemicals. Even today, where the price of sugar (and of other carbohydrates) has gone up it is interesting to note that the increases in prices of certain petrochemicals have, in fact, exceeded the increases in the price of sugar.

*World production*

The total amount of sugar which is likely to be used industrially is unlikely to equal or even approach the amount which is today used as a food. Total world production of centrifugal sugar by 1980 is estimated to reach 97 million tons (Fig. 1). This steep rise in production is predicted because prices are attractive, and also because there has been an unprecedented increase in *per capita* consumption in developing nations. If one compares the amount of sugar which goes into food with the amounts of commonly known petrochemicals used as industrial chemical reagents, it is readily appreciated that food applications require enormous quantities of sucrose (Table I). Most, if not all, of the 97 million tons production of sugar estimated for 1980 will go into traditional food markets.

**Table I. Annual consumption of heavy organic chemicals and of sucrose as a food in the USA (1970)**

| *Commodity* | *Consumption (Million metric tons)* |
|---|---|
| Sucrose (raw) | 10·4 |
| Ethylene | 9·0 |
| Benzene | 4·3 |
| Propylene | 4·0 |
| Methanol | 2·5 |
| Styrene | 2·2 |
| Ethylene oxide | 1·8 |
| Butadiene | 1·5 |

The use of sugar to date for industrial purposes has been negligible (Table II) as reflected in data from the USA. Perhaps too much attention in the past was focused on using sucrose as a starting material for other products by using so-called "degradation" reagents. Unfortunately, degradation products of sucrose (Fig. 2) are of lower molecular weight and accordingly may be readily synthesized from cheaper carbon sources.

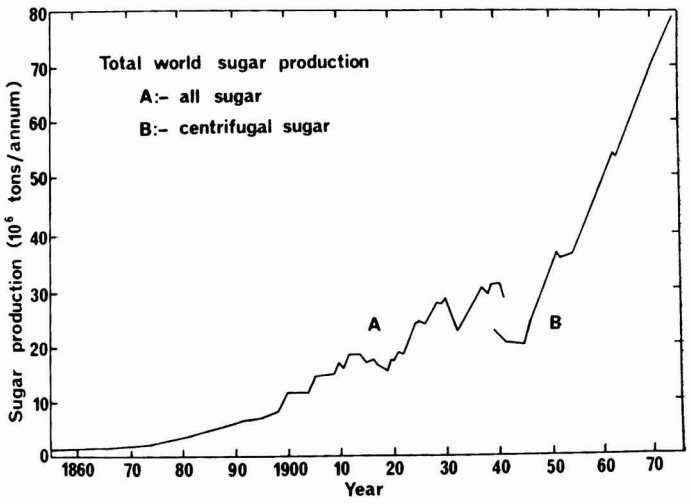


Fig. 1. Total world sugar production

**Table II. Sugar imported into the USA for uses other than human consumption (metric tons)**

| | | |
|---|---|---|
| 1967 | ..... | 215,718 metric tons |
| 1968 | ..... | 52,582 „ „ |
| 1969 | ..... | 58,417 „ „ |
| 1970 | ..... | 59,073 „ „ |
| 1971 | ..... | 76,500 „ „ |
| 1972 | ..... | 35,221 „ „ |
| 1973 | ..... | 9,784 „ „ |

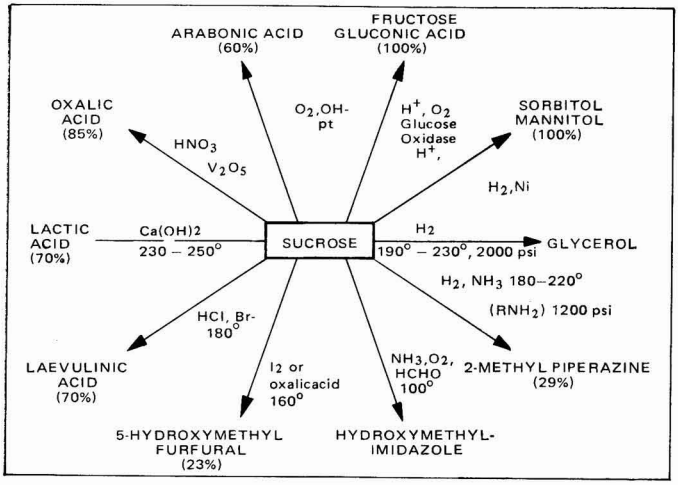


Fig. 2. Degradation reaction of sucrose

In 1965, 10% of the total production of glycerol was derived by the catalytic hydrogenation of sucrose, with propanediol, ethylene glycol and erythritol as by-products. In 1969, owing to increased competition from oil-based synthetic glycerol, a major producer of glycerol closed down a sucrose hydrogenation plant—but the economics today, owing to the petrochemical situation, make the hydrogenation process attractive once again! This is true of most of the industrial processes involving sucrose which seemed hopelessly uneconomical only two or three years ago. In general, however, degradative processes in sucrochemistry are not likely to be attractive in the long term, especially if economical means are discovered of employing cellulose and cellulosic crop wastes as the carbon source. If degradative reactions of sucrose are "not on" what are the remaining alternatives? There are essentially two attractive approaches.

The first involves synthetic reactions of sucrose. Sucrose has many advantages in synthetic reactivity over other sugars, such as glucose for example. It is more stable, and as a polyhydric alcohol (Table III) its relative cost to other polyhydric alcohols is favourable. It is chemically comparable with sorbitol but

**Table III. USA (1974) prices of polyhydric alcohols**

| | *Bulk price cents/lb* |
|---|---|
| Sucrose (refined) ..... | 53 (11·3*) |
| Glucose (anhydrous) ..... | 24·5 |
| Penta erythritol ..... | 45 |
| Glycerol ..... | 50 |
| Sorbitol ..... | 54 |
| Fructose ..... | 120 |
| Mannitol ..... | 202 |

*Source:* Chemical Marketing Reporter, 4th November 1974.
* EEC Intervention price.

at only 1/10th the cost. Also, as a polyhydric alcohol it is potentially capable of giving rise to an almost unlimited range and number of derivatives—some of which have considerable commercial value (Table IV) —including esters, ethers, acetals, urethanes, xanthates and so on. One may ask why such products, based on sucrochemistry, have not been commercially exploited long before now? The technology was known, the sugar was available and chemists have known for many years how to produce many of the sugar-based products.

*Restrictions*

The main restrictions to the development of synthetic surcose chemistry in the past have been (a) the relatively low price and easy availability of petrochemicals, (b) the slight solubility of sucrose in solvents other than those which are similar in reactivity to sucrose itself, and (c) the fact that the sugar industry has traditionally favoured markets which take enormous quantities of sugar rather than markets which require relatively small amounts of sugar to produce relatively high-priced commodities.

**Table IV. Derivatives of sucrose**

| *Functional type* | *Examples* | *Applications* |
|---|---|---|
| 1. Esters | Monostearate | Surfactant emulsifier |
| | Monoacetate | Humectant |
| | Distearate | Emulsifier |
| | Hexalinoleate | Surface coating |
| | Octa acetate | Denaturant plasticizer |
| | Octa benzoate | Plasticizer |
| | Di-isobutyrate Hexa-acetate | Viscosity modifier |
| | Monomethacrylate | Resin monomer |
| | Polycarbonate | Resin intermediate |
| 2. Ethers | Mono octadecyl ether | Surfactant |
| | Hepta-allyl | Drying oil |
| | Octacyanoethyl | Dielectric |
| | Octa Hydroxypropyl | Cross-linking agent in polyurethane resins |
| | Tetra-carboxyethyl | Chelating agent |
| 3. Urethanes | N-Alkyl sulphonyl | Surfactant |
| 4. Xanthates | S-Alkyl monoxanthates | Surfactant Chelating agent |
| 5. Acetals | Cetyloxyethyl sucrose | Surfactant |

The slight solubility of sucrose in organic solvents has led to a great deal of research involving the reactivity of sucrose after it is dissolved in water. In such aqueous solutions, sugar reacts preferentially only with simple epoxides, acrylonitrile, carbon disulphide, with certain N-methylol-amines and with alkali. Pyridine, dimethylformamide and dimethylsulfoxide are the preferred solvents, but these are expensive, unless a very high valued product is the result. Therefore, the markets for sucrose-based chemicals are divided into (a) those for "large-scale production, low cost derivative" which do not require expensive solvents, and (b) into the high profitable areas of "small-scale production, specialty chemicals" which can bear high manufacturing costs. The total amount of sugar required for the latter markets is relatively little, but the profit margins are relatively high.

A rather special case in sucrochemistry is that in which no solvent at all is required. This approach seems to offer the greatest potential for sucrose-based products fo the future. Such examples are the reaction of sugar with natural triglycerides to produce mixtures of sucroglycerides. The new, patented Tate & Lyle sucrose-based detergent is one such product of this reaction. Sugar is reacted with a fat in the absence of a solvent, in very simple equipment, to produce a biodegradable sugar-based detergent.

This new material is equal or slightly better, on a cost-performance basis, to petrochemical-based detergents. It does not require ethylene or propylene oxide or any other petrochemical in the reaction.

Sucroglycerides have been shown to be completely free from toxic side-effects in feeding trials with rats—especially if the product is prepared without organic solvents. The products are excellent surface-active agents, they emulsify easily and they disperse oils, as well as showing other detergent properties. Of course, they are completely biodegradable provided that they are not formulated with polyphosphates.

It is worth mentioning that solvent-free sucroglycerides are more readily assimilated than unmodified fats by veal calves and other farm animals, resulting in a more efficient utilization of food rations and increased growth rates.

In the baking industry, sucroglycerides incorporated in dough in place of glyceryl monostearate result in improved bread volume, finer crumb texture, better humectancy and more rapid dispersion of fat in confectionery dough. A great proportion of soft to hard wheat flour can be used, while the natural flour phospholipids are complemented. This permits adding soya flour in the bread without loss of structure.

As a detergent, the sucroglycerides show excellent lime soap dispersing compared with conventional detergents. They also show superior soil redisposition activity, particularly at low concentrations. Foaming is low, which makes them suitable for use in automatic washing machines.

Another recent use for the new detergent is in herbicide formulations. The sucroglyceride appears to assist absorption and translocation of herbicides in the plant. Being diodegradable it leaves no persistent or toxic residues. Because the economics of sucrose-based detergents are attractive, even at the present high world price of sugar, the product has commercial potential.

But sucrose-based detergents are not the only promising lines open to the sugar industry. Sucrose-based polymers, melamine-formaldehyde resins and sucrose derivatives with biological activity are now more likely to be economically viable because of the tendency towards much higher prices and shortages of petrochemicals. There is also another approach to transforming sucrose to useful marketable products. This is based on microbiological transformations rather than on the activity of the organic chemist *per se*.

As mentioned earlier, most of the oxidation and reduction reactions of sucrose, carried out by organic chemistry, resulted in considerable degradation of the sucrose molecule and the resulting products were of lower molecular weight.

In contrast, micro-organisms are able to carry out modifications of the sucrose molecule, ranging from oxidation at a single point in the molecule—for example to make 3-ketosucrose—or through partial oxidation of the molecule, leaving the carbon skeleton intact (i.e. gluconic acid), or to the partial splitting of the carbon skeleton to produce other polyhydric alcohols. Also, microbes can build up polymers from sucrose, dextrans, for example, in a manner which cannot be duplicated very easily by *in vitro* reactions. If we take the microbial production of biopolymers from sucrose as an example it will illustrate the potential open to the industry.

The best known of the biopolymers is dextran. This is produced on an industrial scale and is used as a blood plasma expander, as a stabilizer for several kinds of formulated food products and, after chemical cross-linking, as a molecular sieve in analytical chemistry. More recently, dextran preparations have been used on the pilot and industrial scale for the preparation of pure enzymes for clinical use. On the industrial scale, dextran is prepared by the fermentation of sucrose with *Leuconostoc mesenteroides*. The total world production is extremely small and consequently a few years ago we decided to look into polymers with a much greater market potential.

We developed a process, which is now covered by worldwide patents, to produce a polymer almost identical to alginic acid. This is done by fermentation of sugar by *Azotobacter vinelandii*. An illustration of the complicated chemistry which a single micro-organism can undertake is shown in Fig. 3. The process is operating on a pilot plant.

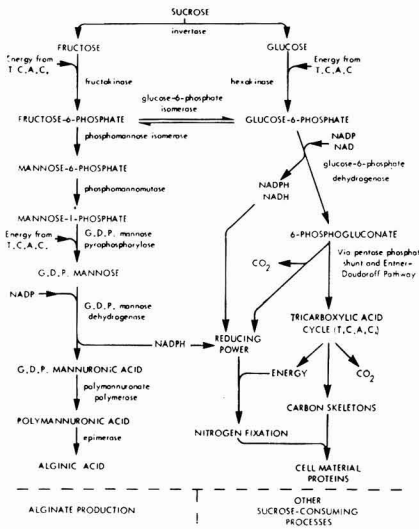


Fig. 3. The biochemical pathway of sucrose utilization for the production of alginate

It is estimated that the world market for industrial gums is between 50,000 to 60,000 tons per annum—not very much by sugar standards—but of course the gums sell at between two and four times the present world price for sugar. Polysaccharides are used in a wide range of products and the uses are increasing.

In summing up, there are three points which should be reiterated:

(1) Industrial uses for sucrose may have attractive commercial potential if synthetic reactions, rather than degradative ones, are investigated more thoroughly.

(2) It is unlikely that synthetic chemical reactions will require the amounts of sugar presently used as a food, but the fermentation industry in future could demand much more sugar or molasses than is used presently—especially if high value products are to be produced, and

(3) The limits of creative and imaginative research in this field have yet to be reached, and it is likely that new advances will be made rapidly now that a need exists to utilize natural resources more efficiently.

*Acknowledgements*

The author wishes to acknowledge and to thank his colleagues, Dr. K. J. PARKER, Mr. F. K. E. IMRIE, Dr. R. KHAN, Dr. J. JAMES, Dr. C. LAWSON, and a number of others of the R. & D. Staff, who have contributed to this article. It has been a team effort to assemble the data and prepare the manuscript.

# Protecting the sugar cane crop from frost

By DONALD P. GOWING
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ALTHOUGH the great bulk of sugar cane is grown under totally frost-free conditions, there are several areas in which temperatures below freezing are encountered regularly or occasionally. Cool weather is an excellent aid to ripening cane, and economic returns from cropping in areas subject to frost are apparently worth the risks. Several published papers have dealt with the topics of identifying frost injury and handling frosted cane, but there is little information published on practical measures to avoid frost in cane plantings, or to reduce its severity.

There are several mechanical protective devices used by temperate-zone horticulturists (such as heaters, wind-machines, mist blowers, etc.) Are these being tested or are they being used in commercial sugar cane areas? What passive measures are used in other crops where frost is expected? Are these now used or adaptable for sugar cane culture? What is the experience in the sugar world, and what advice can be given on the basis of such experience?

Some information on these points has been gathered from contacts with scientists in a number of frost-prone areas, and there was an informal discussion on the topic in the Agronomy Section of the 15th ISSCT Congress at Durban in 1974. A summary of the findings may be of interest*.

*How and where does frost occur?*

Growing of commercial sugar cane is limited by geography, and experience or opinion has usually precluded extensive cane farming at latitudes above 35°N or below 35°S or at very high altitudes where freezing temperatures are common or regular. However, advective movements of cold polar air masses can be a first cause of frost down to latitudes of 25°, and radiational heat losses from soil and foliage to the cool sky on a succession of clear calm nights in winter can result in fairly severe damage.

Actually, air temperatures below 2·5°C lead to injury in the sugar cane plant, although some recovery is often observed when the tissues have not actually been frozen by temperatures below 0°C. Temperatures in instrument shelters are frequently 1·5°C above those at ground level, such that lodged cane is more likely to suffer. Frosts of several hours below 0°C are regarded as serious, and shorter times below —2 or —3°C result in frozen cane.

As radiative heat loss occurs, temperatures will fall faster in drier air. The heat capacity of water is the highest of all common substances except hydrogen, and moist air is thus more resistant to temperature changes. Further, the more moist the air, the greater likelihood that the dewpoint (the temperature at which 100% relative humidity will be reached) is above the frost point. The condensation of water vapour at the dewpoint will release the heat of vaporization—540 calories per gram—and resist lowering temperature until this heat can be removed. And further, the freezing of liquid water releases the heat of fusion—80 calories per gram—and it helps more to have this available at 0°C than at lower temperatures after some damage is done.

Radiative heat losses create inversions in which the layer of air near the ground is cooler and denser than that above it, and on windless nights the condition will persist until the morning sun again warms the soil and the air immediately above it by convection. The cooler, denser air will drift to areas of lower local elevation, which may also be shielded from sunlight at both ends of the day, and hence more prone to frost.

There is little that can be done in the less frequent years when a massive freeze will occur. But the important problem is what to do in *most* years, in *most* areas where cane is grown and *some* frost occurs. What conditions or devices will give the critical few degrees of protection, often for only the critical few hours?

*Protective measures used in other crops*

In general, active measures for frost protection are aimed at adding heat, conserving heat, mixing the air, or influencing air movement.

* In particular, there were informative exchanges with F. A. FOGLIATA (Argentina), R. E. COLEMAN, J. E. IRVINE, K. A. SUND (USA), R. S. KANWAR (India), A. GONZÁLEZ GALLARDO (Mexico), O. J. MIAN (Pakistan), A. C. LONG (Rhodesia), and G. D. THOMPSON (South Africa).

The most obvious device, in widest use for many years, is the heater, the open pail of burning oil, the smudge pot, stack heater, or more sophisticated nearly smokeless radiant heaters now in limited use. In adequate numbers (often more than 100/hectare, though fewer may be in use at a time), distributed properly, depending on the crop, these can raise the ambient temperature 2 to 4°C by radiant and convective heating. Heaters are started as the temperatures near the ground fall to freezing.

Initially, the smoke generated was considered to provide additional benefit, reducing radiative heat loss as would a cloud cover. However, social pressures have forced a closer look at this, and it is now recognized that the carbon particles of smoke prevent passage of the shorter wavelengths in the daylight, but have little effect on radiative losses in the longer wavelengths at night. The generation of smoke is now considered inefficient use of fuel. Improved individual oil heaters are still in widest use, although centralized systems with plastic piping, gas, and infra-red heaters are new concepts under development.

As with heaters, wind machines are most useful on still nights when the temperature inversion is large, and with a low ceiling. These are large fans mounted on a column, single or double, fixed or oscillating, which mix the air around the crop. Wind machines can be more effective than heaters alone, under ideal conditions, but are efficiently used in combination. Indeed, there are now ground-level or column-mounted "Thermojets"—fixed, rotating, or oscillating machines providing forced hot air—or "Ramjets", in which fuel is burned from the tips of the propeller. The area protected depends much on other conditions in addition to the size of the units, but for a wind machine covering 7 or 8 hectares, 90 horsepower at the propeller is not an unusual recommendation, and would be considered a large machine.

Horizontally-mounted helicopter rotors have been used on smaller areas to pull down the warmer levels of air in the inversion, and helicopters themselves for mixing the air have had a limited use. Helicopters are much more flexible in application than wind machines in fixed installations, but cold air temperatures near the ground can be re-established in less than an hour after a "pass", in the absence of light winds or air drift.

For this reason, wind machines are best continued in operation for an hour or more after the sun comes up, and this also is essential for success with sprinklers operated over the foliage canopy. Sprinklers function by release of heat as the water freezes, and droplet diameters are maintained between 1 and 2 mm by nozzle size and water pressure. This permits freezing in a brief time, and yet prevents premature dissipation by evaporation or as mist in the wind. Sprinklers have been used on low, sturdy crops and in orchards and vineyards, and do keep the temperatures of the plant parts covered with ice near to 0°C as long as they are operating, even when the air temperatures are much lower. Sprinklers are kept operating until the danger of frost is past and all the ice is melted, and 0·3 cm of water freezing per hour releases about the same amount of heat, and provides about the same protection, as 100 heaters per hectare.

Raising the atmospheric humidity through sprinklers or irrigation adds little actual heat, and may even result later in lower soil temperatures through evaporative cooling, but the moister air does resist temperature change, and artificially generated fogs have been used to hold heat in the crop area in recent years. The technology is new, and still somewhat experimental, and meteorological requirements for success are fully as restrictive as for the methods already mentioned. Fog droplets between 10 and 40 microns are needed, and too dry an atmosphere will reduce their size too rapidly. Droplet stabilization with cetyl alcohol is used in one system, and when wind speeds have not exceeded 5 km.hr$^{-1}$, up to 20% of the potential heat loss has been retained.

Frost from radiative heat loss is less likely on nights with natural fog or cloud cover, and glass and clear plastic shields are also used in horticulture to confine the infra-red radiation. Screens and covers of brush or cloth are often used commercially, and temporary strips of foam have been tested in applications to low-profile crops. Moreover, sprays of reflective or plastic paints, of anti-transpirants, of growth regulators and retardants, and the like, have also been tried in certain truck crops, orchards, and vineyards. Various degrees of success have been reported, but none is in widespread regular use.

There are other positive measures that can be used for frost protection in some circumstances. The removal of barriers to movement of cool air can provide better air drainage for crops on a slope. And conversely, for crops lower down, bands of dense, tall bushes above the crop on the slope can become barriers to frost by ponding cooler air up the slope. A moist firm soil will transfer heat from the lower layers to the surface better than dry loose soil, and is desirable. Weeds transpire moisture from the soil and dry it out, and lower its heat capacity, and are not desirable. And sometimes the timing of the cropping operations, the locations and nature of the crops, and of the varieties, can be chosen with a view to avoiding the most injurious circumstances as prudent farming practice.

*What is adaptable to sugar cane culture?*

In most commercial cane areas in which frost occurs, some attention has been paid to determining the locations most likely to be affected, and there is some information, although often highly subjective, on the duration and depth of sub-freezing temperatures.

At Haft Tappeh, at 32°N latitude and 40–80 metres elevation in southern Iran on the Khuzestan plain near Ahwaz, frosts occur after the approach of a cold front. When observations at 17h00 have shown a clear sky, the wind to have been from the west or northwest, calm air with temperature of 7·5°C or lower and relative humidity less than 35% in the instrument shelter, there has been an 80% likelihood of ground frost by morning. Only 20% of the time did frosts occur when the previous evening temperature was higher than 12°C or when the humidity exceeded 65%. Although some ground frost has occurred in every year, and periods of severe frost in most years, massive freezes have occurred only twice in 14 years, with minimum temperatures to —10° and —8°C. The median annual extreme minimum is —3·5°C. What are the prospects of gaining this amount of protection?

Actually, none of the mechanical devices described earlier is in use in commercial cane plantings anywhere, insofar as has been determined. Small areas for seed cane have indeed been protected by perimeter placement of oil heaters on occasion, in Iran and elsewhere.

But even this expedient is more often avoided by locating the seed cane area in frost-free sites. At Haft Tappeh, all planting is now scheduled for late summer and early fall, and the need for seed cane in the spring is thus eliminated. (Since the winters are cold, 90% of the growth at Haft Tappeh is made in the period between April and September, when the average daily minima are above 12°C.)

Would it help to burn cane at night as a source of heat? Probably not. Cane fires are quite fast and hot when the foliage is dry, and the strong up-draught would readily pierce the ceiling of the temperature inversion and lose the heat. Where heaters are used, small units are preferred to larger units for that reason; much of their benefit comes from convective circulation under the ceiling.

In tall commercial cane, there would be little opportunity for radiant heating, or convective heating, and the cane canopy is so different from that of spaced orchard trees or low, row crops that proper distribution of many heaters seems impracticable. Even the best heaters fully protect an area little more than 50 square meters.

Canopy configuration is involved with wind machines as well, but the air inversion is the first consideration. The characteristics of the air inversion at Haft Tappeh have been studied: air temperatures averaged 2·5°C higher at 11·3 meters height than at 1·25 m. This is a weak inversion by California orchard standards, where strong inversions of 7°C make wind machines and heaters more effective.

Sugar cane is also quite unsuited mechanically to protection by sprinkling water to freeze on the foliage. And since the cane is often being ripened for harvest in the cool weather, even furrow irrigation in mature fields is usually undesirable. Wet fields are harder to ripen, and harder to work with harvest equipment.

Fields will drain off excess water to field capacity by gravity alone, but from then on they dry by evaporation and by transpiration. The evaporation may be limited in a heavy crop and in lodged cane where the sun does not penetrate. And transpiration may be stopped by frost-killed foliage even when the cane itself is not frozen. Thus, mature fields can stay wet for many weeks after winter rains or irrigations. Where irrigated cane is grown, some water run only in the canals, supply ditches, and into reservoirs does help to raise the atmospheric humidity, but the protection for wide areas may be minimal.

Irrigation of young fields is quite a different matter, and is desirable when frost is expected. Predictions of minimum temperatures by formulae developed from observations in the previous evening assume a standard pattern of change overnight. They have been more successful at Haft Tappeh in December-February than in the more unsettled weather of November and March, but have usually averaged within 2°C of actual. There is often insufficient time for furrow irrigation of large areas on the first day, but successive clear nights can give successively lower temperatures, and some protective irrigation is feasible. Minima of 2·6, 2·0, 1·5, 1·0, 0·2, —0·3°C and 3·1, —0·6, —1·0, —1·5, —2·9, —3·5°C are examples of typical arrays for several days in a row.

Hence, young plantings dispersed over the plantation, requiring irrigation, present a wider area by which to raise humidity than do the ditches alone. Such scattered fields may be more helpful in preventing frost injury over the plantation, but conflict with management practices causing them to be grouped for an efficient planting operation.

And the same considerations apply to ratooning: dispersed ratoon fields being irrigated may resist a drop in temperature over a wider area, but scattered fields are less efficient to harvest. It is now our practice to harvest the frost-prone areas first in any case, so that the protection of recent irrigations can be obtained. Wet fields are more resistant to injury.

Artificial fogs are yet to be tested in cane areas, and shielding the commercial cane seems an unlikely prospect, and the evidence on sprays of various kinds is presently inconclusive. Point by point, frost protection in sugar cane seems unlikely to be gained by adaptation of the mechanical devices used in horticultural crops. Protection is more to be found in passive, though positive, measures to avoid frost and reduce its severity.

### *What else is being done?*

Positive measures to avoid or reduce injury involve study of the meteorological conditions, dates, and locations on the plantation in which frost has occurred, and the scheduling of the overall harvest to avoid having susceptible cane at hand. New plantings or young ratoons are more readily protected by irrigation, as noted above, and more tolerant varieties may be used where frost is most likely.

At Haft Tappeh, the range in minimum temperatures is usually about 4°C at the six meteorological stations we maintain for our 10,000 hectares of cane. The hygrothermograph records show the number of hours below freezing, from which injury can be predicted in the crop.

Juice quality can decrease and then recover somewhat after a mild frost. Even when the cane has been frozen, there are usually still some days or weeks before cane becomes unworkable in the mill.

Having base-line data beforehand on pH or acidity or dextrans and gums in the juice helps in early identification of injured or deteriorating fields. Separate Cuban mill samplings of the stalks by quarters or thirds, in the 20-stalk samples, are informative, and aid in establishing the degree of topping required. Such data can be obtained with the approach of the critical season, and should surely be taken after a damaging freeze.

Cane varieties do vary in their juice acidity. At Haft Tappeh, the variety CP 48-103 normally has a titre of nearly 0·9 $cm^3$ of 0·1N NaOH per 10 $cm^3$ of juice, in contrast to that of N:Co 310 at about 0·7 $cm^3$. Titres rising 0·3 $cm^3$ more than these values after a frost are usually accompanied by some drop in pol and purity, but much larger changes occur before the cane becomes unworkable.

Cane varieties do vary in tolerance to low temperatures and light frost, although we have found none to resist a severe freeze. In our experience, CP 48-103 is more frost-tolerant than N:Co 310, although N:Co 310 has been mentioned as one of the better varieties in several countries: Argentina, Mexico, USA, Australia, Iran, South Africa (with N:Co 376) and Rhodesia among them. Most areas have found or developed some varieties with good tolerance, but the list is not long, and these varieties are often not the most profitable ones to grow all over the plantation.

Tolerant varieties are described as erect, and a heavy, uniform crop with dense foliage is desired,

ripened to get the highest sugar content before a frost occurs. (Solutes lower the freezing point.)

Although they are thus more susceptible to injury, our crops at Haft Tappeh are usually completely lodged at harvest. We accept this situation in order to get our heavy yields, averaging 120 tons of cane per hectare overall, with plant crops usually over 140 tons.ha$^{-1}$ and record fields at 200 tons.ha$^{-1}$.

However, we do emphasize early maturity for varieties in frost-prone areas, and start the fields scheduled for harvest first on ripening by withholding water in the late summer. We sacrifice some yield to get an early start with the harvest, and have expanded the factory capacity to permit more rapid harvest and processing of cane when necessary.

CP 48-103 matures faster in response to cold weather than N:Co 310 at Haft Tappeh. And the CP- and L-varieties, selected in the USA against a background of cold winters, have generally matured earlier here than canes from more tropical areas, but this is not necessarily related to actual tolerance to frost. It may well be that chemical cane ripeners will be a useful tool for some varieties to permit an earlier harvest before a frost. Thus far, our experience has been that they were more effective on late-maturing varieties than on early-maturing varieties. However, each season brings new data for evaluation.

*Recommendations*

Primarily, protection of the commercial cane crop depends on prudent location of fields, frost-tolerant varieties, and scheduling for early ripening and early harvest.

A study of the patterns of frost occurrence for frost prediction, and keeping young plantings and young ratoons well irrigated at such times, and maintaining atmospheric humidity by ponding water even in unused canals, ditches, and reservoirs will help.

To minimize losses after a frost, the temperature records should be analysed and field sampling intensified to identify the most injured fields for immediate harvest, before heavy spoilage, in order to maintain or increase the milling rate. It may be necessary to discard some cane by lower topping to remove damaged tissues in order to complete the harvest as rapidly as possible. Some recovery from cold-weather injury occurs, but frost-killed leaves can make no more sugar, and cane actually frozen can only later lose the sugar it has at the time.

Except in small open nursery areas in which the soil should be kept firm, moist, and free of weeds, heaters generally give inadequate protection, and they and other mechanical devices seem impractical for use on the commercial crop. However, newer modalities for protection from frost do arise, and should be examined. A great deal can actually be done, but whatever the sugar world does now is apparently not enough.

*Summary*

The origins of frost and principles of protection are discussed. The protective devices and measures used in other crops are reviewed, and their adaptability to cane culture considered. Where frosts derive from radiative cooling, a few degrees of protection for a few hours may be critical, since some recovery occurs from mild cold-weather injury to cane. Except for limited use of heaters in nursery areas, no mechanical devices for protection from frost are apparently in use anywhere for the commercial sugar cane crop. Emphasis is on scheduling for early harvest of the coldest areas, on early-maturing and frost-tolerant varieties, on dispersing new plantings and selected harvest areas, keeping these well irrigated, and on keeping water in unused waterways to raise the atmospheric humidity. To minimize losses after a frost, temperature records should be kept and studied, and field sampling begun earlier should be intensified, to identify the most injured fields first, leaving varieties which resist injury and have good keeping qualities until later. Deteriorating cane which will delay processing should be discarded in order to complete the harvest as rapidly as practicable.

# Diffusion in South Africa

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*Paper presented to the 15th Congr. ISSCT, 1974*

## PART II

*Diffuser operating conditions*

Diffuser operators in South Africa have experimented with variations in temperature and pH in the diffusers and, so far, have not reached agreement on the optimum level of these two parameters.

Temperatures in the diffusers range from 70 to 95°C, the lower values being due to fears of harmful effects on juice quality while the higher temperatures are reported to give better extraction. Union Co-op. and Entumeni for example, report better extraction at 82 to 88°C but this may be due to the relatively coarse preparation at these factories.

Lime is added to the juice hoppers along the length of the diffuser at all factories except Malelane where the only pH control is by return of clarified press water at a pH of about 7·5, the pH along the length of the diffusers being usually maintained at between 6·0 and 6·5. At Umfolozi pH control is achieved by liming the scalding juice and press water.

The biggest difference in operating procedures of various installations is to be found in the treatment of press water. The first installations commissioned in South Africa were supplied with press water clarifiers in which press water, limed to a pH of 9 or above, was settled for one to two hours and the clear overflow returned to the diffuser. This practice has been retained at Malelane and Entumeni although press water is now limed to a lower pH (8·0 to 8·5) to reduce possible destruction of reducing sugars. Under these conditions, the clarifier overflow is dark but causes no percolation problems in the diffuser. Union Co-op. has worked alternatively with and without press water clarification with no apparent effect on juice quality. At Empangeni, press water is returned

untreated but the bagasse bed in the diffuser is churned up by vertical screws to improve percolation[9]. The other factories return unclarified press water to the diffusers and the trend away from press water clarification is illustrated by the fact that the last three diffusers commissioned or on order are designed to accept press water without any form of clarification.

Different clarifying agents have been tried at pilot plant scale for press water clarification at Union Co-op.[10] Some of these chemicals, such as phosphoric acid or sulphur dioxide, followed by liming, yielded a very clear overflow at low retention times but the cost of the chemicals makes them uneconomical for use under normal circumstances. An interesting observation made during this work was that, regardless of the reagent used, a stable precipitation of press water occurred only at pH lower than about 4·5 or higher than 9·5.

The problem of press water treatment is compounded by the disposal of the underflow from the clarifier. Because of the importance of the mill mass balance in the South African cane payment system, this "mud" must either be weighed, returned to mixed juice or returned to bagasse after the diffuser. The only mill equipped for weighing press water underflow is Malelane. At Entumeni press water mud is returned to mixed juice.

The procedure adopted during normal scheduled stops is not standard for all diffuser mills. Some empty their diffusers (Empangeni, Umfolozi, Entumeni) while others do not (Union Co-op., Malelane). Sucrose losses have been found to be negligible for stops of up to 15 hours and the decision to empty the diffuser is prompted by fears of adverse effect on boiling house work on start-up.

*Cane preparation and bagasse de-watering*

The first four diffusers installed in South Africa were rectangular diffusers in which juice percolates by gravity through a bagasse bed about 2 m in depth. Percolation rates are critical in this type of diffuser which is characterized by flooding and even overflowing whenever juice flow through the bed is restricted. This occurred frequently when processing dirty and especially muddy cane.

To improve percolation, fineness of cane preparation was reduced, the best example of this being provided by Empangeni where the shredder was removed and only two cane knives retained[9]. With more experience in diffuser operation and modifications to press water return systems and the ratio of screen area to volume of recirculated juice in the last stages of the diffusers, the trend towards coarse preparation has been reversed. Malelane and Empangeni have installed very heavy swing-knife sets fitted with overhead anvil plates which can be considered as intermediate between knives and shredders. Entumeni and Umfolozi have improved the performance of their shredders while Union Co-op. has achieved better preparation by reversing the rotation of the first set of cane knives.

Since the beginning of the 1973 season, cane preparation has been measured by a standardized method and reported in terms of Preparation Index (Procedure described in Appendix I). Values of Preparation Index (PI) reported at the end of September 1973 by the diffusion factories and by some milling factories known for their good preparation[11] are listed in Table III.

**Table III. Preparation Index**

| *Factory* | *Type* | *PI* |
|---|---|---|
| Malelane | Diffuser | 85 |
| Umfolozi | Diffuser | 79 (Occasional tests) |
| Empangeni | Diffuser | 85 |
| Entumeni | Diffuser | 64 (Occasional tests) |
| Union Co-op. | Diffuser | 75 |
| Gledhow | Mills | 89 |
| Jaagbaan | Mills | 87 |
| Sezela | Mills | 89 |

Except at Union Co-op. and Entumeni, preparation at all diffusion factories is now fine to very fine and, in spite of this, flooding is no longer an operational problem. This has influenced the design of preparation equipment for the last two diffusers installed (Pongola and Amatikulu) and in both cases, very heavy knives and shredders have been specified, a PI of over 90 being the objective.

With the exception of the Saturne, all diffusers in South Africa are followed by conventional mills and no special technology has been developed for bagasse de-watering. The Saturne diffuser is followed by light de-watering rollers which can lower the moisture content of bagasse to 70% therefore reducing the work load on the de-watering mills.

Hot, wet (80%) moisture bagasse is difficult to feed to mills and tall chutes and underfeed feeder rollers are standard equipment on de-watering mills. The moisture content of final bagasse from diffusion plants is slightly higher than the industrial average but still within the range of moistures of bagasse from milling tandems. Final bagasse at Union Co-op. has the lowest moisture content in South Africa and shows that high moisture is not inevitable but is a function of the roller volume available for de-watering. It is generally accepted that more roller volume per unit of fibre is required for de-watering than for conventional milling but no scientific work has been done on this subject and values quoted must be accepted with caution.

The setting of mills used for de-watering differs from that of conventional mills and more juice drainage space has to be provided. Feed to discharge work opening ratios of 3:1 and even 4:1 are reported instead of the 2:1 commonly used in milling.

Equipment used for de-watering in South African diffuser factories is shown schematically in Fig. 1.

*Diffusion juice quality and effect on boiling house work*

This has been the most controversial aspect of diffusion since its introduction to the cane sugar industry and a considerable difference of opinion still exists as to whether a diffuser installation has an adverse effect on boiling house performance. PERK[12] showed that the boiling house recovery for South African diffusion factories lay significantly below the industrial average but LAMUSSE[13] was able to show that a substantial amount of the evidence may be due to extended teething problems with the new process.

GRAHAM *et al.*[2] found that pH and temperature in a diffuser had very little effect on the extraction of the commonly determined impurities except for starch. If the operating temperature exceeded that

[9] VAN DER RIET & RENTON: *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 42–48.
[10] TEOKAROVIC & LAMUSSE: *SMRI Internal Rpt.*, 1972, (1), 72 pp.
[11] *SMRI Weekly Summary Lab. Data*, 1973–74 season, (20) (Week ended 15th September 1973).
[12] *Proc. 44th Congr. S. African Sugar Tech. Assoc.*, 1970, 1–18.
[13] *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 61–71.

of the starch gelatinisation temperature, however, starch was extracted to an appreciable extent. Operating above this temperature, the ratio of impurities in diffuser juice to first mill juice was found to be of the same order of magnitude for both milling and mill-cum-diffusion. The extraction of wax, however, was significantly lower in diffusion than in milling. The authors further demonstrated the effectiveness of pH as a control for enzymatic destruction of sucrose.

BUCHANAN & JULLIENNE[4] confirmed the temperature dependence of polysaccharide extraction by diffusion noted above and investigated further their dependence on the degree of preparation.

REIN[6] during his modelling work provided further confirmation of the past work on the extraction of organic impurities and extended this into the field of inorganic impurities. He found the inorganic species measured occurred in the following order of decreasing concentration: K, Cl, Ca, Mg, Na. Further, he noted that the degree of preparation influenced the availability of inorganic cell wall constituents for extraction. DOUWES DEKKER[14] reported measurements of Ca and Mg in mixed juice which show order of magnitudes in agreement with this work.

Based on the premise that organic acids formed by the decomposition of sucrose and reducing sugars would be concentrated in final molasses mainly in the form of calcium salts, BRUIJN & VANIS[15] analysed by chromatographic means final molasses samples from both milling and diffusion factories. No major differences in composition or quantity or organic acids were found.

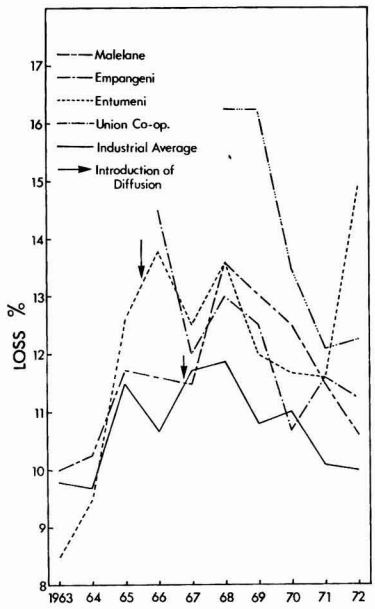


Fig. 2. [Sucrose lost in boiling house % sucrose in cane for diffuser factories during crushing seasons 1963–1972

An inspection of Fig. 2 in which sucrose lost in boiling house % sucrose in cane are plotted for diffuser factories together with the industrial average will reveal arguments for use against diffusion. In all cases diffusion factories reported higher losses than the industrial average. If, however, the losses are corrected for difference in mixed juice purity as is done in Fig. 3 in which reduced boiling house recovery is plotted for the same mills, one finds that all diffusion factories save one now have higher reduced boiling house recoveries than the industrial average.

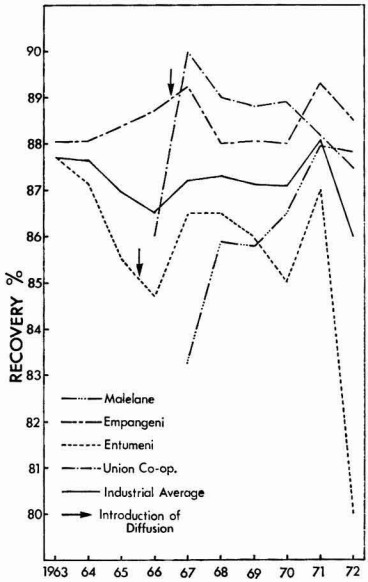


Fig. 3. Reduced boiling house recovery of diffuser factories during crushing seasons 1963-1972

Reduced boiling house recovery is based on mixed juice purity and therefore does not compensate for any juice deterioration in the diffusers. An attempt has been made to evaluate deterioration across the diffuser by calculating the percentage increase in non-pol from cane to mixed juice using data provided by the Sugar Industry Central Board for the direct analysis of cane. Results are listed in Table IV.

**Table IV. *Percentage increase in non-pol across extraction plant (based on to-date figures at 1st September 1973)**

| *Factory* | *% Increase in Non-Pol* |
|---|---|
| Malelane | 6 |
| Empangeni | 6 |
| Entumeni | 12 |
| Union Co-op | 16 |
| Average diffusion factories | 10 |
| Industrial average | 10 |

* % increase in non-pol

$$= \frac{\text{Non-pol in cane by Mass Balance} - \text{Non-pol in cane by Direct Cane Analysis}}{\text{Non-pol in cane by Direct Cane Analysis}}$$

Once again diffusion results straddle the industrial average and do not indicate systematic deterioration. Even the high percentage increase calculated for Union Co-op is within the range reported by some milling tandems.

[14] *SMRI Comm.*, 1952, (12), 71 pp.
[15] *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 64–68.

Purity of final molasses does not appear to be affected by the diffusion process with some diffuser factories reporting lower purities and others higher than the industrial average. There is, however, a definite indication that more molasses is produced by diffusion than by milling factories and that consequently molasses losses are higher. This is shown in Table V.

**Table V. Sucrose in final molasses % non-pol in cane (mass balance).**

| *Factory* | *To date 1st September 1973* | 1972/73* *Season* | 1971/72* *Season* |
|---|---|---|---|
| Malelane | 45·2 | 49·2 | 50·7 |
| Empangeni | 49·8 | 49·2 | 44·2 |
| Entumeni | 76·0 | 70·2 | 57·0 |
| Union Co-op | 62·4 | 48·6 | 51·3 |
| Industrial Average | 44·1 | 46·2 | 45·2 |

* Based on *non-sucrose* in cane.

## *Conclusion*

After seven years of industrial experience, diffusers are accepted in the South African sugar industry as the most economical way of achieving high extraction. Capital and maintenance costs of diffusers are far lower than those for mills required to achieve the same extraction.

There is still a divergence of opinion as to the best type of diffuser and at least three distinct types are in operation or on order. Experience with bagasse diffusers has stimulated interest in cane diffusion which is more attractive from a capital investment point of view.

Experience has shown that diffusers are capable of processing finely prepared cane and that this is a requirement for good extraction. Attempts to compare the performance of different types of the diffusers have not been successful because of the effect on performance of cane preparation and the position of the diffuser in the extraction plant. This work has revealed that, in addition to the extraction achieved in diffusers, the unit made more sucrose available for extraction by the de-watering mills and that the unit extraction of these mills was about twice that of the last two mills of a milling tandem.

The following trends can be noted in diffuser operation:

(*a*) The return of unclarified press water;

(*b*) Liming juice in the diffuser to a pH of about 6;

(*c*) Operation at higher temperatures;

(*d*) Processing of more finely prepared cane;

(*e*) A reduction in the number of washing stages and a corresponding increase in stage efficiency.

The reduced boiling house recovery of all but one of the diffuser factories is now higher than the industrial average but losses in molasses per unit of non-sucrose in cane are still higher with diffusion than with mills although the process has no apparent effect on molasses purity. Research carried out has failed so far to identify any differences between the molasses from either processes.

## *Acknowledgements*

The authors would like to thank the technical management of the diffuser factories and of the Central Board for their co-operation in supplying data and information used in this paper.

## *Summary*

The cane sugar diffusion process in South Africa is reviewed. Topics discussed include research, diffuser operation, maintenance and running costs and the effect of diffusion on boiling house performance.

## APPENDIX I

### Procedure for the Determination of Preparation Index

#### *Sampling*

It is not easy to sample shredded cane in a representative way, and great care should be taken to avoid biased sampling. When catching a sample by hand, or when sub-sampling, do not shake the handful of cane, as this will lead to a bias in favour of larger pieces of cane. When a sample is brought to the laboratory do not sub-sample directly from the bucket. Tip the sample out onto a flat surface, mix it thoroughly and spread it out into a layer 5–7 cm thick before sub-sampling.

(1) Grab samples of shredded cane should be taken from the air-operated hatch in the screw conveyor feeding the Central Board prebreaker, over a period of 3 to 5 minutes. Until this hatch is available samples should be taken by hand from the cane falling from the screw conveyor into the hatch feeding the prebreaker. Do *not* sample by hand directly from the screw conveyor itself because of safety hazards. The samples should be placed in plastic or stainless steel buckets, fitted with lids, and taken directly to the laboratory.

(2) Samples of prepared cane are taken simultaneously from the prebreaker discharge and placed in a separate bucket fitted with a lid.

(3) The two samples are taken to the laboratory and each sample is thoroughly mixed before sub-sampling.

(4) The sample taken from the *screw* is used for leaching and the sample taken after the *prebreaker* is used for disintegration.

#### *Analytical procedure*

Two procedures can be used depending on equipment available for leaching. The preferred procedure is based on the use of plastic bottles which are rotated on a special frame[16].

An alternative procedure using tumbling drums as described in SMRI Quarterly Bulletins Nos. 19 and 20 is also given for those mills which have this equipment.

The two methods have been found to give closely comparable results but the first method (rotating bottles) is preferred because of the larger sample and shorter tumbling time.

(1) *Rotating Bottles Method*

(1) Leaching

500 g of prepared cane from the *screw* sample and 3000 g of water are weighed into a plastic bottle. The bottle is rotated on a specially designed frame for 30 *minutes*. The Brix reading of the filtered extract ($B_1$) is measured by means of a precision refractometer.

(2) Disintegration

333 g of prepared cane from the *prebreaker* sample and 2000 g of water are weighed into an Elgin-type cold disintegrator and distintegrated for 20 *minutes*. The Brix reading of the filtered extract is measured ($B_2$).

(2) *Tumbling Drums Method*

(1) Leaching

200 g of prepared cane from the *screw* sample and 2000 g of water are weighed into a 4500 $cm^3$ drum fitted with internal baffles. The drum is rotated for 60 *minutes* at 45 rpm. The Brix reading of the filtered extract ($B_1$) is measured by means of a precision refractometer.

(2) Disintegration

200 g of prepared cane from the *disintegrator* sample and 2000 g of water are placed in a cold disintegrator which is run for 20 *minutes*. The Brix of the filtered extract is measured ($B_2$).

#### *Calculations*

$$\text{Preparation Index} = \frac{B_1}{B_2} \times 100$$

*Note:* The use of pol instead of Brix will affect the results because of differential extraction of pol and Brix during leaching.

[16] Markham: *Proc. 43rd Congr. S. African Sugar Tech.*, 1969, 230).

# Sugar cane agriculture

**Varietal work done at the main sugar cane research station, Shahjahanpur, U.P. during the last decade.** K. KAR, R. S. DIXIT and K. M. BHARDWAJ. *Indian Sugar*, 1974, **24**, 433–435.—Tabulated data are given showing the crosses raised at Shahjahanpur during the period 1960–70 and indicating the varieties rejected because of red rot susceptibility as a result of trials during the period 1970–73.

* * *

**Economic feasibility of growing sugar beet as a companion crop in autumn-planted sugar cane.** O. P. SINGH, S. N. L. SRIVASTAVA and C. N. BABU. *Indian Sugar*, 1974, **24**, 445–447.—Results of tests showed that yields of both cane and beet were reduced when beet was grown between rows of cane, although the decrease in cane yield was not as marked as when wheat was grown as intercrop, which also caused a fall in cane juice quality. However, the most drastic fall in cane yield, to about 13% of the yield when autumn-planted cane was grown without intercropping or crop rotation, occurred when spring-planted cane was grown after wheat. Beet grown after spring-planted cane had a greater yield than when grown between the cane rows, but the cane yield was only 22% of the yield for autumn-planted cane grown on its own.

* * *

**Identity of a strain of sugar cane mosaic virus occurring in Mexico.** H. U. FISCHER and B. E. LOCKHART. *Plant Disease Reporter*, 1974, **58**, 1121–1123.—Transmission studies and electron microscopy have yielded evidence of cane mosaic in Moroccan cane. Inoculation of N:Co 310 and CP 44-101 cane with isolates showed that the former variety was highly susceptible to the disease, found to be strain D, whereas it has been generally regarded as tolerant to the strain. The other variety proved immune. The aphid *Rhopalosiphum maidis*, which occurs naturally in Morocco, transmitted the disease in experiments, while *R. padi* did not act as a vector. Both cane varieties tested have been selected for growing in Morocco because of their high tolerance to low temperatures and for their high yields.

* * *

**Chemical increases sugar yield from cane.** ANON. *Chem. Eng. News*, 1975, (Jan. 20), 31–32.—"Ripenthol" (a mono-N,N-dimethylalkylamine salt of "Endothall"), developed by Pennwalt Corporation, of Philadelphia, Pa., USA, has increased sugar yield of cane by up to 25% in small-scale field tests, and large-scale tests are being conducted in Hawaii with rates of aerial application of 2 gal aqueous solution per acre containing 4 lb active ingredient. The chemical penetrates cane leaves within 12–24 hours of application, so that there is little risk of it being washed off by rain.

**Preventing soil erosion on sugar cane land in Natal.** ANON. *S. African Sugar J.*, 1975, **59**, 15.—Details are given of the procedures by which technical services are to be provided to cane growers by the South African Sugar Association and the Department of Agricultural Technical Services to combat and prevent soil erosion on cane lands in Natal.

* * *

**Leaf scald in Bundaberg.** ANON. *Australian Sugar J.*, 1974, **66**, 382.—Reference is made to an outbreak of leaf scald on cane of Q 93 variety in three areas of the Bundaberg district of Queensland. Symptoms and means of transmission of the disease are described.

* * *

**NSW encouragement of new cane-growing areas.** ANON. *Australian Sugar J.*, 1974, **66**, 385.—The Newrybar Swamp is one of the most expansive areas of potential cane land in New South Wales. A major drainage scheme will be needed before the area can be fully developed, and negotiations are already under way concerning this. When properly drained, the area could provide about 8000 acres of good cane land. A revival of interest in cane growing in NSW is demonstrated by the activities of seven farmers who in 1974 supplied some 5000 tons of cane to Broadwater sugar factory.

* * *

**The Massey Ferguson 102 cane harvester.** L. G. VALLANCE. *Australian Sugar J.*, 1974, **66**, 393–397. Details are given of the MF 102 harvester, of which 250–300 units are in operation in Queensland cane districts. The twin-disc topper assembly is particularly mentioned, as is a kit developed to prevent stones entering with the cane.

* * *

**Hodge trash planter at Bundaberg.** L. G. VALLANCE. *Australian Sugar J.*, 1974, **66**, 397–399.—Information is given on a planter for unstripped seed cane developed in Queensland where trash planting is now used in many areas.

* * *

**A model for the simulation of the water balance.** J. FABER. *Saccharum (Publ. Cient. Inst. Central de Invest. Azuc.*, Peru), 1974, (1), 1–42.—An account is given of the use of a computer for studying a model water balance, produced for monthly measurements of water distribution, availability, reservoir contents and losses, etc., whereby important factors may be identified and studied in optimization of water usage by sugar cane plantations.

* * *

**Parcel size in industrial field experiments with sugar cane.** L. E. RAMÍREZ D., M. MORÁN S and L. ORTIZ P. *Saccharum (Publ. Cient. Inst. Central de Invest. Azuc.*, Peru), 1974, (1), 43–73.—For a uniformity experiment in sugar cane, the SMITH coefficient of soil

heterogeneity[1] (*b*) was estimated and found to depend on plot forms. Tabulated values indicate the relationships between *b*, plot size (1–6 × the unit of 135 m²), number of replicates, and two probability levels (0·80 and 0·90) of obtaining a significant result.

* * *

**Influence of the age of sugar cane on the accumulation of sucrose and mineral elements.** S. VALDIVIA S. *Saccharum* (*Publ. Cient. Inst. Central de Invest. Azuc.*, Peru), 1974, (1), 74–89.—Samples were taken from a plot of H32 8560 cane at regular intervals after an age of 334 days and analyses made for pol, Brix, reducing sugars, moisture, fibre, N, P, K, Ca, Mg and Na. It was observed that pol and purity increased up to 537 days, decreasing at 649 days and increasing again at 807 days but without surpassing the levels obtained at 537 days. The mineral constituents decreased with age except for Na which increased. It is concluded that harvesting should be at 18 months of age and that the mineral concentration can be used as an indirect measure of maturity.

* * *

**A multi-purpose prime mover for infield cane transportation.** E. GILLIES. *Sugarland* (Philippines), 1974, **11,** (3), 6–8, 26.—Details and illustrations are given of a patented multi-purpose vehicle which can be converted from a pneumatic-tyred articulated truck to a tracked cane transporter and towing tractor. The various wheel and track arrangements are indicated.

* * *

**Sugar cane internode rind hardness.** F. A. MARTIN and B. J. COCHRAN. *Sugar y Azúcar*, 1975, **70,** (2), 26–30.—Determination of internode rind hardness for three cane varieties showed, as did earlier studies, that the hardness increased from the top to the bottom of the stalk. With increase in length of the internodes near the apex, the initial rates of hardness development accelerated, followed by decreasing rates until the 10th–13th internode, where maximum hardness occurred in the top of the internode. Hardness was initially greater in the upper part of each internode, followed by the middle and lower internode regions in that order. The results agree with concepts of sugar cane ontogeny originally developed by ARTSCHWAGER and with concepts of growth and maturation gradients of Gramineae.

* * *

**Cane scrapping.** L. L. LAUDEN. *Sugar Bull.*, 1975, **53,** (7), 4.—The amount of cane left in fields can be considerable, and the author indicates the financial advantages of scrapping, which can appreciably increase the cane yield per acre.

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**The resistance of sugar cane to the mosaic virus in Cuba.** V. KOLOBAEV, R. MORÍN, O. CARVAJAL and I. OTERO. *ATAC*, 1974, **33,** (4/5/6), 56–66.—The programme of varietal substitution introduced in 1931 has brought mosaic under control in Cuba, with only few cases being reported, of which most (68 out of 70) were identified as strain B, the predominant strain in the island. New varieties are screened for resistance by inoculation of seedlings, and an account is given of this work.

**Physical properties of spike virus, a disease of sugar cane.** A. JHA, H. C. PRASAD and B. MISHRA. *Indian Sugar*, 1974, **24,** 619–620.—Studies of the physical properties of spike virus, in which *Chenopodium amaranticolar* was inoculated with diluted extracts from infected cane after the extracts had been heated to 40–90°C for 10 minutes, showed that the thermal death-point of the virus is 85–90°C, the dilution end-point between 1:10,000 and 1:15,000 and the longevity *in vitro* 15 days at room temperature (25–30°C) and 25 days at 4°C.

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**Studies on yield of cane and juice quality (loss) due to ratoon stunting disease of sugar cane in India.** G. R. SINGH. *Indian Sugar*, 1974, 623–629.—The influence of RSD on cane yield and juice quality in plant cane of ten varieties was determined. The adverse effects on the various growth parameters are reported, and it is concluded that the disease reduces sugar yield through the decrease in cane yield, while the sugar content remains little affected.

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**Studies on *Sturmiopsis inferens* Twn., a natural parasite of the sugar cane stalk borer *Chilo auricilius* Ddgn.** O. P. SINGH. *Indian Sugar*, 1974, **24,** 631–632.—Preliminary indications are that *S. inferens*, a tachinid fly, is a promising parasite of *C. auricilius*.

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**Nitrogen and sugar cane. V. Relative efficacy of farmyard manure and oil cake applied singly and admixed with ferrous sulphate and lime in comparison with sulphate of ammonia.** U. S. SINGH. *Indian Sugar*, 1974, **24,** 635–638.—While ammonium sulphate proved more effective than the other forms of nitrogenous fertilizer mentioned in the title as regards cane yield, which was far greater than for the untreated control, caution in its use is necessary since it adversely affects the sugar content, which was below that of the control as was juice purity. This was generally true of all treatments, however, and even where there was improvement in sugar content and juice purity over the control, the difference was not noticeable.

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**Influence of potassium on yield and quality of sugar cane.** R. H. PAWAR. *Sugar News* (India), 1974, **6,** (7), 21–22.—The advantages of applying K to cane, especially when high rates of N are applied, are discussed. The K can offset the adverse effects of N on juice quality and will give a higher cane and sugar yield than when it is not used.

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**Ratooning potential of sugar cane varieties under different levels of nitrogen.** P. P. SINGH. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A1–A5.—Results of variety × nitrogen tests conducted during 1967–68 on ratoon crops are discussed.

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**Some observations on the relationship of cane yield with respiration and catalase activity.** A. ALI and R. G. SINGH. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A7–A12.—Investigations showed that respiration and catalase activity in cane were stimulated by "normal" soil moisture, inorganic

[1] *Agron. J.*, 1938, **28,** 1–23.

N fertilization, a row spacing of 90 cm and hot water treatment of setts, while albino-affected cane showed a fall in the values of both variables. Close correlation was found between these and cane yield, which was stimulated by the same set of factors as were respiration and catalase activity.

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**Red rot resistance of sugar cane varieties.** K. KAR. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A21–A27.—The importance of red rot control through growing of resistant varieties in India is discussed and data given showing the reactions of a number of varieties to the disease.

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**Response of sugar cane varieties to different dates of planting and harvesting.** R. S. DIXIT and K. M. BHARDWAJ. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A29–A34.—Trials with three varieties planted and harvested at three different times are reported.

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**Agricultural efficiency is the key to profitability of the sugar industry.** M. LAKSHMIKANTHAM. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A35–A41.—Factors having effect on cane sugar content are examined, viz. climate, variety, farming practices and plant protection, and the criterion of sugar production per unit time and unit area used to compare the cane agricultural efficiencies of Indian states.

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**Effect of nitrogen, phosphate and potash fertilization on yield and juice quality of sugar cane.** S. K. OJHA, S. P. DUA and S. V. SINGH. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A43–A48.—While applications of N increased cane yield, but also adversely affected juice quality, P application gave inconsistent results while K did not have any effect on yield or juice quality. These were the findings of tests conducted during 1957–72.

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**Heat therapy of sugar cane seed material—its extension to cane growers' holdings.** E. J. RAO. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A53–A57. Large-scale treatment of setts with hot water at 52°C for 20 minutes reduced grassy shoot incidence in cane grown on 8500 acres to 0·04% compared with 2·30% in cane fields in which untreated cane was grown. The % germination of cane in preliminary tests was 70% with the shorter treatment as opposed to 61% with longer treatment (50°C for 2 hours).

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**Studies on sweet sorghum in India. II. Effect of date of sowing and stage of harvest on yield and quality of sweet sorghum (*Sorghum bicolor* Moench).** B. K. MAHESHWARI, J. PRASAD, G. B. SINGH and R. K. SHARMA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A59–A64.—Tests showed that by staggering the time of sowing, sweet sorghum could be made available for processing from early October until November when sugar factories start receiving their normal cane supplies in sub-tropical areas.

**Inhibition of flowering in sugar cane with "Gramoxone" and "Reglone" sprays.** S. SINGH and K. K. SRIVASTAVA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A65–A71.—Experiments are reported in which Co 1171 cane was sprayed to inhibit flowering. Application of 0·6 kg.ha$^{-1}$ "Gramoxone" in 4 equal doses at 3-day intervals during the 3rd and 4th weeks of September reduced flowering from 80·3% before treatment to zero; almost as good results were achieved with 4 doses totalling 0·45 kg.ha$^{-1}$, but a single dose of 0·3 kg.ha$^{-1}$ reduced flowering only to 20–33%. "Reglone" added in the same doses as "Gramoxone" was not as effective, while 6 and 12 kg.ha$^{-1}$ pentachlorophenol had approximately the same effect as "Reglone". The sugar content of treated non-flowered cane was greater than with the untreated flowered cane in April but not in February.

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**Studies on drought tolerance of sugar cane varieties.** R. G. SINGH and S. SINGH. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A73–A80.—Pot experiments are reported in which 24 cane varieties were grown under conditions of 40–45% available moisture and moisture deficiency. In the varieties found to be capable of obtaining moisture from a level far below the "wilting coefficient", close correlation was established between their stomatal characteristics and drought tolerance.

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**Effect of micronutrient on growth, yield and juice quality of sugar cane.** R. G. SINGH, H. P. VERMA and J. P. SINGH. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), A81–A89.—Experiments during 1952–72 showed that application of trace elements either as foliar spray or incorporated in the soil had varying effects on cane growth and yield and juice quality, but none of the results were significant. However, where there was an iron deficiency, application of 2% ferrous sulphate in 1000 litres of water per ha reduced losses from 50–75% to 5–15%.

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**Biotypes in *Colletotrichum falcatum* W., the cause of red rot of sugar cane, and their bioassay.** S. C. GUPTA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), G5–G13.—Details are given of cane varietal tests for resistance to red rot, in which the various isolates used differed mainly in their virulence, although the choice of isolates was further complicated by the tendency of some to mutate.

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**The toxin-binding protein of sugar cane; its role in the plant and in disease development.** G. A. STROBEL. *Proc. Nat. Acad. Sci.*, 1974, **71**, 4232–4236.—The toxin-binding protein in eye spot-susceptible cane was also found to bind raffinose. Previously, a number of α-galactosides were found to inhibit the binding of helminthosporoside, and application of $^{14}$C-labelled raffinose (also an α-galactoside) to cane protoplast demonstrated the possibility that the toxin-binding protein participates in the transport of α-galactoside. Activation of membrane $K^+$, $Mg^{++}$ ATPase by the toxin must take place through the toxin-binding protein, since ATPase does not directly interact with the toxin, and membrane proteins may be affected by the toxin-binding protein by one of several mechanisms which are discussed.

# Sugar beet agriculture

**Influence of certain pesticides on sugar beet physiological processes.** J. KRÁLOVIČ and J. HLAVATÝ. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 183–196.—The effect of treatment of glasshouse-grown beet plants with one of four preparations (one insecticide and three fungicides) on photosynthesis under laboratory conditions was studied, wherein results differed according to chemical applied. While treatment was effective in controlling *Cercospora beticola* and *Erysiphe communis*, this in itself did not increase beet or sugar yield, and in one case a reduction in sugar yield resulted in field tests. In the case of "Kuprikol", assimilation processes were stimulated under laboratory conditions, but variable results were obtained in the field. In the case of treatment with "Pirimor" ("Pirimicarb"), "Bavistin" and "Topsin M", photosynthesis tended to be greater than in the untreated control, particularly at the lowest concentration of preparation tested.

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**Possibilities of interaction between "Aldicarb" and I.P.C.** L. VAN STEYVOORT. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 197–200. Tests have shown that "Aldicarb" insecticide, although found to be non-phytotoxic when applied in beet fields, does interact with I.P.C. herbicide, another member of the carbamate group, to increase its phytotoxicity; in the presence of I.P.C. alone, the beet population in part of a field was normal, whereas in another part of the field treated with both chemicals emergence was poor.

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**General considerations on the various insecticide-herbicide interactions in beet agriculture.** J. F. MORIN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 209–221.—Reference is made to tests over the past 10 years aimed at establishing possible insecticide-herbicide interactions. Generally, it is concluded that insecticides must be highly selective and very effective against soil-inhabiting and airborne pests in order that pre- or post-emergence herbicides can act selectively against weeds and provide for drilling to a final stand. Whatever interaction exists must be beneficial to the beet plant; thus, for example, carbamates such as "Aldicarb" and "Carbofuran", which have a wide sphere of activity but are sufficiently selective, have increased the harmless nature of "Pyrazone" and "Phenmedipham".

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**The selectivity and effect of "Pyrazone" after pre-emergence application with particular reference to weather conditions and types of soil.** S. BEHRENDT and H. KLAASSEN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 225–239.—Observations on the effects of "Pyrazone" during 1963–74 under varying conditions (air temperature, rainfall and soil type) are reported. Results generally showed that beet tolerance and effectiveness of the herbicide varied; fluctuations in selectivity were, however, much less noticeable than fluctuations in the herbicidal efficiency, which was mainly governed by the type of weed, and by moisture conditions after application and after weed germination, maximum results being obtained with heavy rainfall in April–May. An average temperature above 15°C after herbicide application and rainfall of 10–30 mm permitted greater herbicidal effects than did lower temperatures, although variations in the reaction of weeds to "Pyrazone" were observed. At a given rate of application, "Pyrazone" was less effective with increase in the soil silt and clay as well as organic matter content. Beet tolerance was practically unaffected.

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**Behaviour of "Medinoterb" acetate in highly absorptive soils and sugar beet.** R. HÄNSCH. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 241–254.—In soils of high organic matter content, only certain pre-emergence herbicides will be effective and then only if applied at high dosage rates based on their absorbability. "Murbetex O" (containing 15% "Medinoterb" acetate and 30% "Propham") is specially intended for sugar and fodder beet growing in such problem soils, but has been found to be relatively toxic to mammals. Tests were conducted on various types of soil to investigate the chemico-physical behaviour of the herbicide, its decomposition and availability to plants. No residues were found in the fields at harvest time during the test period (1972–74), and it is suggested that any residue in soil will not be phytotoxic to crops grown after the beet.

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**Persistence of "Ethofumesate" in soil.** H. NABER and D. C. VAN DORD. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 255–262.—In soils containing more than 3% organic matter, noticeable residues of "Ethofumesate" herbicide have been found in beet fields in Holland as a result of pre- and post-emergence application, while post-emergence application was also found to leave high residual levels in other types of soil, resulting in reduced yields. Even at a pre-emergence application rate of only 0·8–1·2 kg.ha$^{-1}$ on loam, clay and sandy soils of low organic matter content, about 10% of the herbicide remained in the soil at harvest time. While the chances of damage to a subsequent wheat crop seem small, even if only surface soil cultivation is used, further research is needed to confirm this finding.

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**Behaviour of "Pyrazone" [amino-5 chloro-4 phenyl-2 (2H) pyridazinone-3)] in the soil—a survey of the literature.** P. JAMET. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 263–274.—A survey is presented of the literature concerning the

behaviour of "Pyrazone" in the soil and the effect of the soil organic matter content on its absorption and, hence, herbicidal efficiency.

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**Evaluation of the effect of weed growth on sugar beet yield and quality.** W. R. SCHÄUFELE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 277–289.—In a study, lasting several years, of the effects of weeds on beet yield and quality, it was found that the majority of weeds compete with the beet and that the major effect is a reduction in yield, while quality is less affected. With "early" weed growth, the interval up to elimination of the weeds (at thinning) is of significance for yield, subject to environmental factors or use of herbicides which reduce the importance of this factor. The extent to which yield and quality are affected is highly dependent on the type and density of the weeds. While weeds can have a beneficial effect (by reducing wind erosion, improving micro-climatic conditions, distracting pests, etc.), advantage can be taken of this fact only if the weeds are eradicated before affecting beet growth.

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**Late- and slow-emerging weeds in Danish sugar beet growing.** C. MARCUSSEN, S. OIEN and H. E. PETERSEN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 291–299.—*Chenopodium album* is the most important late-emerging weed in Denmark and often causes considerable falls in yield of beet drilled to a stand, although in most years it can be controlled by application of a pre-emergence herbicide such as "Pyrazone", "Lenacil", "Cycloate" and "Ethofumesate" followed by post-emergence application of "Phenmedipham". Under dry conditions in spring, early treatment with "Phenmedipham" followed by a further application 8–12 days later has proved effective. *Solanum nigrum*, also a troublesome but less frequently occurring weed, may also be controlled by a pre-emergence herbicide followed by a post-emergence application of a 2:1 "Pyrazone"-"Phenmedipham" mixture. Other late- or slow-emerging weeds briefly mentioned do not cause significant reductions in beet yields.

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**Possibilities of destroying successive late-emerging weeds in the Limage (Central France).** L. A. DURGEAT, J. F. MORIN, J. CADE and J. LETOUBLON. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 301–311.—Details are given of the more important weeds encountered in the beet fields of the Limage region and of results obtained with "Pyrazone" and "Diallate" applied before sowing and "Phenmedipham" and NC 8438 post-emergence herbicides.

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**Adventitious flora difficult to combat in Spain.** J. L. VILLARIAS. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 313–320.—Details are given of weeds found in beet trial grounds in Spain. Because of the nature of the weeds, chemical control has been based on use of two herbicides, one active against grasses and the other against dicotyledons; the dosage rates have been adjusted according to the particular weed in question in order to obtain the widest possible sphere of activity, but this has considerably raised the costs of treatment.

**Competition between weeds and sugar beets.** T. G. STROUTHOPOULOS. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 321–335.—Field experiments carried out in Greece to evaluate the critical period of competition between weeds and beet have shown that weeds emerging at the same time as beet provide marked competition which, however, the beet can tolerate, without any significant reduction in yield, for a period of 10–30 days (or even more) from emergence, depending on weed density, type and rate of growth. Subsequently, competition increases and can cause considerable reductions in sugar yield (48% reduction in one test). Weeds emerging after a period of control lasting 20–50 days (or even longer) have no detrimental effect on yield (which is gradually increased by the treatment), while a 10-day control period is followed by yield reductions which may range from light to serious. A significant factor is also the time which is allowed to elapse before weed control.

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**Particulars of chemical weed control in winter-grown sugar beet in Morocco.** K. PETZOLDT and A. SALAH-BENNANI. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 337–346.—Details are given of the most important weeds which infest beet fields in Morocco and of the herbicides used.

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**Possibilities of combating *Galium aparine* and *Mercurialis annua* in beet agriculture.** J. M. BELIEN, J. F. SALEMBIER, W. HAQUENNE and M. GOMAND. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 347–352.—For control of these two persistent weeds which occur in Belgian beet fields, two methods have proved successful: (i) for 92% control of *M. annua* alone, pre-emergence application of 1 kg "Ethofumesate" and post-emergence application of 0·3 kg "Phenmedipham" + 1·6 kg "Pyrazone" per ha, and (ii) for 81% control of *M. annua* and 98% control of *G. aparine*, pre-emergence application of 1 kg "Ethofumesate" and post-emergence application of 0·9 kg "Phenmedipham" + 1 kg "Ethofumesate" per ha. Care should be taken to ensure that, when method (ii) is used, no "Ethofumesate" remains in the soil if winter wheat follows the beet in rotation.

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**Combating *Agropyrum repens* before sugar beet culture.** W. HAQUENNE and J. M. BELIEN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 353–363.—Of various systemic herbicides tested against *A. repens*, the most effective was found to be "Glyphosate" which acted very quickly, gave up to 95% control and left no residue, so that beet could be sown within a week of treatment without risk of phytotoxicity.

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**Some observations on winter destruction of grasses with "Carbetamide" in seed-bearing culture of industrial beet.** J. P. DELEPLANQUE, J. FAUCHERE and J. F. MORIN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 365–371.—Problems of grass weed control, particularly of *Avena fatua* and *Alopecurus agrestis*, in fields of autumn-drilled seedlings are explained and the successes achieved with "Carbetamide" applied in the winter are described.

**Change in the weed flora during the last 10 years as a result of modern agricultural practices in intensively cultivated beet areas of Austria.** H. NEURURER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 375–388.—The composition of weeds encountered in Austrian beet fields has altered noticeably in the last 10 years—some types have increased, some have decreased, others have remained at the same level of infestation, while yet others have disappeared. Causes of the changes are considered to be chemical weed control and agricultural and cultivation practices. The changes have made weed control more difficult, and suitable measures are described which can prevent radical undesirable changes in the weed flora.

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**Changes over 25 years in the weed population in sugar beet grown on a Norfolk farm.** W. E. BRAY and J. G. HILTON. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 389–394.—Changes during 1950–74 have been noted in the types and incidence of weeds at the Norfolk Agricultural Station. The major changes have been a decline in the number of *Stellaria media* and *Polygonum aviculare* and an increase in the population of *Poa annua*. It is suggested that the use of MCPA, controlling most broad-leaved species and thus reducing inter-weed competition, has permitted a build-up of *P. annua* (meadow grass). Marked fluctuations in the total weed population could not be related to weather conditions during the spring months.

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**The more important types of weeds in beet crops on different soils.** S. BEHRENDT. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 395–408.—Details are given of the more important weeds found in West German beet fields. The effect of soil type on distribution of specific weeds is indicated; the incidence data show how populations of the various species have altered during the period 1960–72.

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**Behaviour of a winter wheat crop after a beet crop treated with "Ethofumesate".** M. GOMAND, J. F. SALEMBIER, L. DETROUX and J. M. BELIEN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 425–432.—"Ethofumesate", applied in beet fields as a post-emergence herbicide at the rate of 3 $kg.ha^{-1}$, was found to cause serious damage to winter wheat grown after the beet crop. However, the adverse effects (which are described) can be avoided if deep ploughing is used rather than merely surface treatment of the soil.

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**Behaviour of "Pyrazone" in the soil and effect on subsequent crops.** N. DRESCHER and B. H. MENCK. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 411–423.—Reference is made to earlier studies on the bacterial decomposition of "Pyrazone", acting as carbon source in the soil, and to the significance of this for crop growing. Half-life values had been established for the herbicide in different soils; a considerable leaching effect was found in light sandy soil, but such soil is not practical for beet growing, and no residue was found in percolating water after normal rainfall. Further tests have shown that 2·6 kg "Pyrazone" per ha can be applied without detriment to subsequent crops, including spring barley, maize and potatoes as well as sugar beet, provided ploughing is carried out within 4 weeks of the application, whereas two other unnamed herbicides placed limitations on later crops. Any winter cereal crop could be grown after beet harvesting. Screening tests on maize, winter rape and winter cereals yielded no evidence to suggest that residues would be present in the harvested crops.

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**Study of "Ethofumesate" residues in cereal crops following beet.** F. VERNIE, G. QUERE and J. Y. PUJOL. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 433–441.—In trials during 1972 and 1973, "Ethofumesate" applied in beet as pre- and post-emergence herbicide at the rate of 1 and 2 kg a.i. per ha had no effect on yields of cereals grown after the beet crop.

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**"Ethofumesate" in the soil: contribution to a study of its persistence.** J. F. MORIN, S. D. VAN HOOGATRATEN and A. TABORIN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 443–454. Results of tests have shown that "Ethofumesate" applied in beet fields can have an adverse effect on subsequent winter wheat crops unless ploughing is used before sowing of the wheat.

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**Analysis of residue and behaviour of "Metamitron" in sugar beet and soils.** H. J. JARCZYK. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 455–467.—Details are given of a gas chromatographic technique for determining residues of "Metamitron" in beet and soil, and results are given of trials in which no detectable residues were found in either beet or soil at harvest time.

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**Effect of treatment with beet herbicides on the development of maize planted on ploughed-up beet seed.** W. HAQUENNE, J. F. SALEMBIER and L. DETROUX. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 469–479.—Trials are reported in which the effects of herbicides (for specific use in beet fields) on subsequent maize crops were determined. Provided a sufficient interval was allowed to elapse between herbicide application and sowing of the maize and if deep tillage was used, none of the hercibides tested ("Diallate", "Cycloate", "Lenacil" and "Pyrazone") had adverse effects on the cereal crop. Immediate sowing after treatment was followed by serious damage to the crop by "Propham" on its own or with "Fenuron", while "Pyrazone" had a certain phytotoxicity but caused less damage. Tests are recommended to establish the effects of "Ethofumesate" and "Isocarbamide". The results are particularly significant where a grower decides to replace beet which has shown poor germination and emergence.

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**Preliminary investigations on the action of herbicides used in beet crops on the environment.** J. LHOSTE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 483–493.—The author examines the possible effects of herbicides on the environment, particularly on phreatic water and game, and concludes, from the results of tests, that at the present level of knowledge on the subject, herbicides used in beet crops have no side effect on the environment.

**Behaviour of farmers faced with the problem posed by the persistence of herbicides used in maize in beet areas.** J. P. LOUBARESSE, J. CORTIER and B. PINEAU. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 495–504.—In France, most of the weed control in maize crops is with herbicides of the triazine group, and where other crops follow in rotation they are liable to damage by residues of the herbicides. This particularly applies to wheat which is normally grown after maize, and the question of growing beet after maize is especially significant. Of farmers in a beet region to whom questions were put, a small majority thought that beet growing after maize would be possible with some risk of damage by residual herbicide, whereas the others considered beet growing impossible under the conditions. It is suggested that other herbicides for selective use in maize should be sought so as to permit the growing of beet.

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**Herbicides as an energy input in sugar beet production.** D. PRICE JONES. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 507–515.—The cost of herbicide application as a proportion of the total costs of beet production is shown to be very small, so that large economies cannot be made in this sector. Moreover, herbicide use has still not reduced the energy input (within the ecosystem) by reducing the need for mechanical cultivation, although the trends are towards this; the farmer appreciates the role of herbicides more in economic than energetic terms. The energy requirements (in MJ per ha) for various planting methods and manual or chemical weed control are tabulated and discussed.

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**Cost/yield analysis of chemical weed control in sugar beet agriculture.** H. NEURURER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 517–526.—In a discussion of the profitability of chemical weed control, it is shown that a 5% increase in beet yield as a result of herbicide application would cover the costs of the treatment. However, the critical threshold is that at which one-tenth of a given weed infestation causes 5% reduction in yield or disrupts the normal agricultural practices. This is explained.

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**Recent results on improvement in the effect of "Pyrazone".** A. FISCHER, G. RETZLAFF, W. ROHR, G. SCHEUERER and B. WÜRZER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 529–539.—Details are given of two new herbicides from Badische Anilin- und Soda-Fabrik AG (BASF) which are derivatives of sulphamoyl glycolic acid: 87 959 which is an amide, and 90 016 which is an anilide. Tests have shown that both are highly effective against a large number of weeds when used before or after emergence at the rate of 1–2 kg.ha$^{-1}$ and can be used in combination with "Pyrazone".

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**R-11913/"Benzadox", a new contact and residual post-emergence herbicide for sugar beet.** D. H. BARTLETT, R. V. EDWARDS and B. E. GROENWOLD. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 541–555.—In trials at a number of sites, R-11913 (proposed name "Oxyprocarb") at 0·5–1·0 kg a.i. per ha plus 1·3 kg a.i. per ha "Benzadox" applied at the 2–4 true leaf stage of sugar beet have given excellent control of a number of weeds which are named. Details are given of the experiments.

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**Weed control trials in sugar beet with "Isocarbamide" and its combination with "Lenacil": results of four years' experimentation.** J. M. BELIEN, L. DETROUX, J. F. SALEMBIER and M. GOMAND. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 557–584.—Trials during four years are reported in which the effectiveness of "Isocarbamide" (1-*iso*-butylcarbamoylimidazole-2-one) on its own and in combinations with other pre-emergence herbicides, particularly "Lenacil", was studied.

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**Experiences with "Desmedipham" and "Desmedipham"/"Phenmedipham" mixtures in sugar beet under various climatic conditions.** C. AHRENS, C. M. GATES and H. LAUFERSWEILER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 585–596.—Experiments with "Desmedipham" (3-ethoxycarbonylaminophenyl-N-phenylcarbamate), a new post-emergence herbicide for control of dicotyledons, have shown that it is more phytotoxic to beet than is "Phenmedipham", particularly when temperatures are high or fluctuate markedly. It is therefore most suitable in a mixture with "Phenmedipham", the proportions of the components depending on local factors.

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**Interactions between stage of sugar beet development and mixtures of "Ethofumesate" and "Desmedipham".** E. E. SCHWEIZER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 597–604.—Trials are briefly reported in which mixtures of the two title herbicides were effective against *Setaria* spp., *Kochia scoparia* and *Amaranthas retroflexus* in beet fields. Maximum control was obtained when "Ethofumesate" was applied before planting and the "Ethofumesate"/"Desmedipham" mixture applied after emergence; under these circumstances, application of the mixture could be delayed until the 6-leaf stage, whereas without the pre-planting application, treatment at the 4-leaf stage was necessary, although control was still not as good as with the pre-planting treatment plus post-emergence application.

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**Old and new products applied with different cultural techniques in sugar beet weed control.** G. COVARELLI. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 605–615.—Trials in Central Italy with a number of herbicides and their mixtures are reported.

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**H 22234, a new pre-emergence herbicide for sugar beet.** S. K. LEHMAN and L. VEEGENS. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 617–631.—Results of trials with this new herbicide [N-chloroacetyl-N(2,6-diethylphenyl)-glycine ethyl ester] in a number of countries are reported.

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**Pre-emergence and pre-planting weed control in sugar beet with "Ethofumesate".** W. GRIFFITHS, H. M. HOLMES and R. K. PFEIFFER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 633–642.—Trials with "Ethofumesate" in Austria, France, Greece and the UK are reported for 1972–73.

**Preliminary results obtained with a "Cycloate"-"Ethofumesate" mixture in beet crops.** J. Y. PUJOL, F. VERNIE and G. QUERE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 643–653. Reports of field trials at a number of locations in France, in which pre-planting application of 1·44 kg a.i. "Cycloate" and 1 kg a.i. "Ethofumesate" per ha was followed by post-emergence application of "Phenmedipham" at 1 kg.ha$^{-1}$, indicated excellent control of specific mono- and dicotyledons. The data are tabulated.

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**Experiments in Italy with "Ethofumesate" used in pre-emergence applications for weed control in sugar beet.** G. BELLINI and G. ZAMBONI. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 655–667.—Trials during 1971–74 in Italy in both autumn- and spring-sown beet with "Ethofumesate" on its own and in mixtures with other herbicides, particularly "Lenacil", are reported. Results are given for effectiveness and phytotoxicity.

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**Post-emergence weed control in sugar beet with "Ethofumesate"/"Phenmedipham" combinations.** R. K. PFEIFFER, H. M. HOLMES and W. GRIFFITHS. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 669–680.—Trials with post-emergence application of the title mixture carried out in Austria, France, Greece and the UK in 1973–74 are reported. Optimum results were obtained at 1·0 kg "Ethofumesate" and 0·8 kg "Phenmedipham" per ha applied at the 2–4 beet leaf stage at temperatures no greater than 20°C.

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**Two years of trials with "Ethofumesate"–"Phenmedipham" mixtures.** F. VERNIE, J. Y. PUJOL and G. QUERE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 681–692.—Trials with 1 kg "Ethofumesate" and 0·835 kg "Phenmedipham" per ha applied as a post-emergence mixture are reported in which up to 100% control of specific weeds was obtained.

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**Possibilities of using "Ethofumesate" in France for weed control in beet crops.** L. A. DURGEAT and J. F. MORIN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 693–712.—"Ethofumesate" has proved, in trials, to be of value, particularly as a post-emergence mixture with "Phenmedipham", since it is effective against certain weeds resistant to other herbicides. Details are given of test results obtained at a number of sites.

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**"Metamitron"—a new beet herbicide on a triazinone base.** R. R. SCHMIDT, L. EUE and W. DRABER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 715–728.—"Metamitron" [3-methyl-4-amino-6-phenyl-1,2,4-triazin-5(4H)-one] is a new herbicide for pre-planting and pre- and post-emergence application as well as during beet emergence; it is highly water-soluble, so that it is quickly absorbed via the roots or leaves of weeds and translocated to the chloroplasts where it prevents phyotosynthesis. The rate of application is governed by a number of factors (type of weed, stage of weed growth, temperature and soil conditions). Its efficiency may be increased by additives.

**The use of "Metamitron" ("Bay 6676") with regard to results of spraying in beet.** H. HACK. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 729–745.—Field trials are reported in which "Metamitron" as a 70% preparation was applied before planting and before and after emergence. Since the trials were conducted under exceptionally dry conditions, it is suggested that even better results could be obtained under normal conditions. The effect against specific weeds is indicated in tables.

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**Study on "Metamitron" in view of its application for selective weed control in sugar beet in Belgium.** J. M. BELIEN, J. F. SALEMBIER and M. GOMAND. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 747–768.—In trials during 1974 "Metamitron" proved most effective as a post-emergence herbicide, but *Chenopodium album*, *Stellaria media* and grasses were very difficult to kill. Full details are given of the tests.

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**Preliminary large field trials with "Metamitron" ("Bay 6676") in France.** L. A. DURGEAT, J. F. MORIN, P. POURCHARESSE and F. MICHEL. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 769–783.—Tests during 1973–74 are reported, in which the herbicide was found to have a residual action lasting 3–4 months. Certain weeds have proved relatively resistant to "Metamitron", which has shown no phytotoxicity to beet.

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**The accumulation of sugar in sugar beet.** F. PAPY. *Sucr. Maghrébine*, 1974, (13), 5–11, (14), 3–9. Growth-governing factors discussed include the intensity of light energy and photosynthesis, fertilization, temperature, moisture conditions and soil profile. Competition between beets and weeds and between the beets themselves is examined in somewhat greater detail, and ways in which the beet population can be maintained at a required level are indicated diagrammatically. The adverse effects of pests and disease are discussed, and breeding of beet varieties for high yield and/or sugar content as well as suitable for growing under Moroccan conditions is also treated.

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**Nitrogenous fertilizer in sugar beet agriculture.** A. ANBA. *Sucr. Maghrébine*, 1974, (13), 11–16.—The role of nitrogen in beet agriculture, its effect on growth and composition, recommended rates of application for Morocco and optimum method of application are discussed.

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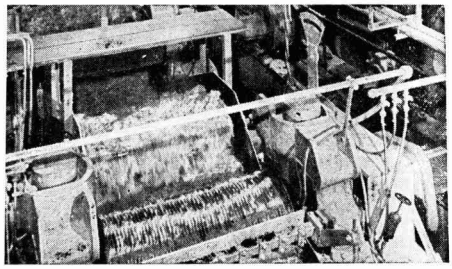
**The nitrogen requirement of the sugar beet.** A. BENVENUTI. *Ind. Sacc. Ital.*, 1975, **68**, 7–10.—The fundamental role of nitrogen in the productive cycle of the sugar beet is examined and the N requirements of the plant discussed by comparing the pattern of dry solids increase and proportionment in the aerial and root parts with the N percentage of the dry solids in both parts throughout the growth period. The importance of N application date and dosage is indicated, and beet sucrose content, juice purity and yield per ha tabulated for 0, 60, 120 and 180 kg of N per ha. A graph also indicates the position of beet relative to other plants, including wheat and barley, as regards sugar yield per ha for N application up to 150 kg.ha$^{-1}$.



# Cane sugar manufacture

**Effect of mechanical treatment of the cane variety on bagasse quality.** R. BAMBANASTE and C. M. LORENZO. *Revista Icidca*, 1974, **8**, (2), 42–50.—Bagasse particle size analysis was carried out at intervals during the 1972/73 season at Pablo Noriega sugar factory and the information fed to a computer which related it to cane variety and mechanical wear in the mills. It was found that significant differences existed between the bagasse from different varieties but that falling efficiency of cane preparation and milling plant had a greater effect on bagasse particle size distribution and its suitability for depithing. Consequently, mid-season changing of knives, etc., is recommended.

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**Continuous operation of exhaustion crystallizers.** A. VALDEZ and J. CASTAÑEDA. *ATAC*, 1974, **33**, (4/5/6), 4–14.—Operation in series of the crystallizers for final massecuite has reduced retention time while attaining the same exhaustion with fewer units at one Cuban sugar factory, and at another has reduced final molasses purity by 4·28 units with a reduction of retention time from 24 to 14–16 hours using the same number of units. The system is being extended to other factories.

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**Electronics in process controllers.** R. C. SHARMA. *Sugar News* (India), 1974, **6**, (7), 13–14.—Electronic process control is discussed and its advantages over pneumatic control indicated.

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**A note on observations of the mechanical circulator working at reduced speed.** V. B. BAGAL and M. ANAND. *Sugar News* (India), 1974, **6**, (7), 17–20.—Advantages of massecuite stirrers are discussed and results reported of *C*-massecuite boiling in a pan in which the stirrer operated at 75 and then at 67·5 rpm without any adverse effect on the motor or boiling variables despite the 10% reduction in speed.

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**Sweet sorghum a possible new source of sugar.** A. D. KARVE. *Sugar News* (India), 1974, **6**, (7), 23–24. Reference is made to sorghum trials in India in 1968/69. Recommendations are given on growing of the Rio variety of sorghum and on jaggery manufacture from the juice.

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**An assessment of the performance of the milling-cum-D.D.S. diffusion system.** T. T. OOMMEN. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E1–E5. Tabulated data indicate that straight milling in an 18-roller tandem with 17–18% imbibition water at Sakthi Sugars Ltd. gave better sugar recovery and extraction than did a milling-cum-DDS diffusion system using 25–26% water addition subsequently installed at the 1500 t.c.d. factory. The drop in purity from primary to mixed juice was much greater in diffusion than in straight milling.

**Modifications made in the design of a vacuum filter and improvement achieved thereby in New Horizon Sugar Mills Private Ltd., Pondicherry, during the season 1972-73.** L. C. BANERJI. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E7-E10.—Provision of two additional suction points under each screen of a vacuum filter for light filtrate discharge reduced filter cake pol content from 3·2 to 2·2–2·4 at the author's sugar factory.

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**Evaluation of degree of preparation of cane achieved by preparatory devices such as cane knives and shredder.** K. R. DAS and K. B. RAO. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E11–E16 + 5 figs. Experiments were carried out to determine possible relationships between % ruptured cells in cane and bulk density of the prepared cane and to evaluate the effect of the cane preparation equipment on quality of preparation. Regression equations for knifed and shredded cane are of limited application in view of the dependence of bulk density on both variety and cane fibre content, but it is thought that the effects of the two factors can be allowed for by introducing a new factor, the "filling ratio", as proposed by MUNRO[1]. Further experimental work is required to test this hypothesis. Results also indicated that knifed cane had a higher bulk density than did shredded cane at the same given percentage of ruptured cells. This difference is explained.

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**Improved technique for reducing pol and moisture in bagasse.** A. L. BHATIA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E17–E21.—Three defects in cane mill operation generally found by the author in a study of the performances of more than 60 units were: (i) poor juice drainage, particularly in 1st and 2nd mills, with low cane fibre content, (ii) irregular maceration juice flow, and (iii) inefficient mixed juice screening. How these faults were remedied is described and data given demonstrating the considerable improvements in milling efficiency and reduction in bagasse moisture content.

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**Total energy concept in the Indian sugar industry.** V. V. SUBBARAO and S. J. LAGARE. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E23–E30. As a contribution to saving of energy in a cane sugar factory, the authors aim to set out an optimum steam cycle based on the processing of 100 tons of cane per hour. Details are given of the scheme and of the financial savings possible.

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**Present power crisis—suggestions to supplement (power) by the sugar industry.** K. S. NARAYANA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E31–E34.—Data are given to show how it is possible for

[1] Ph.D. Thesis, University of Queensland, 1964.

cane sugar factories to generate more power than they require and supply it to the national grid.

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**A case study of fuel economy through steam and power balance.** K. S. VIRDI and S. K. GHOSE. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E35–E44. It is concluded from analysis of the processes in a 3810 t.c.d. sugar factory that judicious selection of turbo-alternators can prevent losses of fuel in the form of exhaust steam vented to the atmosphere when the installation of more modern equipment raises the power load. The power load and exhaust steam requirements of individual processes are set out, from which the total exhaust steam availability is shown to be slightly below demand (% on cane), necessitating reduction of some live steam.

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**The effect of fibre percent cane on mill setting.** L. B. VERMA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E45–E52 + 1 fig.—A method for calculation of cane mill settings as a function of cane fibre content is described and pertinent opening ratios tabulated.

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**An approach to better feeding arrangement to a mill.** A. V. NARAYANARAO. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E53–E55 + 4 pp. Measures adopted at the author's factory to overcome mill feeding problems are described. They included installation of an intermediate carrier, the nose shaft of which was used as the drive shaft. Advice is given on installation. The performances of both primary and dewatering mills improved.

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**Studies on mill roller grooves.** P. N. R. RAO and H. N. GUPTA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), E57–E65 + 9 figs.—From investigations of the effect of grooving on mill performance using an experimental 14-roller milling tandem crushing 50 t.c.d., preceded by two sets of knives, it was concluded that the advantage of higher compression ratios, leading to greater number of ruptured cells and hence greater availability of free juice for extraction, was offset by the resultant decrease in bagasse blanket permeability, which reduced juice extraction. However, at higher compression ratios with differential-angle grooves the drop in permeability can be reduced by providing a larger "no-pressure" zone at the bottom of the grooves.

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**One-grade sugar by open pan manufacturing process.** V. M. BHALWAR. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M1–M4.—The author shows how it is possible to reduce the 3–4 grades of sugar produced by the open pan process to just one by melting the low-grade sugar and recrystallizing.

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**Effects of dextran on sugar processing.** Z. THOMAS and M. V. VIJAYAKUMAR. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M7–M11.—See *I.S.J.*, 1975, **77**, 279.

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**Importance of pan testing before starting the season.** Y. GUPTA. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M5–M6.—Testing the pan station under hydraulic pressure and vacuum conditions and sealing any leaks thus found is recommended as a means of improving factory performance.

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**Production of raw sugar and its advantages over the production of white sugar. I.** P. F. JAIN. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M13–M22.—See *I.S.J.*, 1975, **77**, 279.

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**Observation on the working of Wal-Konti-8/34° continuous centrifugals for curing of low-grade massecuite.** N. N. JOSHI, G. C. SINGH and R. C. SINGHAL. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M23–M30.—The advantages of continuous centrifugals for low-grade massecuite curing are discussed. A higher purity molasses than with batch centrifugals and a short screen life are the two major problems.

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**pH control in juice sulphitation.** M. SINGH and V. V. SUBBARAO. *Prov. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M51–M55.—Desiderata of a suitable automatic pH control system for sulphitation are discussed and the factors governing pH control precision examined.

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**Studies on the use of flocculating agents during sugar cane juice clarification. IX. Settling studies with "Tulsepar A-30", "Tulsepar A-40", "Floxin-10", "Boze Floc A 51 BT" and "Boze Floc A 61 BT".** S. BOSE, K. C. GUPTA and S. MUKHERJEE. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M57–M64. Results of laboratory tests on limed and sulphited juice are discussed. These indicated that the best settling rates were achieved with the last two agents named in the title (6 times that obtained with the untreated control), while the first two agents in the title gave $2\frac{1}{2}$ times the rate of the control. "Floxin-10" did not give any significant improvement. All flocculants reduced the amount of alcohol-precipitable matter compared with the control.

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**Studies on colour in sugar manufacture.** D. P. KULKARNI and J. R. UNDE. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M65–M84 + 2 figs. Studies have been carried out on the development of colour in plantation white sugar manufactured by double sulphitation and in raw sugar produced by simple defecation, and data obtained relating to each process and to the effects of pH and temperature on colour formation.

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**Jaggery manufacture at Jaknur.** R. V. SHIRGOANKAR. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M95–M103.—The processes used at the author's jaggery factory are described and a number of problems incurred in manufacture of a high-grade product discussed.

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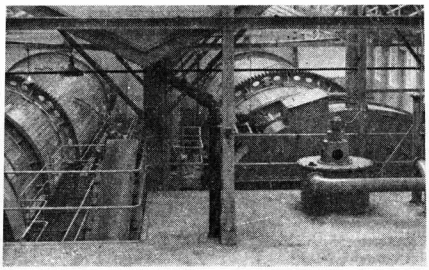
**Trials of flocculating agents for improving settling characteristics of first carbonatation juice.** N. N. JOSHI, S. K. GOEL and P. K. AREN. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (1), M105–M112. Laboratory and factory-scale tests with a number of Indian and imported flocculants are discussed. While the imported products were effective in improving the settling rate of 1st carbonatation juice, none of the Indian flocculants had a positive effect.



# Beet sugar manufacture

**Experience in the use of sugar factory waste water for irrigation.** V. T. DODOLINA, V. M. NOVIKOV and A. A. SOLLOGUB. *Sakhar. Prom.*, 1975, (1), 18–22. Use of Class III waste water (including flume and wash water and muds from various sources) to irrigate land for the growing of a variety of crops is discussed and experience in a number of factory areas of the USSR is mentioned, showing the increased yields obtained by this means.

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**Interaction between anion exchange resins and sugar solution components.** V. P. MELESHKO, I. P. SHAMRITSKAYA, V. F. SELEMENEV and G. A. CHIKIN. *Sakhar. Prom.*, 1975, (1), 23–29.—The major factors causing loss of efficiency in decolorizing resins have been studied in investigations involving pure solution, melanoidins and invert sugar alkaline decomposition products. The greatest deterioration in properties was observed in anion exchange resins in $OH^-$ form, regardless of their characteristics, while the chemically and mechanically most durable was a highly basic anion exchanger in $Cl^-$ form.

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**Carbonatation gas purification.** YU. I. KOLOMIETS and A. A. CHUKHVANTSEV. *Sakhar. Prom.*, 1975, (1), 45.—A scheme for raising the efficiency of a $CO_2$ gas scrubber is briefly described.

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**Influence of raffinose on low-grade work.** L. WIENINGER. *Sucr. Belge*, 1975, **94**, 11–18.—See *I.S.J.*, 1975, **77**, 314.

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**Experiences with the Enviro-Clear system for rapid clarification of first carbonatation effluent.** F. G. EIS. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 105–114. Operation of a bottom-feed Enviro-Clear clarifier at Woodland sugar factory and of a top-feed Enviro-Clear clarifier at Spreckels is reported and results in treatment of 1st carbonatation mud compared with those obtained with 4-tray clarifiers. Data for 1971 indicated a number of advantages enjoyed by the new clarifiers over the earlier clarifiers, including lower colour and lime salts formation during clarification, a reduction in the pH drop in evaporation, improvement in juice thermal stability and reduction in the amount of soda ash required for evaporator cleaning. Average for Spreckels was a feed rate of 4·2 gal. $min^{-1}$ $ft^{-2}$, giving a suspended solids content in the underflow of 21% and in the overflow of 0·02% (by weight) at 11 minutes retention; for Woodland, the average retention was 5 minutes, feed rate was 6·8 gal.$min^{-1}$ $ft^{-2}$, and underflow and overflow suspended solids contents were, respectively, 18·8% and 0·011% by weight.

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**Optimization of sugar end processing.** V. M. JESIC and L. T. ZANTO. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 115–125.—The possibility of obtaining high-quality white sugar from low-purity standard liquor of high colour content has been investigated. A boiling house scheme which is outlined incorporates recirculation of affined low-grade raw sugar to the high-grade raw sugar pan and recirculation of high-grade raw sugar to the standard liquor melter for preparation of the white sugar massecuite. By this means, the amount of massecuite is reduced in comparison with a conventional scheme, sugar extraction is increased, the steam and power requirements are cut, and the high-grade raw sugar centrifugals are no longer idle but are used for affination of the low-grade raw sugar.

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**The effects of processing conditions on carbonatation elimination.** V. M. JESIC, L. L. WHEELOCK and L. T. ZANTO. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 180–185.—Studies showed that maintenance of 1st carbonatation optimum alkalinity end-point increased impurity removal in a simple system, but no evidence was found to support the argument that impurity elimination was temperature-dependent. Increase in the amount of CaO added is accompanied by increased sugar extraction, low juice colour and lime salts and improvements in settling and filtration. Increase in alkalinity, CaO addition and temperature causes increased removal of citric and malic acids.

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**The thermal stability of juices obtained with use of alumina.** I. A. OLEINIK and A. A. LIPETS. *Pishch. Prom.*, 1974, **19**, 6–7.—Water treated with $Al_2O_3$ before use in beet diffusion gave juice of lower colour and reducing sugars content than did water treated with $SO_2$ in experiments. The results, tabulated for raw and 2nd carbonatation juice, thus indicated greater thermal stability when aluminium oxide was used.

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**The technological properties of juice electrodialysates.** L. D. BOBROVNIK, N. S. FEDOROVA and V. DUTCHAK. *Pishch. Prom.*, 1974, **19**, 7–10.—Electrodialysis of sulphitation juice was studied. The order of non-sugars as regards migrating ability was found to be: mineral substances > organic non-N substances > N substances; with increase in the demineralization efficiency there was a fall in thermal stability and buffering capacity of the dialysates, the buffering capacity being governed by temperature. The thermal stability can be increased by adding 0·3–0·5M sodium sulphite per M reducing matter.

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**Effect of different methods of press water recycling on sugar losses in pulp.** A. I. FEL'DMAN, O. V. STRATIENKO, A. A. LIPETS and V. M. LYSYANSKII. *Pishch. Prom.*, 1974, **19**, 11–15.—Two press water recycling methods were studied: (1) where part of the water is returned to the diffuser together with feed water, while the remainder is recycled to the diffuser but at

some distance from the fresh water feed point, and (ii) where the press water is fed to the diffuser at two points along its length but separately from the fresh water. Lowest sugar losses were found to occur with method (i), which is recommended where the pulp undergoes considerable pressing; on the other hand, where pulp pressing is not so intense, method (ii) is advocated.

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**A settling centrifuge for separating muds from carbonatation juices in beet sugar manufacture.** V. S. FURS. *Pishch. Prom.*, 1974, **19**, 59–64.—A design for a horizontal rotary scroll-type mud separator, in which the mud particles are removed from the juice under centrifugal force, is described which is intended to replace settlers and filter-thickeners.

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**Liquid spray mixers for intensification of technological processes in beet sugar manufacture.** L. P. ZARUDNEV, V. M. ROSINSKII, S. P. TKACHUK and V. YA. BORISENKO. *Pishch. Prom.*, 1974, **19**, 77–81. The possibility of using continuous liquid spray mixers for sulphitation and carbonatation is examined and advantages of such mixers over conventional vessels are discussed. A mathematical model has been developed for calculation of mass transfer parameters, and details are given of experimental tests to determine optimum residence time.

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**Decomposition of limestone in sugar factory kilns.** A. M. AIZEN, N. P. TABUNSHCHIKOVA, N. N. MARUTOVSKAYA and T. E. BURAVSKAYA. *Pishch. Prom.*, 1974, **19**, 89–93.—In a study of limestone decomposition, allowance was made for the effect of heating temperature on heat conduction. A mathematical expression was obtained for calculation of the decomposition time for spherical segments at constant temperature of the heating means. A nomogram is presented for establishing the fractional composition of the material as a function of residence time in the combustion zone at 95% and 99·5% decomposition.

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**Concentration, storage and subsequent processing of raw juice. Technical aspects and economic justifications.** F. ZAMA, C. A. ACCORSI and G. MANTOVANI. *Ind. Sacc. Ital.*, 1974, **67**, 131–136.—Because of the relatively short campaign in Italy (40–50 days), the return on capital invested in factory plant is poor. In order to reduce the production costs of beet sugar and increase plant utilization, tests were conducted at Jesi sugar factory on concentrated raw juice storage. The juice from an extra 2000 tons per day continuous DDS diffuser was brought to 70–72°Bx in a supplementary multiple-effect evaporator before storage in standard 5000 $m^3$ tanks. Care had to be taken to ensure that cossette particles were eliminated by screening. The average pH of the concentrated juice was initially 9·5. When reclaimed, the juice was diluted to 17–18°Bx by mixing with normal diffusion juice and subsequently processed as usual. No significant losses occurred during more than 20 days' storage, and purification gave good results. There was no appreciable difference in colour between the thin juice and normal thin juice, nor was there any increased scale formation in evaporation. The resultant white sugar was of excellent quality. The capital costs of the extra plant installed, which raised the daily slice to 6000 tons of beet, are very much lower than those for plant to store and process thick juice, while the direct processing costs for the two systems would be about the same after 105 days of a campaign, with the raw juice storage system being cheaper but gradually rising in cost.

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**The principle of purification methods based on precipitation of $Mg^{++}$ ions in juice.** J. BURIÁNEK. *Listy Cukr.*, 1975, **91**, 6–13.—A method is described in which colloids in beet juice are separated by means of a magnesium salt added before liming. $MgCO_3$ and $H_3PO_4$ were one combination tested under laboratory conditions; the magnesium and phosphate ions were precipitated with the lime to give a considerably improved filtration compared with conventional purification, and the pH (8) was that considered optimum for cane juice treatment. The mud had a 2–3% nitrogen content (on dry solids) and could be used as fodder. A more economical method was addition of MgO, $SO_2$ and CaO, the resultant bisulphite precipitation still giving better results than with normal processing.

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**Milk-of-lime preparation.** Z. SOMORA. *Listy Cukr.*, 1975, **91**, 13–20.—The requirements of adequate milk-of-lime preparation are discussed and details given of a scheme used at Šurany sugar factory incorporating the usual slaker and means of sand removal.

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**Pollution and demineralization ion exchange resins: II. An industrial unit.** P. DEVILLERS, J. C. GIORGI and R. GONTIER. *Sucr. Franç.*, 1975, **116**, 25–34.—A factory slicing 4500 tons of beet daily and demineralizing about one-third of its 2nd strike green syrup is used as an example to demonstrate the various items of equipment and their capacities required and the quantities of steam, water, lime, regenerants, etc. consumed. Balances are calculated for each stage of the process previously described[1], and flow diagrams are presented.

* * *

**Effect of the crystal structure of massecuite on yellow sugar quality.** I. N. AKINDINOV, E. G. VOLKOVA and L. A. SOLONENKO. *Sakhar. Prom.*, 1975, (2), 21–24. Laboratory tests with artificial low-grade massecuite showed that at a given mother-liquor viscosity the resultant yellow sugar colour increased and purity fell as the proportion of crystals measuring 0·5 mm fell and those measuring 0·25 mm and fines increased. This was attributed to adherence of some of the mother-liquor to the surface of the sugar crystals when the pores became blocked by the fines. The only exception to this pattern in the viscosity range studied (approximately 4–10 poises.$sec^{-1}$) occurred at 10·5–12·0 poises.$sec^{-1}$ where there was a fall in colour and a rise in purity; the explanation is that the pores were blocked by the fines more rapidly than the rate of movement of the mother-liquor. Hence, given a good massecuite crystal composition, the Brix and purity can be raised and molasses sugar thus reduced.

* * *

**Improvement in the nozzle for washing sugar in centrifugals.** A. G. SERYI. *Sakhar. Prom.*, 1975, (2), 35–37. Poor water distribution in centrifugal baskets is discussed, and details given of a new variable-angle nozzle which sprays a "flat" stream of water onto the sugar. Tests have shown that it is suitable for normal vertical-sided baskets.

[1] *I.S.J.*, 1975, 77, 313.

**Throughput of inertial centrifugals for sugar.** G. M. CHUDAKOV. *Sakhar. Prom.*, 1975, (2), 37–39.—The optimum massecuite throughput of a continuous centrifugal can be calculated by means of a formula which is presented. Use of the formula is demonstrated in the case of a Soviet centrifugal, and the significance of throughput optimization discussed.

* * *

**Experience in improving vacuum filter operation.** A. F. YAKIMOV. *Sakhar. Prom.*, 1975, (2), 42–45.—Information is given on a number of steps taken at a Soviet sugar factory to improve the performance of vacuum filters used for 1st carbonatation mud treatment.

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**Effect of the properties of the medium and of hydrodynamic conditions on the composition of scale in sugar juice heaters.** I. I. SAGAN', YU. S. RAZLADIN and M. I. BARABANOV. *Izv. Vuzov, Pishch. Tekh.*, 1974, (6), 90–93.—Examination of scale on the heating surfaces of heaters used for raw juice, 1st and 2nd carbonatation juice showed that the composition of the scale was a function of the nature and composition of the juice and of the hydrodynamic conditions with each juice. With increase in the flow rate, the scale became denser and harder and adhered more strongly to the surface. Detailed analyses are given.

* * *

**Main liming and the quality of purified juice.** V. A. GOLYBIN and S. Z. IVANOV. *Izv. Vuzov, Pishch. Tekh.*, 1974, (6), 142–144.—Results of tests, in which juice from beet of high reducing matter was limed, showed that best results in terms of colour, reducing matter and lime salts were obtained by liming at 50°C for 5 minutes followed by liming at 80°C for 10 minutes, or by liming at 50°C for an extended period of 30 minutes. Results compared very favourably with those obtained by liming at 80°C or 90°C for 10 minutes, even where filtration preceded the liming at 80°C.

* * *

**Analysis of heat transfer in trough-type diffusers.** A. SOKOLOWSKI and A. MADEREK. *Gaz. Cukr.*, 1975, **83,** 3–6.—Investigation of the heat balance in beet diffusers showed that an inadequacy of heating can be avoided by ensuring that the difference in temperature between cossettes and juice is not greater than 15°C. At a cossette temperature in the range —4° to +20°C and a juice-cossette temperature difference of 10–15°C, heating is adequate and the heating surface utilization coefficient is below 100.

* * *

**Selection and parameter calculation of a baffle-type barometric condenser.** G. BATOR, A. KUBASIEWICZ and B. MARJANOWSKA. *Gaz. Cukr.*, 1975, **83,** 7–10. An algorithm is presented for calculation of the parameters of a barometric condenser, and some heat transfer data are given for a condenser having up to five baffles as guidance in the designing of such equipment.

* * *

**Methods of production and use of liquid sugar.** M. PIETRZAK. *Gaz. Cukr.*, 1975, **83,** 10–13.—Practices in liquid sugar production in West Germany and the USA, its storage and transport, and the advantages for both producer and customer are surveyed.

**The role of surface aeration in effluent treatment and its application at Wissington factory.** J. N. SMITH, M. F. BRANCH and R. H. ROGERS. *Sucr. Belge*, 1975, **94,** 41–56.—See *I.S.J.*, 1975, **77,** 88.

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**Increase in the slope of flumes.** I. SALÁNKI. *Cukoripar*, 1974, **27,** 216–219.—Details are given of the procedures used to increase the gradient of the sides of the beet flumes at Szerencs sugar factory in Hungary; the increase from 12 to 20 mm per m in the angle of slope was made necessary by the increase in the amount of dirt accompanying the mechanically harvested beet and the resultant increase in flume cleaning required.

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**Investigation of domestic use of the Quentin process.** O. KRIEGER and M. KERÉKGYÁRTÓ. *Cukoripar*, 1974, **27,** 220–225.—Results are reported of tests on use of Hungarian ion exchange resins in the Quentin molasses treatment process. Of the two considered, the more suitable was "Varion KSM", and this was used in tests at three factories. Average results indicated that at an exchange rate of 40% replacement of K and Na with Mg, a 0·43% recovery of sugar could be obtained (at an initial molasses sugar content of 2% on beet), which is approximately the value claimed for the process in the literature. The economics of the process are also discussed.

* * *

**Use of computers for analytical supervision and quantity balancing in a sugar factory.** W. KERNCHEN and H. LUHRS. *Zeitsch. Zuckerind.*, 1975, **100,** 82–85.—As an example of rational application of computers in a sugar factory, the system used at Wevelinghoven (West Germany) is briefly described. This includes a "Sucromat" automatic polarimeter for beet, isotope density measurement using $^{90}Sr$ as beta-ray source for run-off, remelt liquor and molasses, and various weighers and counters. An "Alpha LSI-2" computer processes the data and prints out balances and values of process factors calculated from the input data. It is pointed out that such a system can easily pay for itself by the greater control exercised over processes and hence the reduction in losses which can result.

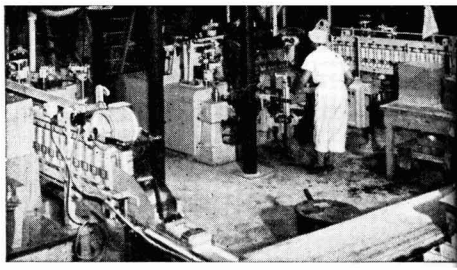
* * *

**Factory accounting with electronic data processing in the sugar industry.** W. LEIBIG and G. SCHNEIDER. *Zeitsch. Zuckerind.*, 1975, **100,** 86–88.—The use of electronic computers for data processing as an aid to sugar factory costing processes and basic accounting is demonstrated by the example of Franken sugar factory (West Germany); details are given of the system used, a diagram clearly showing the principles of the scheme.

* * *

**An industry in permanent evolution. I. A sugar factory in 1930.** P. DEVILLERS, J. C. GIORGI and G. WINDAL. *Sucr. Franç.*, 1975, **116,** 61–70.—This is the first of a series of articles intended to review the development of the French sugar industry and endeavour to predict its future course. The processes and equipment used in a beet sugar factory in 1930 are described with the aid of photographs.

# Sugar refining



**Investigation of new types of active carbon.** YA. O. KRAVETS, G. P. PUSTOKHOD, M. V. DVORNICHENKO and G. V. BUZOVETSKAYA. *Sakhar. Prom.*, 1975, (2), 17–21.—Tests are reported in which AGS-4M fine granular active carbon and D-2 crushed carbon proved more effective in decolorization of syrups and liquors than did AGS-4, which is currently widely used in Soviet refineries. The pH of the treated solutions remained reasonably constant.

* * *

**Some questions concerning the economic expediency of transporting granulated sugar in liquid form to refineries.** V. L. MAR'YANCHIK, S. A. BRENMAN, V. V. PRYADKO and V. R. DUMANCHUK. *Sakhar. Prom.*, 1975, (2), 25–28.—The economics of transporting beet raw sugar in bags, in bulk or in liquid form to refineries in the USSR are examined on the basis of actual deliveries during 1972/73 and 1973/74. Delivery in liquid form is shown to be the most economical, but suggested ways in which yet further savings could be effected are discussed.

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**Sucrose losses during treatment of cane raw sugar and means of reducing them.** A. YA. ZAGORUL'KO *et al. Sakhar. Prom.*, 1975, (2), 46–49.—Causes of excessive unknown losses in remelt liquor carbonatation and in the boiling house as well as high molasses sugar losses at two Soviet sugar factories processing cane raw sugar have been investigated. Certain remedial measures are suggested.

* * *

**Review of the sugar industry in Japan.** JAPAN SUGAR REFINERS' ASSOCIATION. *Sucr. Belge*, 1975, **94**, 57–62. A brief survey is presented of the history of the Japanese sugar industry followed by a discussion of sugar consumption, sugar production from domestic beet and cane, sugar imports, the price of sugar in Japan and the government policy on sugar.

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**Evaluation of flocculants in refinery melt liquor and scum.** J. C. P. CHEN and R. W. PICOU. *Proc.* 1972 *Tech. Session Cane Sugar Refining Research*, 82–92. See *I.S.J.*, 1974, **76**, 339.

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**A new process to produce cube sugar of the "Adant" type.** P. DEWULF and J. BLAUDE. *Proc.* 33*rd Meeting Sugar Ind. Tech.*, 1974, 20–21.—Some information is given on the new process at Tirlemont for production of cube sugar. Dry sugar is heated to 80°C, discharged to a mixer for moistening with 2% water, and fed to the moulding drum in the first section of the conditioning chamber. Pressing takes place at 80°C and moderate humidity, and the moulded cubes fall onto stainless steel plates entering the second part of the chamber as quickly as possible. The sugar dries to 0·35% in about 90 minutes at 80°C and 70% R.H., after which it returns to the first part of the chamber for transfer onto a cooling band. Details are also given of the four tests used to determine cube density, dissolving rate, hardness and resistance to disintegration when coffee or tea is sucked through the cube.

* * *

**Investigation on the production of double-washed raw *versus* affined sugar for refining.** F. C. EALA. *Proc.* 33*rd Meeting Sugar Ind. Tech.*, 1974, 32–39.—After laboratory tests had been made to compare the sugar yield from and wash water consumption in raw sugar double washing and in affination, showing that affination is more advantageous as regards both factors, a decision was made at the refinery of Victorias Milling Co. Inc. to install a new affination station capable of handling all the melt. The new station, commissioned in January 1974 and having a capacity of 1200 metric tons of raw sugar per day (with the possibility of expansion to 1500 metric tons per day), has brought about improvements in the overall performance of both the raw sugar factory and refinery sections: in the sugar factory the quantity of massecuite has been reduced by 25% through discontinuance of the practice of returning 2nd wash molasses from *A*- and *B*-massecuites to the *A*-massecuite pans together with cane and refinery syrup; the refinery has been able to produce 25% more sugar without increasing the capacity of the carbonatation, filtration and carbon decolorization stations but merely by increasing pan house equipment while the quality of affined sugar is higher than that of the previous washed sugar.

* * *

**Equipment cleaning procedures.** R. S. PATTERSON. *Proc.* 33*rd Meeting Sugar Ind. Tech.*, 1974, 40–59. The procedures used by 36 companies as well as California and Hawaiian Sugar Co. in the cleaning of vacuum pans, evaporators, filters and heat exchangers are summarized from details submitted in questionnaires.

* * *

**Packaging production and efforts to improve efficiency.** J. W. ALBERINO. *Proc.* 33*rd Meeting Sugar Ind. Tech.*, 1974, 60–65.—Details are given of the equipment and organization of the line used for making up 5-lb packages at Savannah sugar refinery.

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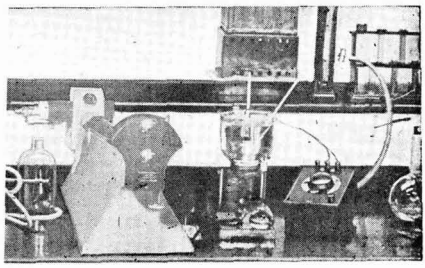
**Granular activated carbon installed at Insular Sugar Refining Corporation, Hulo, Mandeluyong, Rizal, Philippines.** L. CIFRA and R. CINCO. *Proc.* 33*rd Meeting Sugar Ind. Tech.*, 1974, 101–106.—Details are given of the carbon decolorization unit at this refinery and of its operation. The economic aspects are also discussed. At an initial liquor colour of 22·67° (on the Horne scale), a decolorization efficiency of 86% is achieved at a throughput for the two columns of 120 gal.min$^{-1}$.



# Laboratory methods & Chemical reports

**The Galileo number of sugar solutions.** D. E. SINAT-RADCHENKO and V. D. POPOV. *Pishch. Prom.*, 1974, **19**, 97–98.—A nomogram is presented for establishing the Galileo number (a measure of the ratio of molecular frictional force to the force of gravity in a flowing stream) for sugar solutions in the temperature range 10–140°C, 0–90% concentration and characteristic linear dimensions of 0·001–10 m.

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**A study of chemical preservation of beet prisms by means of AITC.** J. ZAHRADNÍČEK and J. HAŠEK. *Listy Cukr.*, 1975, **91**, 21–22.—Laboratory experiments are reported in which beet samples in the form of prisms were stored under a 30-cm layer of sand after treatment with a fungicide, allylisothiocyanate. No micro-organisms formed during 80 days after treatment with $10^{-2}$ and $10^{-3}$ M doses, but with a lower concentration ($10^{-4}$ M) there was slight increase in the micro-organisms at the end of the period.

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**Determination of gums in sugar cane juices.** H. AYALA, A. DELFINI and D. BRAVO L. *Bol. Estación Exp. Agric. Tucumán*, 1974, (115), 4 pp.—The method considered most suitable is that described in "Laboratory manual for Queensland sugar mills" (Bureau of Sugar Experiment Stations, Queensland, 1970), details of which are given.

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**Total solids in molasses. Comparison of methods of analysis. Viscosity.** I. E. DE CASTRO, P. C. S. RODRIGUES and J. M. S. RODRIGUES. *Brasil Açuc.*, 1974, **84**, 487–498.—The solids content of 57 samples of molasses was measured by Brix spindle, by refractometer and by drying in an oven for 5 hours at 100°C on a pumice carrier. At the same time the viscosity of the samples was measured using a Höppler falling-ball viscometer, and the phosphorus content measured spectrophotometrically using a molybdo-vanadate reaction. Viscosity proved not to be related to Brix, and it was concluded that refractometric Brix was a satisfactory measure of solids as well as being simple to determine. Similarly the determination of phosphate was considered simple and satisfactory.

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**The effect of maltose on the degree of dissociation of sucrose in saturated aqueous sugar solutions.** S. E. KHARIN, G. S. SOROKINA and L. A. KOROTKOVA. *Izv. Vuzov, Pishch. Tekh.*, 1974, (6), 41–43.—Investigations showed that at constant temperature the degree of dissociation of sucrose $\alpha'_1$ fell with increase in the concentration of added maltose and, although it rose with temperature (in the range 25–60°C), was always lower in the presence of maltose than in its absence. Calculated values of $\alpha'_1$ obtained with an empirical formula were in close agreement with determined values. Tabulated data also demonstrate the same pattern for sucrose solubility as for dissociation.

**The kinetics of sucrose crystal growth.** V. S. BODANCHIKOVA and A. I. GROMKOVSKII. *Izv. Vuzov, Pishch. Tekh.*, 1974, (6), 125–127.—Investigations showed that at 50–60°C and a supersaturation coefficient of 1·05, the crystal growth rate was a function of external diffusion and that the mass transfer coefficient was inversely proportional to the equivalent diameter of the crystal.

* * *

**Auto-diffusion of molecules in dilute aqueous sucrose solutions.** L. P. ZHMYRYA, M. N. DADENKOVA and V. M. LYSYANSKII. *Izv. Vuzov, Pishch. Tekh.*, 1974, (6), 144–146.—The auto-diffusion of sucrose at sucrose concentrations of 0-10% and temperatures in the range 25–90°C was investigated. The ratio between the product (sucrose auto-diffusion coefficient × viscosity of pure water) and absolute temperature was almost constant, while the relationship between the coefficient and viscosity conformed to the Stokes-Einstein law. The effect of temperature on the coefficient was described by Frenkel's exponential law. The sucrose molecules in the system studied were found to weaken the hydrogen bonds between molecules of water.

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**Nitrogenous compounds in sugar beet juices.** G. W. MAAG, R. J. HECKER and P. A. WHITAKER. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 154–164.—The N constituents were determined in pressed and phosphated thin juice from beet to which three different levels of N fertilizer were applied during growth, and the relative proportions of the components examined in relation to the amount of N applied. Amino-, ammonium-, betaine-, nitrate-N and total N were measured and 21 amino-acids and amides determined. The values obtained are tabulated.

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**Sugar laboratory problems. III. Correlation between the direct and indirect methods of determining total sugars in molasses.** E. R. DE OLIVEIRA, O. VALSECHI, J. P. STUPIELLO, A. A. DELGADO and F. V. NOVAES. *Brasil Açuc.*, 1974, **84**, 499–505.—The direct method of total sugars determination in final molasses is simpler than the indirect method (Clerget sucrose plus reducing sugars) but is less accurate. If the direct method (Lane & Eynon method preceded by inversion by the Walker method) is to be used it should be corrected by the equation $y = 0{\cdot}9x + 2{\cdot}12$, where $y$ is the total sugars % molasses and $x$ is the value given by the direct method.

* * *

**Determination of amino-nitrogen in factory sugar juices.** E. REINEFELD, K. M. BLIESENER and H. KUTSCHKE. *Zucker*, 1975, **28**, 72–79.—Details are given of a method for amino-N determination in beet juices and molasses in which 2,4,6-trinitrobenzene-1-sulphonic acid (TNBS) is used as colour

reagent; 2 cm³ of the 0·1% reagent and 5 cm³ of a phosphate buffer solution (pH 8·5) are added to 2 cm³ test solution (containing 0·2–0·6 μg amino-N) which is then heated for 10 minutes to 80°C, cooled to room temperature in a water bath and 1 cm³ of HCl added before measurement of the extinction at 340 nm. Comparison with the ninhydrin method showed that sensitivity, accuracy and reproducibility were about the same for both methods, but TNBS is more stable and the results are not affected by ammonia. In comparative tests, the new method gave the highest and the "blue number" method the lowest values, while the ninhydrin method gave values slightly tending towards those given by the TNBS method. The differences are attributed to differences in the chemical bases and to the large number of nitrogenous substances in juices. Pre-clarification of the juice was found to be unnecessary.

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**Determination of ash in refined white sugars by means of conductivity.** A. CARMEN A. *Rev. Asoc. Bioquim. Argent.*, 1973, **38**, (207–208), 221–229; through *S.I.A.*, 1975, **37**, Abs. 75-238.—The ash used for the preparation of a standard conductivity curve was obtained by incinerating a mixture of 40 different sugars; the standard curve was derived from conductivity measurements made on solutions of this ash in 3% sucrose solution. The equation relating concentration of ash in the solution, $c$, to the conductivity, $k$, is $c = [k - (2{\cdot}6 \times 10^{-5})]/1{\cdot}19 \times 10^{-2}$. The method gave rapid results which were considered to be in good agreement with sulphated ash measurements obtained by the AOAC method.

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**Determination of moisture in molasses by the Karl Fischer method, using formamide as the solvent.** B. KVIESITIS. *J.A.O.A.C.*, 1975, **58**, 164–166.—Results of cane molasses moisture determination by the Karl Fischer method but using formamide as solvent instead of methanol showed that formamide is effective for dissolving molasses without significantly distorting the moisture content value. The time required for titration of the molasses-formamide mixture was about half of that for titrating undissolved molasses, thus helping to give reliable results. Further studies on the use of formamide are recommended.

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**Conductivity method for sulphited ash % raw sugar. II.** P. F. JAIN. *Sugar News* (India), 1974, **6**, (7), 15–16. The author describes studies carried out at the National Sugar Institute on determination of conductivity of raw sugar samples and hence their sulphited ash content and $C$ ratio.

* * *

**Gel filtration for determining efficiency of colour removal in processed raws.** N. H. SMITH. *Proc.* 1972 *Tech. Session Cane Sugar Refining Research*, 1–7. Details are given of a gel filtration method for determining the extent of removal of colorant fractions in raw sugar affination, clarification, decolorization by bone char and crystallization. It involves fractionation of samples passed through a column of "Sephadex LH-20" and measuring the % transmission $T$ at 420 nm spectrophotometrically. The data obtained in the form of a graph of $T$ *vs.* time are then processed by computer and $T$ converted to absorbance. The area enclosed by the curve represents the quantity of colour in the total sample and is numerically equal to the attenuation index of the sample × the amount of sample in g. However, while good agreement was found between the total calculated area and direct colour measurements, the latter (almost independent of effluent pH) also included colourless components. On the other hand, agreement was poor between calculated area and measurements at 420 nm because of pH variation. Transmission curves are reproduced (without any values) and decolorization results for each of the four processes mentioned are tabulated.

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**The acidic nature of sugar colorants.** C. C. CHOU and A. B. RIZZUTO. *Proc.* 1972 *Tech. Session Cane Sugar Refining Research*, 8–22.—Investigations are reported in which acidic colorants in an ascending sugar liquor stream adjusted to pH 3 with HCl were adsorbed on "Amberlite XAD-2" and then fractionated by stepwise downward elution with solutions of sodium carbonate, bicarbonate and hydroxide, methanol and methanolic HCl. (Basic groups of colorants were ionized at the low pH and so resisted retention by the resin.) The effluent colour was measured at pH 7 (in some cases pH 9) at 420 nm, and the column effluent further fractionated on a column of "Sephadex G-10" to determine the molecular size distribution. The sugar colorants were divided into (i) a strongly acidic carboxyl group, (2) a weakly acidic carboxyl group, (3) a phenolic-type hydroxyl group, and (4) a carbonyl group. Gel filtration showed that colorants with the same acidic strength did not necessarily have the same molecular weight. The significance of the acidic nature of the colorants for decolorization of sugar solutions by absorbents and by phosphatation with and without cationic surfactants is indicated, and studies to show which types of colorants have less tendency to be occluded in a sugar crystal are also described. Molasses colour fractiontion by ion exclusion on "Dowex 50WX4" resin in $K^+$ form was investigated, in which it was found that the majority of molasses colorants were highly anionic at pH 7·5. The highly ionic and weakly ionic (or non-ionic) fractions were further fractionated by "Amberlite XAD-2".

* * *

**Trace elements in sugars.** P. POMMEZ and M. A. CLARKE. *Proc.* 1972 *Tech Session Cane Sugar Refining Research*, 40–46.—Analysis of raw and refined sugar for trace elements, particularly heavy metals, showed that carbonatation and bone char treatment reduced the levels of 20 heavy metals to well below the limits set by the US Government and other official agencies. The levels of the elements in sugar are tabulated and comparison made between the contents in sugar and in soft wheat flour. A table is also given of the contents of 25 elements found by the investigations in raw and refined sugar, and comparison made with data from the literature. The analytical techniques used included spark mass spectrometry, atomic absorption spectrophotometry, flame photometry, colorimetry and polarography.

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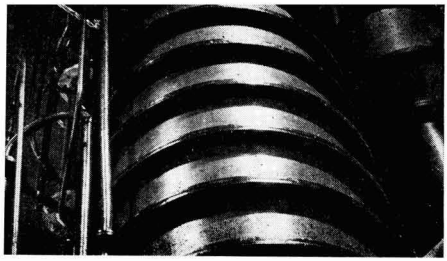

# By-products

**Engineering analysis of ion exclusion for the separation of fructose from glucose.** T. R. DILLMAN, D. E. MOYER and B. D. BURRIS. *Paper presented at 18th General Meeting, Amer. Soc. Sugar Beet Tech.*, 1974, 20 pp.—Factorial analysis has been used to indicate the significance of process variables in the separation of fructose and glucose. For the study, an experimental column containing "Dowex 50W X-4" resin in $Ca^{++}$ form was used to treat (i) a commercial isomerized sugar solution containing about 45% fructose, 50% glucose and 5% polysaccharides, (ii) a 50% invert sugar solution containing about 50% sucrose and 25% each of glucose and fructose, and (iii) a 90% invert sugar solution containing about 10% sucrose and 45% each of fructose and glucose. All solutions were subjected to ion exchange before ion exclusion and contained no dissolved salts. The samples collected were analysed by gas-liquid chromatography to determine the concentrations of the three sugars. Reasons are given for the form in which the resin was used. Analysis of the results indicated that sucrose did not affect the fructose-glucose separation, since it preceded the glucose and was well separated from the fructose. Recovery of fructose is shown to be economically viable and highly profitable.

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**Pollution in industries processing molasses. Accomplishment of the Citrique Belge, at Tienen (Tirlemont).** S. BRENEZ. *Tech. de l'Eau*, 1974, (334), 37–43; through *S.I.A.*, 1975, **37**, Abs. 75-273.—At the above factory, vinasse remaining after citric acid production by fermentation of molasses was formerly disposed of on agricultural land. It is now processed for use as an animal feedstuff. This involves (a) multiple-effect evaporation to 60% dry solids, (b) partial removal of K by precipitation as a double salt with Ca, and (c) further evaporation to 70% dry solids.

* * *

**Influence of some technological aspects on the elimination of pentoses during the process of obtaining dissolving pulps.** C. J. TRIANA F. *Revista Icidca*, 1974, **8**, (2), 3–16.—The hydromodulus was varied (from 1:26 to 1:4 initially and 1:35 to 1:5 finally) while maintaining constant heating temperature (170°C) and times (30 min to temperature and 90 minutes cooking). In other experiments the cooking time was extended to 120 min and cut to 60 min at constant hydromodulus, while in others sulphidity was varied between 3% and 24% and active alkali between 18·6% and 24%. In each case, the monosaccharide contents in the hydrolysates were determined by paper chromatography as a method of measuring pentose elimination. It was concluded that the hydromodulus during the prehydrolysis was the deciding factor in elimination which was greatest in the range 1:2·5–1:3·7. The active alkali content was also important, the preferred range being 20–24%. High sulphidity diminished the action of the cooking liquor and hindered pentose elimination while extended cooking time only marginally improved it.

* * *

**Basic properties of mixtures of bleached chemical pulps from bagasse and long fibre.** R. MOLINA, Y. JODZITSKI and R. RAMÍREZ. *Revista Icidca*, 1974, **8**, (2), 21–41.—Pulps were prepared from depithed bagasse and mixed in various proportions with long-fibre wood pulps. Also included were two pulps which had been modified by chemical treatment with alkali during bleaching. The properties of the mixtures were examined to determine trends, and it was concluded that the results might be useful in predicting the properties of finished papers, provided their validity is confirmed on the industrial scale.

* * *

**Production of proteins as torula yeast, different alternatives.** R. ESTÉVEZ and O. ALMAZÁN. *Revista Icidca*, 1974, **8**, (2), 51–62.—Work carried out in Cuba on the production of yeast on media including final and *A*-molasses, cane juice and vinasse, alone or mixed with molasses, is surveyed. The last is a cheap source of carbohydrate for yeast cultivation and provides many advantages; its future is intimately bound to the future of the Cuban alcohol industry.

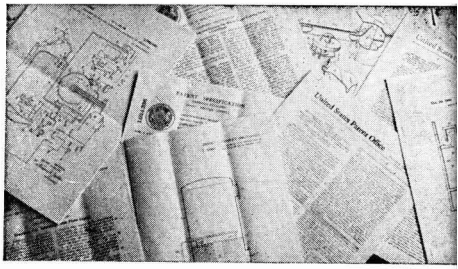
* * *

**The interaction between pantothenate and thiamine in the growth and chemical composition of *Candida utilis*.** J. S. OLIVEIRA. *Ind. Alim. Agric.*, 1974, **91**, 1517–1522.—Thiamine (vitamin $B_1$), added as hydrochloride at the rate of 400 $\mu g.litre^{-1}$ to a culture medium made up of cane molasses supplemented with nitrogen and mineral salts, did not alter the yield of yeast produced by *Candida utilis* var. *major* but did cause a significant change in the composition, particularly a reduction in the ash content (further reduced by addition of calcium pantothenate at the rate of 400 $\mu g.litre^{-1}$) and an unfavourable change in the amino-acid balance. The effects were attributed to inhibition of the action of vitamin $B_6$ by thiamine and subsequent reduction in the rates of transamination and other reactions involving pyridoxine as coenzyme, and were reduced or eliminated when ammonium sulphate was used as nitrogen source.

* * *

**The fine structure of sugar cane bagasse. II.** A. CALDERIN M. and G. OCAMPO S. *Revista Icidca*, 1974, **8**, (3), 3–8.—The structural changes which occur in pulping with soda and subsequent delignification are recorded. This pulping technique was selected for the advantage it presents in the production of high-yield paper pulps and in order to study the possibility of its use in the production of chemical pulps.

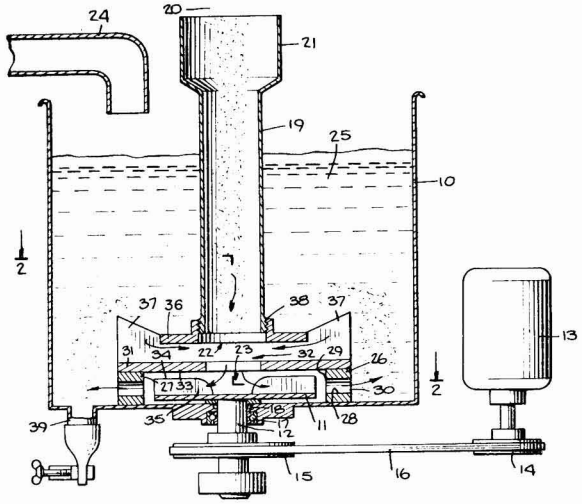
# Patents



## UNITED STATES

**Centrifugal mixer.** D. W. HEGE, of Woodland Hills, Calif., USA, *assr.* HEGE ADVANCED SYSTEMS CORP. **3,820,759.** 5th June 1972; 28th June 1974.

A saturated sugar syrup may be prepared quickly using the mixing device which includes a container 10 having a centrifugal impeller 11 mounted on a shaft 12 which extends through the bottom of the container and is driven by motor 13 through pulleys 14, 15 and belt 16. A seal 18 prevents leakage. A conduit 19, extending almost to the inlet 23 of impeller 11, is provided with an upper funnel section 21 for admission of the sugar, water being admitted to the container through pipe 24. The impeller is surrounded by a chamber which is made up by an annular wall 26 having an inner surface 27 spaced apart from the impeller 11, an annular top 31 having a central aperture corresponding to the outlet 22 of conduit 19, and a series of outlets 30. The threaded end 38 of conduit 19 carries a flange 36 which is provided with radial guide vanes 37 which direct the flow of material from the container into the impeller and prevent vortex formation which reduces mixing efficiency.




In use, the container is filled with the desired amount of water and the motor 13 started whereby the water starts to circulate from the bulk of the container past vanes 37, through inlet 23 and is directed outwards through ports 30. Sugar is then added through funnel 21 and circulation continued until it is dissolved, after which the syrup is drained from the container through port 39.

* * *

**Herbicides.** K. CARPENTER, B. J. HEYWOOD, E. W. PARNELL, J. METIVIER and R. BOESCH, *assrs.* MAY AND BAKER LTD., of Dagenham, Essex, England. **3,823,008.** 13th November 1970; 9th July 1974.—Control of weeds among sugar beet and sugar cane involves application of a herbicidally-effective amount of at least one sulphonyl carbamic ester of the formula $X$ - $C_6H_4$ - $SO_2NH$ - $COCH_3$ where $X$ is a primary amino, methyl amino, N - methyl formylamino or methoxy carbonylamino group.

* * *

**Increasing the sugar content of growing cane and beet.** C. A. PORTER, of Kirkwood, Mo., USA, *assr.* MONSANTO CO. **3,826,641.** 12th February 1973; 30th July 1974.—The sucrose content of cane or beet is increased by applying, 10 days to 10 weeks before harvest [10 days to 5 weeks for beet; 2–10 weeks (3–7 weeks) for cane], an effective amount [0·1–5 lb/acre (0·25–0·4 lb/acre) for beets; 0·1–5 lb/acre for cane] of 1-hydroxy-1,1-ethane diphosphonic acid or an alkali metal salt.

* * *

**Prehydrolysis and digestion of bagasse fibres.** E. J. VILLAVICENCIO, of New York, N.Y., USA, *assr.* PROCESS EVALUATION AND DEVELOPMENT CORP. **3,832,278.** 28th February 1973; 27th August 1974. Bagasse pulp suitable for newsprint is produced by prehydrolysing depithed bagasse fibres in a continuous digester at pH 4·5–5·8 in the presence of about 70–100% moisture on bone-dry fibre feed weight and under autogenous steam pressures at temperatures of 340–370°F for sufficient time to remove 40–60% of the original xylan content of the fibre. The pH is then raised to at least 8·5 by adding alkali metal bisulphite alone or with other alkali and the fibres digested at the same temperature and pressures for sufficient time to reduce the original bagasse hemicellulose content to about 20–22% and provide a pulp G.E. brightness of at least 55. Sufficient alkali metal silicate is added to give 0·8–1·3% by weight of bone-dry original fibre feed, adding at the digester blow line or blow valve just before digestion ends. The pulp is then removed, refined, screened and washed.

Copies of Specifications of United Kingdon Patents can be obtained on application to The Patent Office Sale Branch block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., 20231 USA (price 50 cents each).

# Australia sugar exports[1]

| | 1974 | 1973 | 1972 |
|---|---|---|---|
| | (metric tons, raw value) | | |
| Algeria | 0 | 0 | 23,810 |
| Belgium/Luxembourg | 0 | 0 | 12,712 |
| Canada | 338,717 | 354,023 | 436,270 |
| Chile | 0 | 0 | 19,327 |
| China | 30,949 | 66,220 | 37,157 |
| Finland | 0 | 42,354 | 50,919 |
| Japan | 256,847 | 601,907 | 646,981 |
| Korea, South | 110,152 | 64,502 | 17,971 |
| Malaysia | 210,616 | 104,472 | 66,115 |
| Morocco | 0 | 0 | 22,247 |
| New Zealand | 109,572 | 112,118 | 104,724 |
| Oceania | 9,288 | 8,951 | 10,022 |
| Singapore | 81,476 | 77,695 | 39,479 |
| Tunisia | 0 | 0 | 13,043 |
| UK | 383,095 | 360,870 | 450,904 |
| USA | 221,808 | 244,749 | 201,872 |
| USSR | 53,311 | 64,768 | 142,381 |
| Other countries | 2,118 | 193 | 1,685 |
| Total | 1,807,949 | 2,102,822 | 2,297,619 |

**Tate & Lyle engineering rationalization.**—Tate & Lyle Engineering Ltd. was incorporated on 4th August 1975 to co-ordinate and to carry on the existing business of Tate & Lyle Enterprises Ltd., Tate & Lyle Technical Services Ltd., A. & W. Smith & Co. Ltd., The Mirrlees Watson Co. Ltd., Farrow Irrigation Ltd. and British Charcoals and MacDonalds Ltd., and their respective subsidiary companies. The paid-up capital is £1,000,000, wholly-owned by Tate & Lyle Ltd. The constituent companies of the new Tate & Lyle Engineering Group will continue to trade in their own names where traditional markets or business already in hand provide justification. It is intended, however, that plant procurement and new business of a general nature will be handled by Tate & Lyle Engineering Ltd. in the future.

* * *

**Indonesian sugar machinery order for Stork-Werkspoor Sugar.** Stork-Werkspoor Sugar B.V., of Hengelo, Holland, recently received an order from Indonesia for the rehabilitation and expansion of the Kebon Agung cane sugar factory near Malang (East Java) in order to increase the crushing capacity of the existing plant to 3000 tons of cane per day. The order, which will be executed in two years, involves some 30 million Dutch florins (£5·5 million). A great variety of machinery and apparatus is to be delivered, including two steam boilers, one turbo-generator set, heaters, evaporators, vacuum pans and a sugar dryer. An important part of the equipment will be manufactured in Indonesia by P. T. Boma-Stork at Pasuruan, with whom Stork-Werkspoor Sugar has a licence agreement as well as an agreement for technical and management assistance.

* * *

**The late Nils Weibull.**—NILS WEIBULL, well known in both the beet and cane sugar industries, has died in Malmö, Sweden, at the age of 90. He devoted the greater part of his active life to mechanical engineering aspects of the sugar industry and, in collaboration with the Swedish Sugar Co. Ltd., built and developed machines for the handling of beet and cane and in the production of sugar. But he was best known for his silo designs for the bulk storage of raw and white sugar; Weibull silos have been built in more than 25 countries on several continents with widely different climatic conditions. Most of the equipment was supplied from his own works in Sweden which, for the past 15 years, has been under the management of his youngest son, Claes Weibull.

* * *

**A/S De Danske Sukkerfabrikker 1974/75 report.**—In 1974, 75% of the Danish beet area was sown with monogerm seed as against 50% in 1973. In the very dry spring the germination was slow and irregular but subsequent rain gave such favourable growing conditions that an almost normal sugar harvest was obtained, although in the form of a high beet tonnage with relatively low sugar content. The wet autumn hindered harvesting but all beets were successfully gathered in before the end of the campaign. Beets delivered totalled 2,419,000 tons, from which 326,000 tons of sugar were made, about 3% less than the EEC stipulated target. The campaign progressed according to plan at all factories; the beet were easy to process and juices purer than for several years. Beet pulp drying capacity has been doubled at Nakskov, where a new 28,000-ton silo is being built.

## Brevities

**Gruendler sales in Mexico.**—Gruendler Crusher & Pulverizer Co., of St. Louis, Mo., USA, recently announced that the firm's Mexican affiliate, Gruendler Mexicana S.A., has received orders from the Mexican Government for six new shredders, each of 6000 metric tons per day capacity, to operate in new cane sugar factories scheduled for completion early in 1977. This order makes a total of 79 such machines sold in Mexico by Gruendler.

* * *

**Bolivian sugar factory and distillery contract for Dedini[2].** M. Dedini S.A. Metalúrgica of Brazil has been awarded a contract for the construction of a sugar factory with a crushing capacity of 4000 t.c.d. and an alcohol distillery in Copaico, Bolivia.

* * *

**Australian sugar harvest delay[3].**—Industrial disputes and wet weather are disrupting the Australian sugar harvest. According to the Director of the Bureau of Sugar Experiment Stations, Mr. O. STURGESS, only 9,775,000 metric tons had been harvested by the 19th September out of a total crop estimated at 20·9 million tons; at the same date in 1974 11,002,000 tons had been harvested from a total crop of 19,420,000 tons. The cane sucrose content is slightly lower than last year in Queensland but slightly higher in New South Wales. The continuing rain is helping crop growth in Queensland but hindering harvest, and the delay could mean cane losses at the onset of the wet season, comparable to the 1973 season when over a million tons of cane had to be stood-over.

* * *

**St. Vincent sugar factory proposal[4].**—The Premier of St. Vincent, in the West Indies, Mr. MILTON CATO, recently held talks with a number of Venezuelan businessmen on the erection of a sugar factory on the island. The proposals involve the use of a "Rotocel" diffuser similar to that in operation at Central Azucarera Melaport in Venezuela. The diffuser has the attraction that it can also be used for extraction of oil from crops such as copra, peanuts, cotton seed and sesame. It has been proposed by one of the Venezuelans that his Government-backed firm and the St. Vincent Government set up a joint company to build and operate the plant.

* * *

**International Sugar Colloquium.**—The Official Report of the Colloquium, which was held in London during the 4th–5th March of this year, has now been published and includes details of the organizing committee, summaries and full tests of speeches made by the participants, together with the contributions from the floor. Official reports in French, German and Spanish are to be available in due course but enquiries concerning the English version should be sent to the British Sugar Bureau, 140 Park Lane, London, W1Y 3AA England.

* * *

**Syrian sugar factory projects[5].**—Ateliers Belges Réunis S.A. has signed a contract in Damascus with the Syrian Government for construction of two sugar factories in the Euphrates basin at a cost of 235 million Syrian pounds (US$61,500,000). Each will have a slicing capacity of 4000 tons of beet per day and it is expected that they will be completed within two years.

* * *

**Philippines sugar factory expansion[6].**—Bogo-Medellin Milling Co. is planning to expand its milling capacity to 4000 t.c.d. under a programme to be financed by surplus funds amounting to 22·3 million pesos. Bais Central is also to be expanded from 5400 to 8000 t.c.d. for the 1975/76 season, crushing cane from an additional 20–24,000 ha.

* * *

**Rum distillery for Spain[7].**—The Bacardi company is to install a rum distillery at Malaga, Spain.

[1] *I.S.O. Stat. Bull.*, 1975, **34**, (5), 19.
[2] *Bank of London & S. America Review*, 1975, **9**, 511.
[3] *Public Ledger*, 20th September 1975.
[4] *W. Indies Chron. News*, Sept./Oct. 1975.
[5] *Amerop Noticias*, 1975, (18), 16.
[6] *Sugar News* (Philippines), 1975, **51**, 66, 76.
[7] *Zeitsch. Zuckerind.*, 1975, **100**, 223.

# Brevities

**Yugoslavia sugar expansion**[1].—The old Cukarica factory on the Sava near Belgrade is to be re-erected on the left bank of the Danube near Krnjaca where, with added fermentation equipment, it will be a practically new factory of 6000 tons/day slicing capacity. In addition, nine new factories are to be built between 1977 and 1980, of 3000 tons/day capacity.

* * *

**Bagasse cellulose production in Brazil**[2].—A Taiwan group is to install, at a cost of 200 million cruzeiros, a factory in north-eastern Alagoas to produce 34,000 tons of cellulose a year from bagasse.

* * *

**Malawi sugar expansion**[3].—In 1975 Malawi will export, for the first time, 11,000 tons to the EEC in addition to the 17,000 tons to be exported to the US. These exports, plus the increased supplies to the domestic market, mean that production will be raised by 20,000 tons to about 70,000 tons this year. Target production is 125,000 tons by 1977. At present 17,000 acres are under cane and when the 1975 expansion programme is completed the estate at Nchalo will cover 21,000 acres, representing an increase of 7,800 acres over the past two years. An estimated 14 million Kwacha (£7,160,000) will have been spent over the expansion period.

* * *

**New Venezuela sugar factory**[4].—It is reported that 200 million bolivares are to be invested in the Libertas (Barinas) sugar factory. Initial production is to be 100,000 tons of white sugar a year.

* * *

**Finland sugar expansion**[5].—The increase in world market values for sugar and higher import costs have led to a re-evaluation of the position of the sugar industry in Finland. During the period September 1973/August 1974 Finland imported 186,966 tons, tel quel, compared with 183,551 tons in the previous season. The new sugar legislation which took effect on 15th May provides for an increase from 30% self-sufficiency to 40–50%. To attain this objective the area under beet is to be expanded and sugar beet prices for growers have been raised by about 35%.

* * *

**EEC Commission fines on refiners reduced**[6].—The Advocate-General of the European Court of Justice has concluded that fines totalling 1·8 million units of account imposed on six Italian sugar producers by the EEC Commission for allegedly partitioning the market should be annulled. He also recommended the reduction of fines imposed on the West German firm Pfeifer und Langen AG. and the Dutch producers Cooperatieve Vereniging Suiker Unie and N.V. Centrale Suiker Mij. for alleged concerted practices. However, he called for dismissal of appeals by Belgian, Dutch, French and German producers against other Commission fines totalling some seven million units of account for alleged price fixing and market rigging.

* * *

**Irish sugar imports and exports**[7].—Imports of sugar by Ireland rose to 36,383 metric tons, tel quel, in 1974 from 16,042 tons in 1973. The principal suppliers were Belgium (14,333 tons), West Germany (11,039 tons) and France (6456 tons), of which only the last had supplied sugar in 1973 (5093 tons). The 1973 main supplier—the UK—supplied only 1562 tons last year as against 8375 tons previously. Exports totalled 12,711 tons, all to the UK, whereas in 1973 the 11,616-ton total included 10,650 tons for the UK, 951 tons for the USA and the remainder for other countries.

* * *

**Ghana sugar expansion investigation**[8].—The Japanese Government sent a team of five experts to Ghana at the end of June for a 30-day feasibility study on its project to expand sugar production in that country. The Ghana Government plans to grow sugar cane in the Accra plains and to build a sugar refinery in the country in order to reduce sugar imports. At present Ghana depends on imports for 80% of its sugar needs.

## Trinidad sugar exports[9]

| | 1974 | 1973 | 1972 |
|---|---|---|---|
| | *(metric tons, raw value)* | | |
| Canada | 2,458 | 0 | 0 |
| France | 14,567 | 0 | 0 |
| Holland | 1,528 | 0 | 0 |
| Japan | 11,004 | 0 | 0 |
| Tunisia | 7,888 | 0 | 0 |
| UK | 69,142 | 133,180 | 156,554 |
| Venezuela | 4,600 | 0 | 0 |
| USA | 27,596 | 8,603 | 25,959 |
| Other countries | 0 | 0 | 254 |
| | 138,783 | 141,783 | 182,767 |

**Sierra Leone sugar imports, 1974**[10].—Imports of sugar by Sierra Leone were reduced from 27,098 long tons, tel quel, in 1973 to only 8294 tons in 1974. Imports from the major suppliers were cut: France from 12,351 tons in 1973 to 3168 tons in 1974, the UK from 5323 tons to 2085 tons, and West Germany from 3845 tons to 319 tons.

* * *

**Dominican Republic drought**[11].—Drought is affecting the Dominican Republic, particularly the plantations of the Romana and Vicini companies. Production is likely to fall to 1·3 million tons against a previously estimated 1·4 million tons; however, the C.E.A. (State Sugar Council) claims that export commitments of 880,000 tons this season will be met.

* * *

**New Yugoslavia sugar factory**[12].—The organization UPI will erect the 14th sugar factory in Yugoslavia in Bijeljina. The new plant will be put in operation in 1978 when the country should reach self-sufficiency in sugar against 77·3% at present. The total project involves some 800 million dinars and initial capacity is to be 300,000 tons of beet per year, to be increased later to 400,000 tons. Production goal for the 1980's is around 820,000 tons.

* * *

**Swaziland sugar exports, 1974**[13].—Exports of sugar in 1974 from Swaziland totalled 190,111 metric tons, raw value, the principal destination being the UK which took 105,838 tons as against 81,159 tons in 1973 when total exports were 157,521 tons. Other outlets were the USA which took 37,965 tons (27,625 in 1973), Canada with 30,367 tons (34,318), Zambia with 9962 tons (14,419) and Israel with 5707 tons (0). Other countries took the balance of 272 tons (0 in 1973).

* * *

**New Mexican sugar factory**[14].—A new sugar factory with a capacity of 6000 tons per day is to be erected near Alvaro Obregón. It has been ordered by the Comisión Nacional de la Industria Azucarera which holds power to direct all sugar industry activities and operation of sugar-related Government activities.

* * *

**Somalia sugar project**[15].—A cane sugar complex is planned by Somalia to be established in the Lower Giuba region. It is intended that some 600,000 tons of cane will be grown on 5000 hectares. The sugar mill is scheduled to have an annual capacity of 60,000 tons.

* * *

**New Egyptian sugar factory**[16].—A new sugar factory is to be erected at Paliana in Upper Egypt, with a capacity of 150,000 tons a year.

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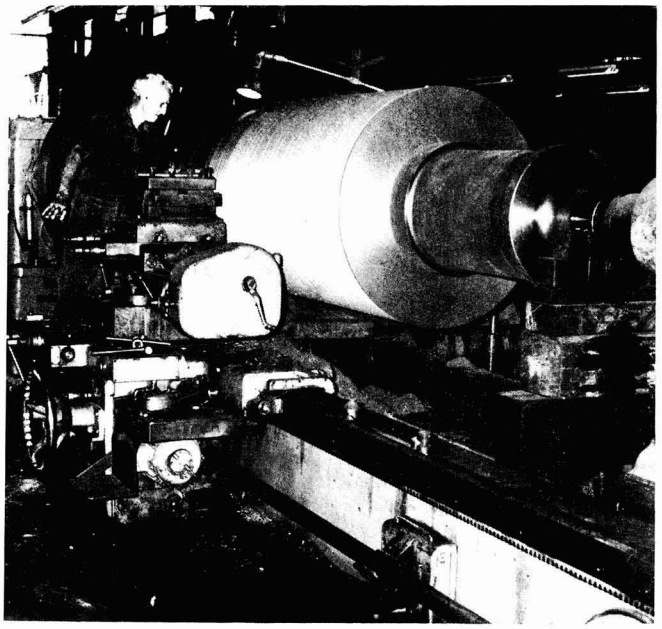
[1] *Zeitsch. Zuckerind.*, 1975, **100,** 222.
[2] *Bank of London & S. America Review*, 1975, **9,** 338.
[3] *Standard & Chartered Review*, June 1975, 7.
[4] *Bank of London & S. America Review*, 1975, **9,** 361.
[5] F. O. Licht, *International Sugar Rpt.*, 1975, **107,** (17), 5.
[6] *Public Ledger*, 21st June 1975.
[7] C. Czarnikow Ltd., *Sugar Review*, 1975, (1237), 106.
[8] *Public Ledger*, 28th June 1975.
[9] *I.S.O. Stat. Bull.*, 1975, **34,** (5), 104.
[10] C. Czarnikow Ltd., *Sugar Review*, 1975, (1237), 107.
[11] *Public Ledger*, 21st June 1975.
[12] F. O. Licht, *International Sugar Rpt.*, 1975, **107,** (21), 10.
[13] *I.S.O. Stat. Bull.*, 1975, **34,** (4), 99.
[14] F. O. Licht, *International Sugar Rpt.*, 1975, **107,** (21), 9.
[15] C. Czarnikow Ltd., *Sugar Review*, 1975, (1242), 126.
[16] *Amerop Noticias*, 1975, (19), 13.



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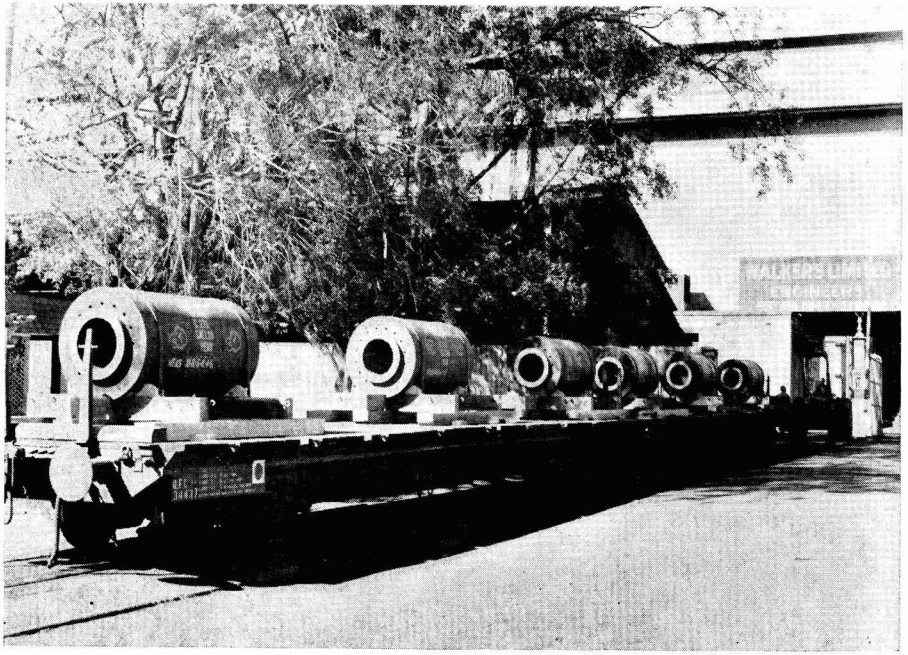

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.

PRINTED IN GREAT BRITAIN.