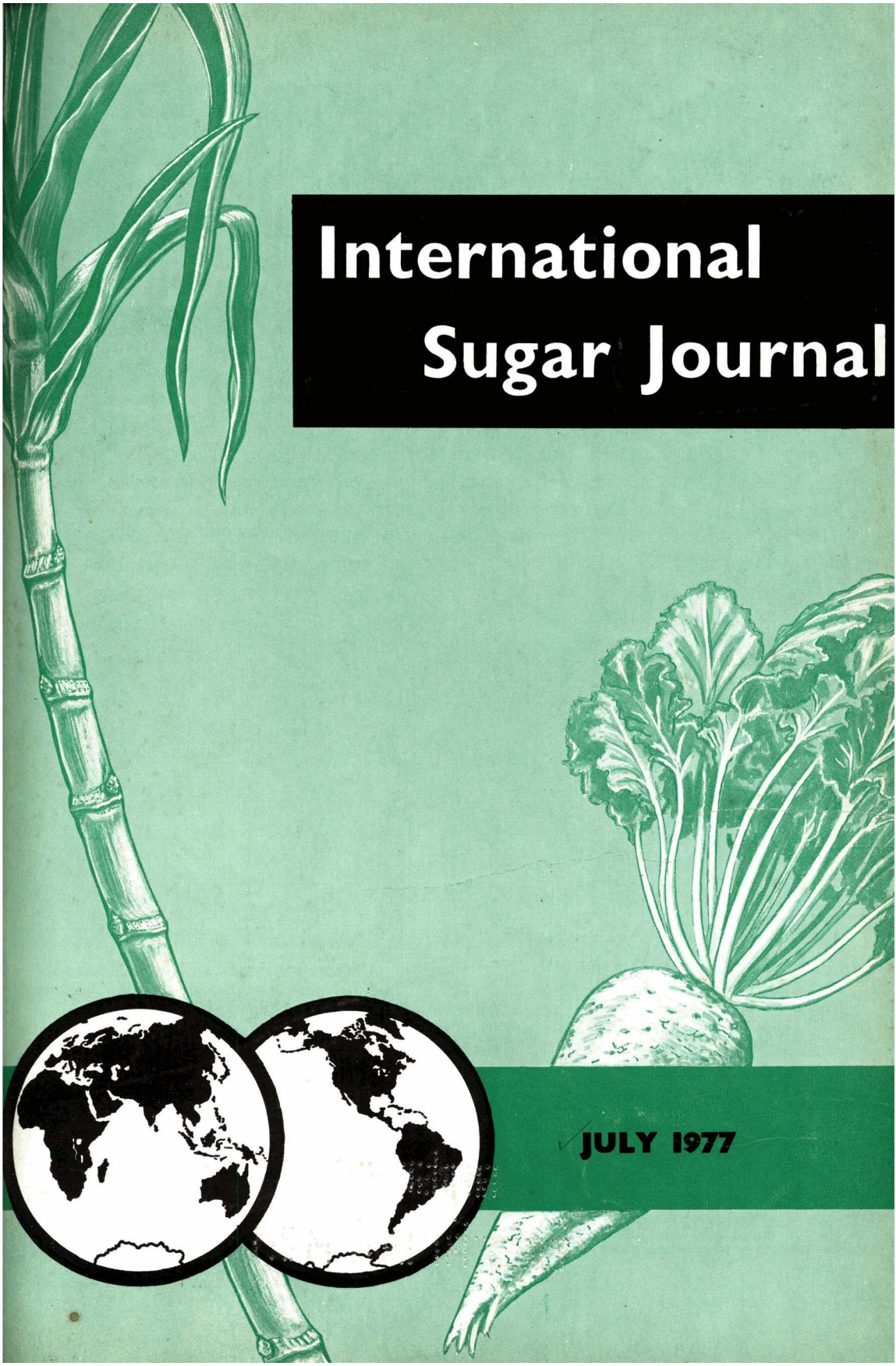
International Sugar Journal



JULY 1977

THE A·B·R ENGINEERING SILO,

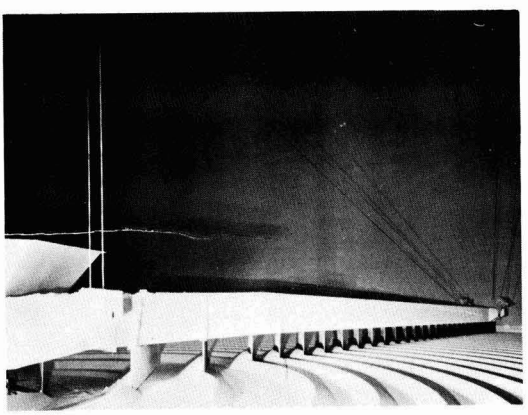
WITH FULLY AUTOMATIC STORAGE AND STOCK REMOVAL

A SOLUTION WORTH EXAMINING FOR THE BEST CONDITIONS FOR SUGAR PRESERVATION.

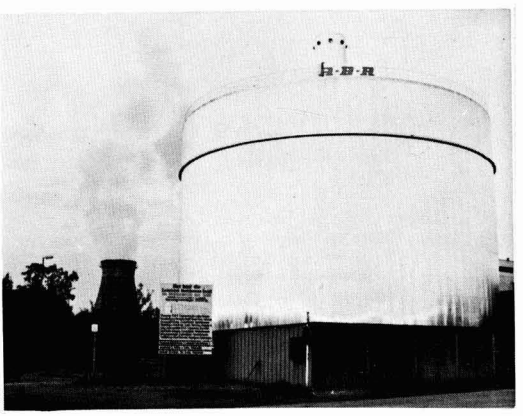
Pollution ... Undesirable lumps ... Moisture migration ... All these problems of bulk sugar preservation have been solved in the mechanized and insulated steel silo designed and developed by A·B·R ENGINEERING, thanks to:

- a waterproof steel shell.
- keeping the sugar at a steady temperature.
- the blowing of dehumidified air through the sugar layers.

The A·B·R solution makes it possible to achieve a very low working cost which may be compared to any other method to the advantage of the A·B·R silo. Its weight is relatively light, giving a considerable saving in foundation cost. Safety has not been neglected: the A·B·R silo is explosion - proof.



Rotating beam with spreading plates.



Our latest silo (25 000 tons.) in West-Germany.

IT TAKES LESS THAN ONE YEAR TO BUILD IT!

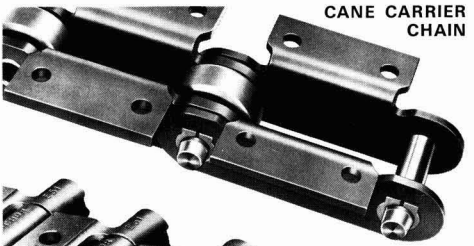
A·B·R Engineering

Square Frère-Orban, 7; 1040 Brussels, Belgium.
phone: (02) 230 01 25; telex: 22 328 abreng.

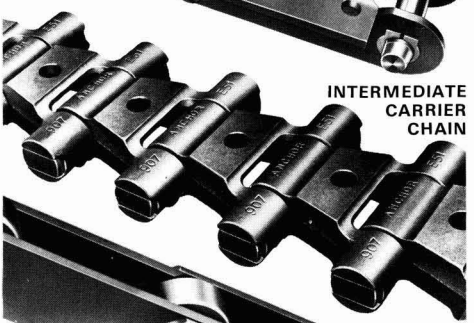
RENOLD

PRODUCTS FOR THE

sugar industry



CANE CARRIER CHAIN

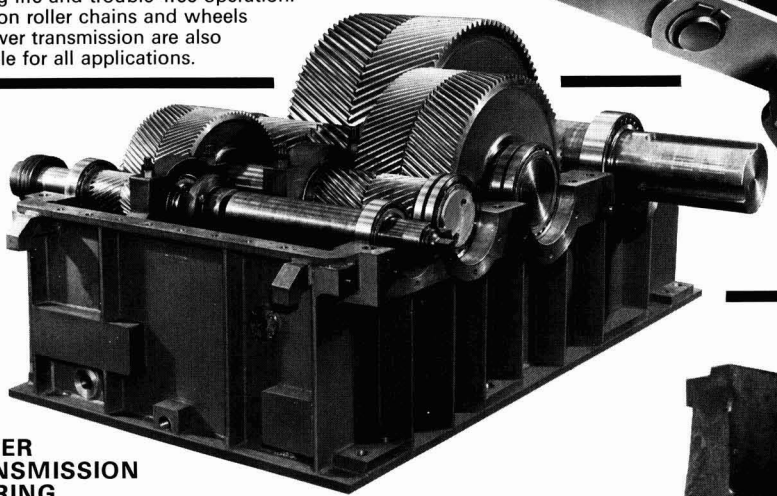


INTERMEDIATE CARRIER CHAIN

BAGASSE CARRIER CHAIN

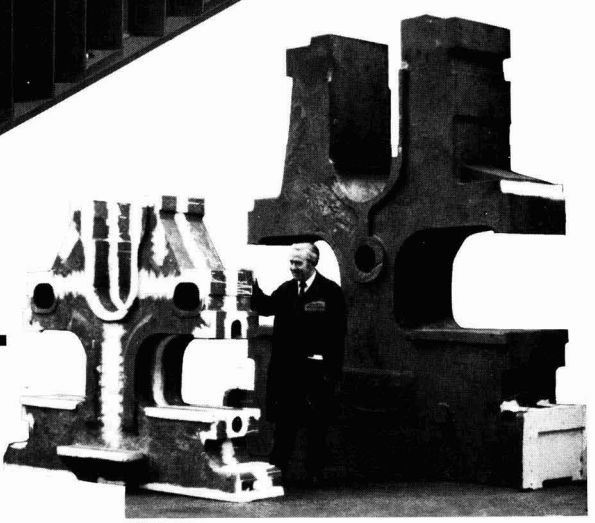
CHAINS FOR MECHANICAL HANDLING

Specialised Renold chains have been supplied to the cane sugar industry since 1920.
Over 90 years of precision chain manufacture ensure a product combining high strength with compactness, minimum weight and low cost for long life and trouble-free operation.
Precision roller chains and wheels for power transmission are also available for all applications.



POWER TRANSMISSION GEARING

One of three 800hp triple reduction, double helical gear units supplied to the Philippines. Spur gears up to 127mm circular pitch, 760mm face width and 4700mm diameter can be supplied for heavy tandem drives. Other gear products include worm and bevel gear units and individual gears.



CASTINGS AND FORGINGS

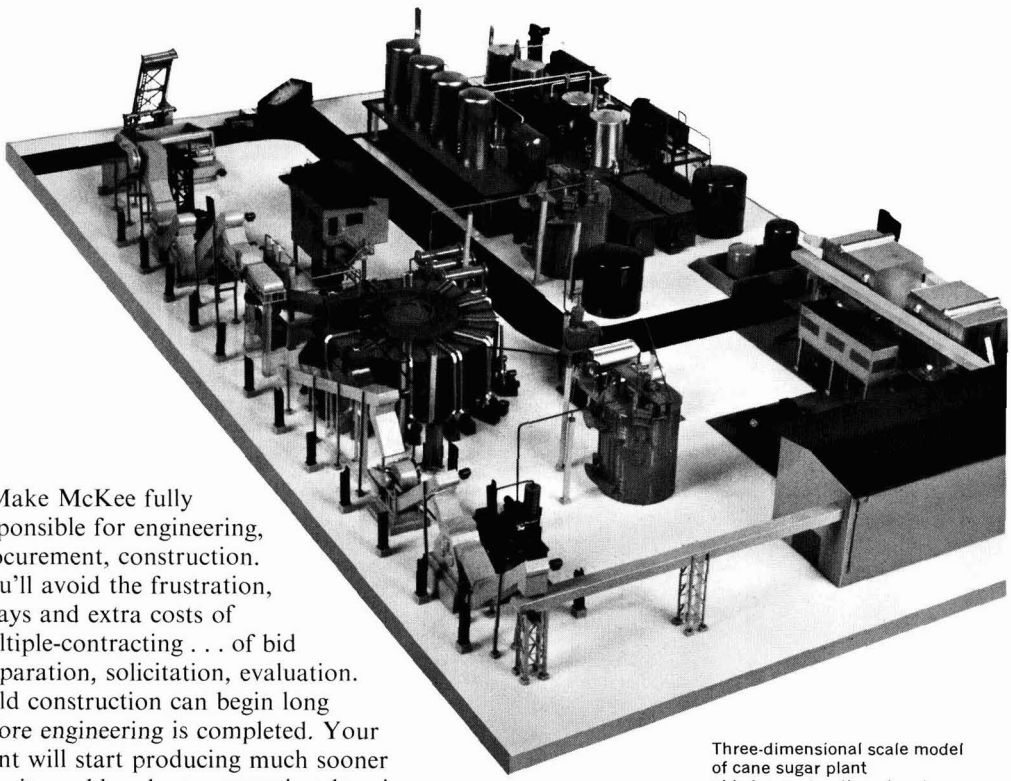
Holcroft Castings and Forgings, a Renold subsidiary company, supplies steel, iron and bronze castings and steel forgings.
The photograph shows a 13½ tonne headstock casting for a 12 roll tandem employing 90 inch (2290mm) long, 44 inch (1120mm) diameter rolls with a smaller casting for comparison.

Other Renold products include:-
Hydraulic, electrical and mechanically operated variable speed systems.
Couplings, clutches and brakes.
Power transmission ancillaries.

RENOLD

RENOLD LIMITED
SALES DIVISION
MANCHESTER · ENGLAND

How you can turn your cane sugar project into a modern factory six months sooner.



Three-dimensional scale model of cane sugar plant aids in construction planning.

■ Make McKee fully responsible for engineering, procurement, construction. You'll avoid the frustration, delays and extra costs of multiple-contracting . . . of bid preparation, solicitation, evaluation. Field construction can begin long before engineering is completed. Your plant will start producing much sooner than it would under a conventional engineer-bid-construct schedule. For example, one project by the engineer, bid and construct method required a 24-month schedule, while the turnkey method required only 18 months—a turnkey schedule and market advantage of 6 months.

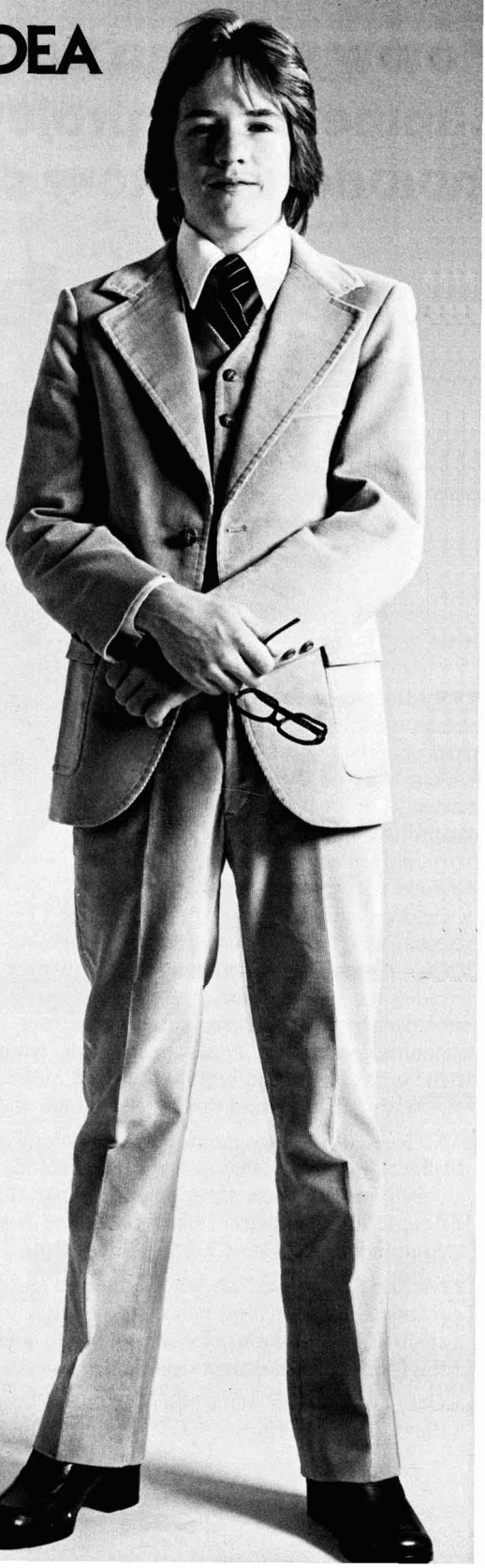
McKee coordinates the newest technology and equipment offered by American suppliers. This includes equipment for yard handling, cane cleaning and preparation, juice clarification, dewatering . . . bagasse fired boilers and boiling house equipment, and also CF&IE's Silver Ring Diffuser.

McKee. The specialists who pioneered single-source responsibility for food processing plants . . . whose experience spans 8 process industries, 70 countries, and 195 projects in the food and pharmaceutical field.

Get in touch with Arthur G. McKee & Company, 10 S. Riverside Plaza, Chicago, Illinois 60606. Phone 312-454-3600. Telex 254562.

McKee®
ENGINEERS AND CONSTRUCTORS

A QUESTIONABLE IDEA COMES OF AGE



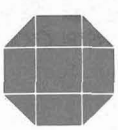
Fourteen years ago, I was just the glint of an idea in a small downtown office in Chagrin Falls, Ohio, U.S.A. My founder realized that the sugar industry at that time did not have the benefit of a broad range of chemical additives to help optimize its processing efficiency. Neither was there an effective force of trained specialists to help sugar plants solve their production problems and reduce equipment downtime.

The idea was to form a company which would achieve both these objectives—to produce cost-effective chemicals, *and* to provide technical field support on an international basis. So in 1963 I was given the corporate breath of life and the name Fabcon.

But I was a questionable idea at best, especially if you consider the industry cynicism prevailing at the time towards the value of any chemical additives. However, one year later Fabcon marketed a very effective product which gradually won acceptance from over 500 sugar mills around the world. It was aptly named Pan-Aid, and was the first of twelve process chemicals to be successfully introduced by Fabcon during the past fourteen years.

Last year, Fabcon sold over three million pounds of process chemicals to the world's sugar factories, and provided necessary after-sales service through our Service Engineers and Sales Representatives in 53 countries. In addition we maintained four overseas manufacturing plants to help expedite the delivery of our products throughout the sugar-producing world.

Today, process chemicals are being used regularly by more and more profit-conscious mills, both to reduce costly production bottlenecks and increase their total sugar recovery. And now that this 'questionable' idea has come of age, I would like to express my thanks to the dynamic industry that made me possible. But at fourteen, I'm still a young company with a lot of growth ahead, and, as the years continue, you can be sure I will be working hard at learning to serve you better.



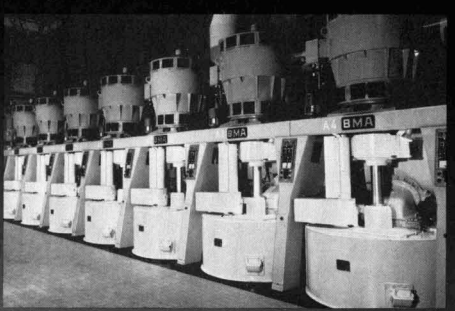
Fabcon International

Corporate Offices: 1275 Columbus Ave., San Francisco California 94133, U.S.A. Telex 340 884

BMA

batch-type centrifugals

for all products



* 500 to 1,550 kg massecuite per charge
* Extremely smooth running
* High number of charges
* Non-oscillating basket suspension during discharging
* A.C. or D.C. drives

BMA centrifugals are first-class products resulting from a specific development.

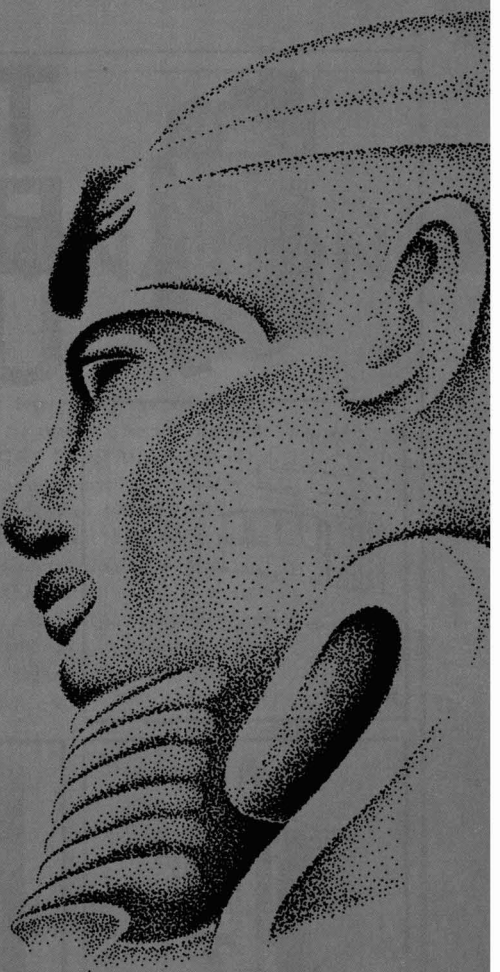
BMA

Braunschweigische Maschinenbauanstalt

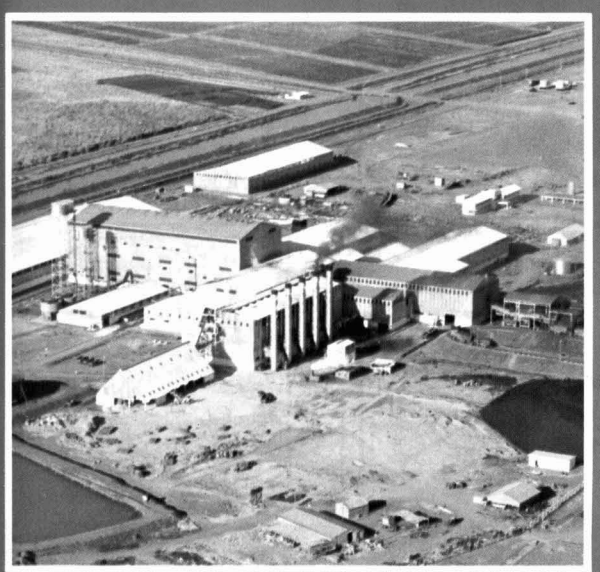
D-3300 Braunschweig Federal Republic of Germany
Telephone (05 31) 8 04-1 Telex 9 52 456 a bema d

BMA world-wide at home

THINGS ARE HAPPENING IN THE SUDAN



"The food bowl of the Middle East" is how world experts are describing the Sudan. However, to transform the undoubted potential of this vast land into reality requires technical skills, experience and above all stamina and dedication.



Fletcher and Stewart Limited possess just such qualities – qualities which have born fruition in the successful completion of the sugar factory project at Sennar on the banks of the Blue Nile some 300 kms south of Khartoum.

The factory which was supplied and erected against a background of extremely difficult manufacturing, shipping and local construction conditions is further evidence of FS commitment to the developing sugar industry of the world.

FS is now concentrating on the completion of its second turnkey Sudanese factory at Hagar El Asalaya in the White Nile Province which is located approximately 96 kms distant from the Sennar factory.

Although they differ in certain respects, each factory is capable of processing 6500 tons of sugar cane per day and will between them have the capacity to produce 250,000 tons per year of refined sugar.

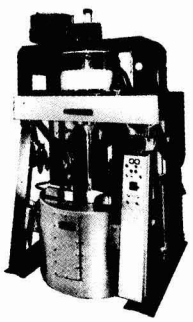
Things are happening in the Sudan!

FS

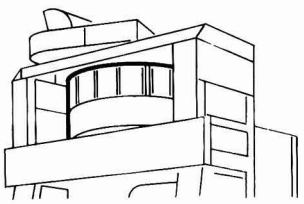
Fletcher and Stewart Limited

DERBY DE2 8AB ENGLAND

FSI

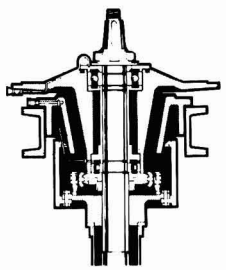


The Build Up



Motor

- Motor specially designed to meet end-users power requirements.
- Special Suspension assists in dampening effects of out-of-balance loads.
- Plough operation ensures free discharge and completely cleared basket: cycle time kept to a minimum since sugar discharges in same direction of rotation.
- Automatic Feed Valve and Limiting Sensor arrangement ensures constant feeding independently of variations in massecuite.
- High unimpeded output ensured by Special Discharge Valve.
- Automatic sequence controls programmed for step-by-step operation throughout cycle.

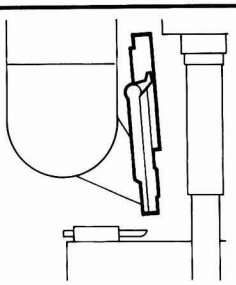


Suspension

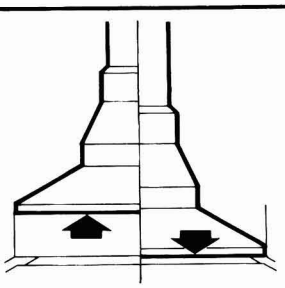
Plough

Broadbent—
BUILT TO LAST...

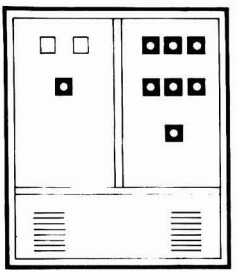
Write for details



Feed Valve



Discharge Valve



Controls

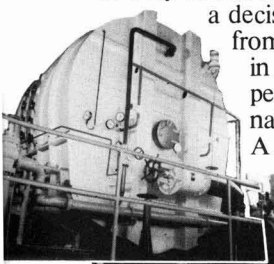
BROADBENT

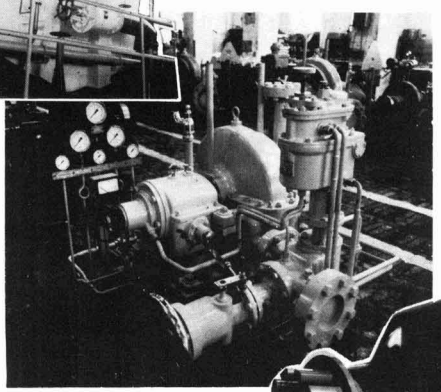
THOMAS BROADBENT & SONS LIMITED
Huddersfield England HD1 3EA
Telephone: Huddersfield (0484) 22111 Telex: 51515 Cables: BROADBENT Huddersfield

LTS8

DEDINI Experienced builders of turnkey sugar mills. Leading manufacturers of machinery for the sugar industry.

We live in the world's largest sugar cane producing country. A country which has been receiving a decisive contribution from the sugar industry in improving the performance of the national economy. A country, above all,





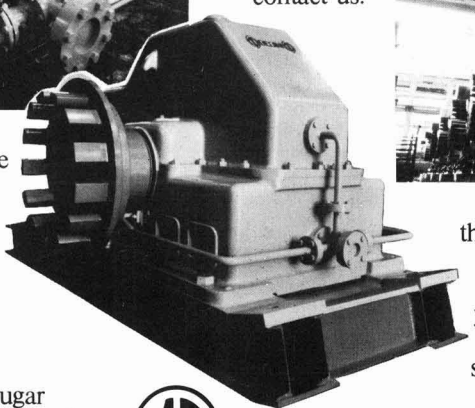
with extensive background experience in sugar cane industrialization. This experience has a name: Dedini.

An organization acknowledged today as Brazil's most important supplier of complete sugar factories and alcohol distilleries.

Our engineering and technical departments will help you with feasibility studies to expand or modernize your present plant or construct a brand new turnkey mill strictly in accordance with your needs and capabilities.

This gives you the great advantage of working with a single supplier, from initial planning, through procurement, to plant construction, installation, start-up and training of your personnel who will be running the plant. This time saving process will help you in getting your new mill in production, with greater profits, sooner.

Whatever your problem in sugar production, please contact us.

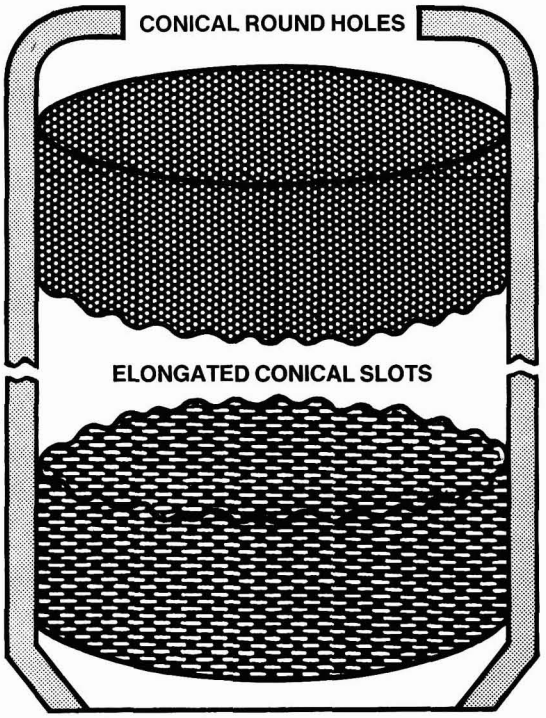


And remember that our technical and advisory services are still yours, long after your mill has started operation.

M.DEDINI S.A. METALÚRGICA

Av. Mário Dedini, 201
Tel.: (0194) 33-1122 - Telex 0191032 MDMN
13.400 - Piracicaba - São Paulo, Brazil.

DEDINI will be present at the 16th ISSCT Congress - International Society of Sugar Cane Technologists - Parque Anhembi - São Paulo - Brazil - September 12th to 22nd 1977.



Centrifugal linings for the international sugar industry.

APW' Filter Linings for Centrifugal Machines are an improved type, and have been specially designed for rapid and economical sugar production and other purposes where close and accurate filtering is required. These linings are supplied in brass or copper, with either elongated slots or round holes as desired.

Both types of holes are conical in shape, the wide outlet on the outside of the lining prevents clogging and greatly assists filtration – the hole retains its size and shape, with the result that a regular product is always ensured.

Woven wire backing cloths can also be supplied in brass, steel and copper. Other uses for woven wire include grading and separating pulp and *juice after boiling, etc.*

Contact APW for a competitive and prompt quotation.

apw

ASSOCIATED PERFORATORS & WEAVERS LTD.

WOOLWICH ROAD, LONDON, ENGLAND SE7 7RS
Telephone: 01-858 6401 Telex: 896648 Cables: Perforator London SE7
Northern Region Office & Works, Church Street, Warrington, Cheshire WA1 2SU
Telephone: 0925 32402
Scottish Office & Warehouse, 24-26 Carnoustie Place, Kingston Industrial Estate, Glasgow C5
Telephone: 041-429 4611/2/3

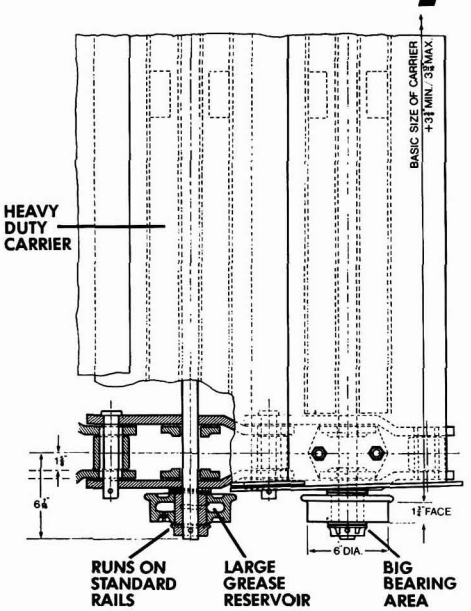
JOINT HARVEY Locker ENTERPRISE

Ewart 'Cobra' spells Reliability

COBRA spells Cane Carrier OutBoard Roller Assembly. Above all, it spells RELIABILITY – proven over the years in handling the heaviest materials under extreme loading conditions. In plants where breakdowns had to be avoided... *maintenance kept to a minimum... where long* life was essential.

The Ewart COBRA is the logical outcome of many years' experience in manufacturing overlapping tray and slat conveyors – incorporating all the technical refinements of these earlier units plus many additional design features of particular interest to the cane sugar industry.

Full details – including tables, section drawings and other illustrations – are given in Ewart Catalogue 400. Send for a copy now.



EWART

Ewart Chainbelt Co. Ltd.
Derby DE3 8LX, England.
Telephone: Derby (0332) 45451
Telex: 37575 Leyewt-G Derby
Cables: Chainbelt Derby

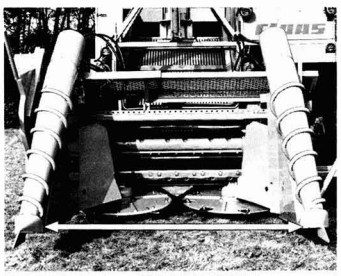
How many days work do you lose because of rainy weather in the cane harvest?

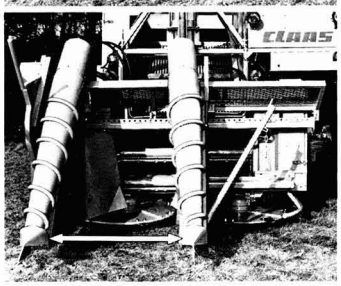
either because it has prevented a good and timely burn

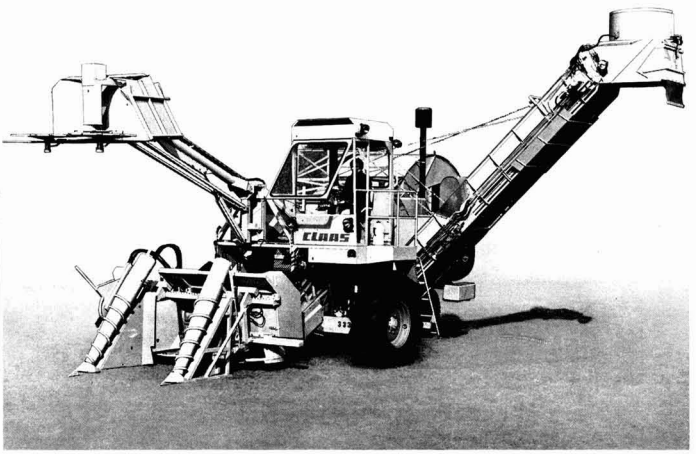
or because rains fell after you had a good burn and could not harvest?

The CLAAS LIBERTADORA 1400 Cane harvester

will solve most of such and other problems:







Because:

1. We harvest GREEN CANE, which has a slower rate of deterioration, at a rate of up to 45 tons per hour. Possible because of

   amply dimensioned rugged base cutters. ⌀ each 1170 mm • high lug tires for wet and slippery soils • two choppers extending the whole width of throat, 1354 mm • no force-feed rollers, no clogging no stalling in wet crop

2. We harvest LAID CROP because of

   an intake throat with hydraulically driven dividers adjustable in steps of abt 2 inches from 30 inch to 75 inch. • side cutters preventing uprooting of the next (uncut) row

3. We harvest BURNT CROP even faster, up to 60 tons per hour

   heavy yields (200 tons/ha) or low yields (40 tons/ha) wide conveyors, a heavy blower system, and infinitely variable speed with a dependable hydraulic drive

4. We harvest even on SLOPES (where others topple)

   because of WIDE (10 FT) front drive axle

We compared our performance with that of other machines. We find advantages, so have our many clients in 20 vastly differing cane producing countries of the world. Write for reference lists and catalogues. Ask the users. We feel sure they will encourage you to approach us — or our dealers in many countries of the world.

GEBR. CLAAS MASCHINENFABRIK GMBH 4834 HARSEWINKEL West Germany
Dept. for Sugar Cane Machinery

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

Advertisement Sales Representatives

Australia: J. J. Hindmarsh,
24–26 Kent Street, Sydney 2000.
Tel.: 241-2471. *Cable:* Hindmarshad.

Benelux: G. Arnold Teesing B.V.,
Hobbemastraat 26, Amsterdam 1007, Holland.
Tel.: 020-768666/768667. *Telex:* 13133.

France: MaG-Watt International,
4 rue de Castiglione, 75001 Paris.
Tel.: 260-88-78.

Japan: Douglas Kenrick (Far East) Ltd.,
Kowa Daisan Building, 11–45 1-chome Akasaka,
Minato-ku, Tokyo.
Tel.: (582) 0951–5. *Cable:* Kenrick Tokyo.

Latin America:
Mr. Mario A. Mascaró
7321 S.W. 82nd Street, Miami, FL, U.S.A. 33143.
Tel.: (305) 667-1724.

U.S.A.—Mid-West states:
The Farley Company,
Suite 1548, 35 East Wacker Drive, Chicago, IL 60601.
Tel.: (312) 346-3074.

U.S.A.—New England and mid-Atlantic states:
Sherwood H. Leavitt Company,
Suite 2707, 220 East 42nd Street, New York, NY 10017.
Tel.: (212) 661-0088.

U.S.A.—Southern states:
Herbert Martin Company,
2325 Old Rocky Ridge Road, Birmingham, AL 35216.
Tel.: (205) 822-7371.

U.S.A.—Western States, incl. Hawaii:
Roy McDonald Associates Inc.,
Suite 265, Baybridge Office Plaza,
5801 Christie Avenue, Emeryville, CA 94608.
Tel.: (415) 653-2122.

International Sugar Journal

July 1977

Contents

* * *

Annual Subscription: $15.00 post free
Single Copies: $1.80 post free

* * *

UK ISSN 0020-8841

SOMMARES : ZUSAMMENFASSUNGEN : SUMARIOS

Relations entre la pureté du jus de betterave clarifié et les impuretés aisément mesurables. P. J. LAST et A. P. DRAYCOTT. *p.* 183–185

La pureté du jus des échantillons de betteraves, utilisés pour divers essais ainsi que d'autres, prélevés dans les champs au cours des années 1964–72, a été déterminée comme mesure de l'extraction potentielle de sucre blanc; les concentrations en sodium, potassium et azote α-aminé des échantillons ont également été déterminées et on a examiné leurs relations, individuelles ou globales, avec la pureté du jus. Alors que la meilleure estimation individuelle de la pureté du jus était usuellement donnée par la concentration en azote α-aminé, la précision était accrue en totalisant les trois impuretés après avoir multiplié chacune d'elles par un coefficient approprié. La totalisation en deux types d'équation de régression (l'une dans laquelle les coefficients étaient limités à des valeurs prédéterminées et l'autre dans laquelle ils n'étaient pas limités) a révélé que les coefficients de ce dernier type d'équation étaient sujets d'un changement en grandeur et en signe, particulièrement dans le cas du K et Na, quoique les deux formes d'équation ont donné des degrés de variance similaires pour les essais individuels et en global; il est cependant recommandé de maintenir un rapport $2\frac{1}{2}:3\frac{1}{2}:10$ pour K:Na:N α-aminé.

* * *

La détermination absolue du saccharose dans les produits de sucrerie et de raffinerie par dilution isotopique. 2ème partie. Modes d'opération pour le contrôle des erreurs dans la préparation de la source et du comptage. N. R. PIPER. *p.* 186–191

On décrit les sources du comptage de radiation et de la préparation de l'échantillon qui peuvent affecter la précision de la technique de dilution isotopique utilisée pour la détermination du saccharose dans les produits de sucrerie et de raffinerie et on indique les moyens par lesquels les erreurs individuelles peuvent être minimisées. Des modes opératoires pour la préparation de l'échantillon et le comptage de radiation sont décrits ainsi que la méthode pour le calcul de la teneur en saccharose. Des résultats-types sont donnés sous forme de tableau pour divers produits, illustrant la précision généralement élevée de la méthode en comparaison avec les méthodes par polarisation. Cependant, si la dilution isotopique est plus précise que la polarisation dans le cas de produits à faible teneur en saccharose, sa précision est considérée comme non appropriée pour les sucres bruts et produits similaires à teneur élevée en saccharose.

Die Beziehungen zwischen der Reinheit von geklärtem Rübensaft und den leicht bestimmbaren Verunreinigungen. P. J. LAST und A. P. DRAYCOTT. *S.* 183–185

Die Reinheit des Saftes in für verschiedene Versuche verwendeten Rübenproben sowie von anderen, von den Feldern 1964 bis 1972 entnommenen Proben wurde als Mass für die mögliche Weisszuckerextraktion bestimmt. Der Gehalt der Proben an Natrium, Kalium und α-Aminostickstoff wurde ebenfalls ermittelt und die Beziehung der einzelnen Inhaltsstoffe und ihrer Gesamtheit zur Saftreinheit untersucht. Wenn auch die beste individuelle Abschätzung der Saftreinheit nach dem Gehalt an α-Aminostickstoff möglich ist, wird die Genauigkeit durch Summierung der drei Verunreinigungen nach Multiplikation einer jeden mit einem geeigneten Faktor noch verbessert. Die Summierung in zwei Arten von Regressionsgleichungen—bei einer wurden die Faktoren auf vorher ermittelte Werte beschränkt, bei der anderen waren sie unbegrenzt—zeigte, dass die Faktoren bei der zweiten Gleichungsart Grösse und Vorzeichen änderten, besonders bei Kalium und Natrium, obwohl beide Gleichungsformen ähnliche Varianzgrade in den Einzelversuchen und insgesamt ergaben. Die Verfasser empfehlen trotzdem, ein Verhältnis von Kalium zu Natrium zu α-Aminostickstoff von 2,5 zu 3,5 zu 10 einzuhalten.

* * *

Die Absolutbestimmung von Saccharose in Rohrzuckerfabriks- und Raffinerieprodukten mit Hilfe der Isotopenverdünnungstechnik. Teil II. Verfahren zur Vermeidung von Fehlern bei der Vorbereitung der Proben und bei der Szintillationszählung. N. R. PIPER. *S.* 186–191

Die Fehlerquellen bei der Szintillationszählung und bei der Vorbereitung der Proben, welche die Genauigkeit der zur Bestimmung der Saccharose in Zuckerfabriks- und Raffinerieprodukten benutzten Isotopenverdünnungsmethode beeinträchtigen können, werden beschrieben. Ferner werden Wege aufgezeigt, nach denen die individuellen Fehler minimiert werden können. Es werden empfohlene Methoden zur Vorbereitung der Proben und zur Szintillationszählung einschliesslich einer Methode zur Berechnung des Saccharosegehaltes beschrieben. Der Verfasser hat für eine Zahl verschiedener Produkte typische Werte in einer Tabelle zusammengefasst und zeigt damit die allgemein hohe Genauigkeit gegenüber den Polarisationsmethoden. Während jedoch im Falle von Saccharoseprodukten geringerer Reinheit gefunden wurde, dass die Isotopenverdünnungsmethode genauer als die Polarisationsmethoden ist, wird ihre Genauigkeit für Rohzucker und ähnliche Produkte mit hohem Saccharosegehalt für unzureichend gehalten.

Relaciones entre pureza de jugo clarificado de remolacha y impurezas fácilmente medidas. P. J. LAST y A. P. DRAYCOTT. *Pág.* 183–185

La pureza del jugo en muestras de remolacha usado para varios ensayos, más otras tomado de campos de los cultivadores mientras 1964–72, se han determinado como una medida del extracción potencial de azúcar blanco; las concentraciones de sodio, potasio y α-amino-nitrógeno en las muestras se han determinado también y sus relaciones, individual y en total, con pureza del jugo se han determinado. Mientras que la concentración del α-amino-nitrógeno dió la mejor estimación individual de la pureza del jugo, sumación de las tres impurezas, cada una multiplicado por un coeficiente apropriado, mejoró la precisión. Sumación en dos tipos de ecuación de regresión (el uno con los coeficientes limitado a valores pre-determinados, y el otro sin estas limitaciones) ha demostrado que los coeficientes en el segundo tipo de ecuación estaban sujeto a cambios en magnitud y indicio, especialmente en los casos de K y Na, aunque ambas formas de ecuación dieron grados semejantes de varianza en ensayos individuales y global; sin embargo, mantenimiento de una relación de $2\frac{1}{2}:3\frac{1}{2}:10$ para K:Na:α-amino-N es recomendado.

* * *

La determinación absoluta por dilución isotópica de sacarosa en productos de la fábrica azucarera y de la refinería. Parte II. Procedimientos para el control de errores en preparación del fuente y en contación. N. R. PIPER. *Pág.* 186–191

Se describen los fuentes de error en contación de radiación y preparación de muestras que pueden afectar la precisión de la técnica de dilución isotópica, como utilizado para determinar sacarosa en productos de la fábrica azucarera y de la refinería, y se indican métodos para reducir al mínimo los errores individuales. Procedimientos recomendados para preparar las muestras y contar la radiación se describen, tanto como el método de calcular el contenido de sacarosa. Se presentan en forma tabular resultas típicas para algunas productos diferentes que demuestran la generalmente alta precisión del método en comparación con métodos de polarización. Sin embargo, mientras que dilución isotópica es más precisa que polarización en el caso de productos de baja sacarosa, su precisión es considerado inadecuado para azucares crudos y otros productos semejante de alta sacarosa.

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIX JULY, 1977 No. 943

Notes & Comments

The late Hugh Martin-Leake

It is with deep regret that we have to record the death on 29th April of Dr. HUGH MARTIN-LEAKE, Sc.D., M.A., F.L.S., F.Z.S., who was Agricultural Editor of the *International Sugar Journal* from 1932 to 1963. Dr. Martin-Leake, who was born in 1878, graduated in 1900 from Christ's College, Cambridge, also being elected Scholar of the College. In 1901 he went to India, becoming Biologist to the Bihar Indigo Planters' Association. In 1904 he was appointed Economic Botanist to the Government of the United Provinces, a post which he held until 1919. In addition, he was Principal of the Agricultural College at Kanpur (now the Chandra Shakher Azad University).

In 1914 his services were lent to the Egyptian Government and in the same year he was awarded the degree of Sc.D. by Cambridge University. During 1919–23 he was Director of Agriculture of the United Provinces and a member of the Legislative Council. He was seconded to the Sudan Government in 1923–24, after which he became Principal of the Imperial College of Tropical Agriculture in Trinidad, from which post he resigned in 1927.

Much of his early work was in plant breeding, particularly of indigo and cotton, but a subsequent major interest was in land tenure. His long experience of Indian botany and agriculture, including sugar cane, gave him an ideal background for his work as Agricultural Editor of this *Journal*. He was able to put his expertise to use in evaluating the work being conducted in cane agriculture throughout the world and drew on his past experience to write many articles which appeared not only in our pages but in many other publications. He was also the author of a number of books. He was also able to attract to our pages articles by many of the world's foremost sugar agriculturalists. His mind was sharp even up to his death and it was only failing sight which caused him to give up his work at the age of 85, when he found difficulty in keeping up with current literature.

We remember him with pride and affection and know that those of our readers who knew him in person or by correspondence will share our loss and wish to join us in expressing our sympathy with his widow.

* * *

EEC-ACP sugar price agreement

Representatives of the EEC and the African, Caribbean and Pacific (ACP) exporters, whose 1·3 million tons sugar trade is governed by the Lomé Agreement, met in Brussels on the 12th–13th May and agreed that for 1977/78 the Community will pay 272·5 units of account (equivalent to £215) per metric ton, raw value. The new price represents an increase of about 2% over that of 1976/77 and will apply from 1st May 1977, as against the EEC's farm year date of 1st July and the 1st January to which the ACP countries wanted the agreement back-dated. A self-balancing special storage levy is to be applied and has met the objections of the ACP representatives to their payment for an average two months storage, which was a matter for contention in the 1976/77 farm year. Further, Tate & Lyle Ltd. have assured the raw sugar suppliers that they will be given the first 10 u.a. per ton of any profit made from anticipated higher refined sugar prices on the UK market, which should bring the actual price paid to 282 u.a. There is no obligation to provide this 10 u.a. if refined sugar prices fall in the UK.

* * *

International Sugar Conference

The United Nations Sugar Conference, convened under the auspices of UNCTAD to negotiate a new International Sugar Agreement, opened in Geneva on 18th April and concluded in failure on the 27th May with no plans for later re-convening.

The meetings opened in an atmosphere of enthusiasm and high hopes for success, although the opening statements made by representatives of the participating Governments indicated wide differences between their views. After some time it became apparent that these were fundamental principles which could not be bridged by adjustment and compromise, one extreme being the position of the EEC which wanted equitable prices and availability controlled only by establishment of internationally-held stocks, with no quota provisions.

At the other extreme, some of the exporters and also Japan favoured an agreement with quotas the main market control factor, with only minimal obligatory stocks, while the USA argued for a combination of both quotas and stocks. The Australian chairman of one of the working groups submitted a package based on export shares of an annually estimated free market requirement, with quotas cut by 5% steps should prices fall below agreed levels and suspension of quotas, followed by release of ISO-checked and obligatory stocks in three stages if prices should go above upper agreed levels. This proposal was, however, thought too close to the basis of the 1968 agreement. Another problem was the refusal of Cuba to provide information on its trade with other Comecon partners.

With the EEC view an isolated one, the major confrontation was over the views of the USA which originally proposed establishment of a 4 million ton stock of which half would be a minimum, built up, held and financed by the exporters. As the price

dropped below half-way through an agreed price range (the US suggested a range from 10 cents/lb to 20 cents/lb) the exporters would start to build up the remaining stock at a rate determined by the ISC with finance provided by a stabilization fund contributed by both exporters and importers. The US later modified this proposal to a 3·2 million tons stock but entirely held and financed by the exporters.

By contrast, the exporters were prepared to finance only a 1·3 million-ton minimum stock, corresponding to nearly 10% rather than over 20% of the estimated free market trade in sugar. There was, however, general agreement on a floor price not below 10 cents/lb and a range of at least 10 cents, in three price bands with stock building and quotas in the lowest, de-stocking in the uppermost and a free market in the middle. A meeting of five key nations—Australia, Brazil, Canada, Japan and the USA—was called but the deadlock could not be broken and the Conference came to an end. Mr. E. JONES-PARRY, Executive Director of the International Sugar Council and Chairman of the Conference, was instructed to continue consultations with participating delegations and then decide whether to recommend reconvening the Conference. He is reported to be bringing together a working group in London in July to decide if reconvening in Geneva in September is warranted.

* * *

US sugar support programme

After the judgment of the International Trade Commission[1] reports appeared in the press that President CARTER did not favour the reduction of overall import quotas as suggested. In the event, he rejected the recommendations of the Commission and announced in mid-May a temporary price support programme which, at a cost between $240 and $300 million, would provide up to 2 cents/lb for producers to bring prices up to the 13·5 cents per pound, raw value, which represents the average break-even point for domestic growers. Congress has 60 days to override the President's decision but no such actions seemed contemplated. The measure was stressed as an interim one, the President wishing to solve the problems of the domestic industry through working of an International Sugar Agreement. With the failure of the Conference to reach agreement, further steps may be taken to aid the US domestic sugar industry.

The US Secretary of Agriculture said that the support regulations will be such as to guarantee that at least 90% of the support money will go to the beet and cane growers and thus no more than 10% will go to the processors. Representations had been made by people, including Senator LONG of Louisiana, concerning application of the support to the 1976/77 crops but this was thought unlikely, while Congressmen representing corn growing areas who thought the support discriminated against HFCS production, while doubtful of the propriety of the programme, could not challenge its legality.

* * *

World sugar prices

During May there was gradual weakening of the optimism that a new International Sugar Agreement would be reached and world sugar prices for both raw and white sugar showed a steady decline from £140 to £121 in the case of the LDP and from £142 to £132 in the case of the LDP(W). There was a slight fillip to the market in the middle of the month owing to rumours of purchases by China but these proved unfounded. With failure of the Conference there was removed the need to hold away from the market by exporters who had been hoping for an agreement with better prices, and lower prices may be anticipated.

* * *

High-fructose corn syrup[2]

In an answer to a written question to the Commission of the European Communities concerning sugar syrup with a high fructose content, it was stated on 1st March 1977 that glucose syrup with a high fructose content (HFCS) possesses a sweetening effect similar to that of sucrose and may replace it directly in the ratio 1:1 in the majority of uses for liquid sugar in the processing industries. The quantities of sucrose marketed in the form of liquid sugar amount at present to 700,000 metric tons. It should also be remembered that, prices being equal, many processors prefer sugar in the solid state to liquid sugar, which is difficult to store, and they dissolve the sugar themselves as and when they need it in processing. In assessing the degree of substitution, account must also be taken, therefore, of the quantities of HFCS which would be used by this potential market if they were to be offered at a price substantially lower than that of sugar. In addition, in order to preserve its properties in the present state of its technology this product requires storage at 32°C, which practically rules out all domestic sale and consumption.

To the question whether scientific research into an industrial crystallization process has reached the stage where it is now possible to envisage within the foreseeable future the manufacture of solid sugar from maize and other farinaceous products, the Commission answered that they do not have enough information to state positively that an economically viable industrial crystallization process for HFCS is to be foreseen in the near future. However, it is aware that certain results have already been obtained in respect of crystallization.

The present standard product contains 42% fructose but several producers have introduced second-generation products with 55–60% fructose and, to a lesser extent, 90% fructose. Industrial ability to produce the last is very limited and will not reach significant levels for 10–12 months; moreover commitment of capital is complicated by the unsettled fate of the various non-nutritive sweeteners. Crystalline fructose can be produced in the laboratory while a granular fructose might become commercially available in the early 1980's but the relative costs of granular fructose and sucrose at that time can only be a matter of speculation.

* * *

European sugar beet area, 1977

F. O. Licht KG have recently published[3] their third estimate of sowings in Europe and have reduced the total from their previous estimate[4] by about 100,000 hectares. Of this reduction, some 34,000 hectares is in Western Europe and is made up by lower estimates for Italy (by 10,000 ha), Ireland (600 ha), Yugoslavia (13,000 ha) and Turkey (10,721 ha), while the Eastern Europe reduction is made up of 50,000 ha for Poland and 20,000 ha for the USSR. The total area for Europe is now set at 7,870,153 ha or some 1% lower than the area for 1976 (7,950,622 ha).

[1] *I.S.J.*, 1977, **79**, 121.
[2] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (11), 9, 18.
[3] *International Sugar Rpt.*, 1977, **109**, (13), 1–4.
[4] *I.S.J.*, 1977, **79**, 152.

Relationships between clarified beet juice purity and easily-measured impurities

By P. J. LAST and A. P. DRAYCOTT
(Broom's Barn Experimental Station, Higham, Bury St. Edmunds, Suffolk, England)

Introduction

In field experiments with sugar beet it is necessary to measure not only sugar concentration and yield but also the proportion of sugar which can be recovered from the roots. In the factory process it is generally considered that unit increase in juice purity, defined as the percentage of sugar to total soluble solids, allows 2% more sugar to be crystallized[1]. Ideally, an assessment of the purity of the factory second carbonatation juice is needed. Simulated factory juices prepared from beet have been produced in pilot plants by BROWN & SERRO[2] and more recently by CARRUTHERS & OLDFIELD[3]. The results showed that the purity of juice expressed from brei and clarified by the lime/phosphoric acid procedure described by CARRUTHERS & OLDFIELD gave a reliable estimate of the purity of the second carbonatation juice prepared in the laboratory and was indicative of potential white sugar production. The assumption was made that in the factory process diffusion and carbonatation conditions, inversion and bacterial activity were constant.

About 80% of the total non-sugars in the factory second carbonatation filtrate consists of potassium and sodium salts, amino-acids and betaine, and these are considered to be the major undesirable constituents influencing juice quality. CARRUTHERS & OLDFIELD[4] summated the concentrations of these in raw juice and related them in a regression equation to the purities of factory juices at the second carbonatation stage during the 1958/59 seasons. The relationship obtained was:

Purity of second carbonatation juice = 100·9 — 1·43 (impurity value in g/100 g sugar); this accounted for 80% of the variance.

Throughout the beet sugar industry, sugar concentration is determined polarimetrically in a lead acetate extract from brei, and it is expedient to use the same extract for analysis of impurities. Lead acetate solution extracts almost all the potassium and sodium from brei, whereas an aqueous solution extracts only 70–80%. Increasing the α-amino-acid concentration in beet decreases extraction of sugar by causing loss of buffering capacity and juice instability; this may also be determined in the lead acetate extract.

CARRUTHERS, OLDFIELD & TEAGUE[5] related the purity of clarified juice from sugar beet in the United Kingdom to the sum of potassium, sodium and α-amino-acids in the lead acetate extracts used for the determination of sugar percentage. The regression equation obtained was:

Juice purity = 97 — 0·8 (2·5 K + 3·5 Na + 10 α-amino-nitrogen).

With impurities expressed as g/100 g sugar, a highly significant correlation coefficient of —0·86 was obtained.

KEARNEY[6] suggested that the formula gave acceptable results within a field but that the variation between fields was large. On a basis of data from five trials in 1964 he proposed the formula:

Juice purity = 101·24 — (0·49 K + 1·13 Na + 2·00 α-amino-nitrogen) and obtained a correlation coefficient value of —0·94.

The impurities were determined in clarified juice prepared in the laboratory, but following further work on the relationship between the individual impurities in lead acetate extracts and in juices clarified by the method of CARRUTHERS & OLDFIELD, KEARNEY modified the regression coefficients to 1·9 K, 2·3 Na and 10 α-amino-nitrogen when the impurities were determined in lead acetate extract. He concluded that both equations produced similar standard errors for the estimation of juice purity.

Elimination of clarified juice purity determinations would decrease the work-load of institutes involved in sugar beet research. This paper therefore investigates the relationship between clarified juice purity and the impurities potassium, sodium and α-amino-nitrogen in lead acetate extracts from roots in experiments made since 1964 (i) by a regression formula of the CARRUTHERS & OLDFIELD type and (ii) by means of a multiple linear regression in which the coefficients for K, Na and α-amino-nitrogen were not restrained. Chemically and theoretically there are strong reasons for maintaining the ratio of coefficients of $2\frac{1}{2}$:$3\frac{1}{2}$:10 as explained by CARRUTHERS & OLDFIELD[2]. All values in such equations were expressed in g/100 g sugar.

Experimental

The experiments were conducted either at this institute or in growers' fields throughout the United Kingdom, under the auspices of the Sugar Beet Research and Education Committee of the Ministry of Agriculture and supervised by field staff of the British Sugar Corporation Ltd.

Sugar, potassium, sodium and α-amino-nitrogen concentrations were determined in lead acetate extracts obtained from brei by the procedure described in the contract between the British Sugar Corporation and its growers. Corresponding juice purities were determined in sub-samples of the brei pressed and clarified by the lime and phosphoric acid procedure described by CARRUTHERS & OLDFIELD[2].

Details of experiments selected for this study are shown briefly in Table I and, where applicable, a reference is given to where the main results and conclusions may be found. All the experiments in growers' fields were analysed chemically at the British Sugar Corporation Central Laboratory, Peterborough, and the remainder made and analysed at Broom's Barn. All statistical analyses were made at Rothamsted Experimental Station.

Results

Nitrogen experiments, 1968–72

A wide range of nitrogen fertilizer dressings from 0–258 kg N per hectare was tested. Using the unrestricted linear regression, the cofficients for K, Na and α-amino-nitrogen varied greatly between experi-

[1] OLDFIELD: *British Sugar Beet Rev.*, 1974, **42**, 105–108.
[2] *Proc. Amer. Soc. Sugar Beet Tech.*, 1954, **2**, 274.
[3] *I.S.J.*, 1961, **63**, 72, 103, 107.
[4] *Proc. 11th Session C.I.T.S.*, 1960, 224–248.
[5] *Paper presented to the 15th Tech. Conf., British Sugar Corp.*, 1962.
[6] *J. Sci. Food Agric.*, 1971, **22**, 342–348.

Table I. Experimental details

Title and date	*No. of experiments*	*Object*	*Reference*
Nitrogen 1968–70	28	Nitrogen response on three contrasting mineral soils	Unpublished
,, 1971–72	12	Effect of harvest date on nitrogen requirement	Unpublished
N/Na/FYM 1964–67	24	Effect of farmyard manure on nitrogen and sodium requirement	DRAYCOTT[7]
Peat soils 1966, 1968–69	12	Fertilizer requirement of organic soils	DRAYCOTT[8]
Broom's Barn 1967–68	2	Effect of previous cropping on sugar beet yield	DRAYCOTT & LAST[9]
,, ,, 1967–69	3	Nitrogen, plant population and irrigation	DRAYCOTT & WEBB[10]
,, ,, 1964–67	3	Sowing and harvesting date	HULL & WEBB[11]

Table II. Mean regression coefficients in the two equations and amounts of variance accounted for by each equation

	Unrestricted: Juice purity = $a_1 - b_1$K $- b_2$Na $- b_3$ α-amino-N					*Restricted*: Juice purity = $a_2 - m(2\frac{1}{2}$K $+ 3\frac{1}{2}$Na $+ 10$ α-amino-N)		
	Constant	*Regression coefficient* K	Na	α-amino-N	*Variance accounted for by equation, %*	*Constant*	*Regression coefficient*	*Variance accounted for by equation, %*
	a_1	b_1	b_2	b_3		a_2	m	
Nitrogen 1968–70	98·46	—1·37	—3·97	—8·10	88	98·77	—0·75	87
1971–72	92·91	—1·74	—15·08	—9·26	88	98·16	—0·67	88
N/Na/FYM 1964–67	97·71	—1·31	—2·02	—8·15	78	98·25	—0·71	77
Peat soils 1966, 1968–69	97·47	—1·68	—5·25	—5·63	61	97·90	—0·72	60
Broom's Barn 1964–69	97·43	—0·92	—8·76	—6·42	69	98·08	—0·77	62
RANGE IN INDIVIDUAL EXPERIMENTS	63·90	—9·21	—61·40	—9·26	1	95·59	—1·14	11
	104·70	31·60	326·5	—5·63	100	100·26	—0·36	99
UNWEIGHTED MEAN	96·80	—1·40	—7·02	—7·51	77	98·23	—0·72	75

Table III. Mean values of (i) correlation coefficients between juice purity and individual impurities and (ii) the amounts of variance accounted for by any two impurities

	Correlation coefficients between juice purity and			*Variance accounted for by regression between juice purity and*		
	α-amino-N	Na	K	(Na + α-amino-N) %	(K + α-amino-N) %	(K + Na) %
Nitrogen 1968–70	—0·96	—0·90	—0·84	88	87	81
1971–72	—0·97	—0·93	—0·93	87	88	84
N/Na/FYM 1964–67	—0·89	—0·71	—0·77	75	77	63
Peat soils 1966, 1968–69	—0·71	—0·63	—0·71	55	58	56
Broom's Barn 1964–69	—0·81	—0·74	—0·71	60	64	59

Table IV. Experiments ranked in order of amount of variance accounted for by the unrestricted regression equation

Title	*Number of experiments*	*Treatments*	*Average number of replicates*	*Mean variance accounted for by unrestricted regression* %	*No. of experiments when variance accounted for is less than* 40%
Nitrogen	40	Nitrogen	5	89	1
N/Na/FYM	24	N, Na, FYM	4	78	2
Broom's Barn	8	Spacing, previous cropping, nitrogen, sowing/harvesting dates	3	70	1
Peat soils	12	N, P, K, Na	1	61	3

ments as shown in Table II. On average of the two groups of experiments, however, both equations accounted for nearly 90% of the variance.

Correlation cofficients for the relationship between each impurity and juice purity are shown in Table III. Concentrations of α-amino-nitrogen were highly correlated with juice purity. Concentrations of Na and K were also well-correlated with juice purity, but to a lesser degree than α-amino-nitrogen.

Regression equations were also determined for any two of the three impurities and juice purity. Table III shows that nearly 90% of the variance was accounted for by either regression which included α-amino-nitrogen. The regression which did not include α-amino-nitrogen accounted for less of the variance.

Nitrogen, sodium and farmyard manure, 1964–67

Tables II and III show that, overall, the variances accounted for by the two regressions were very similar and in none of the individual years was one relationship statistically superior to the other. The coefficients of K and Na again varied in magnitude and sign, but the coefficients of α-amino-nitrogen were more consistent and consequently better related to juice purity. Correlation coefficients for individual impurities and juice purity were smaller than in the

[7] *J. Agric. Sci. Camb.*, 1969, **73**, 119–124.
[8] *Expl. Husb.*, 1971, **20**, 64–68.
[9] *J. Agric. Sci. Camb.*, 1970, **74**, 147–152.
[10] *ibid.*, 1971, **76**, 261–267.
[11] *ibid.*, 1970, **75**, 223–229.

nitrogen experiments above, which may be indicative of the variable supply of nutrients from farmyard manure.

Peat soils, 1966, 1968–69

Experiments testing the four major nutrients, N, P, K and Na were conducted on eroded peat soils and the range and average results of the regression analyses are shown in Tables II and III. Both multiple regressions accounted for less variance than with the two sections above. Again there was no significant difference between the two equations. The relationships between juice purity and individual impurities showed that correlation coefficients were smaller than those obtained above.

Broom's Barn, 1967–68, 1967–69, 1964–67

The unrestrained regression equation relating the three impurities to clarified juice purity accounted for up to 87% of the variance in a previous cropping experiment but for only 27% in a time-of-sowing experiment. The restricted equation accounted for 6% less error variance, on average. The coefficients for K and Na again changed in magnitude and sign between experiments and years, while the coefficients for α-amino-nitrogen showed constancy of sign but ranged in magnitude from 1·3 to 12·6. In the previous cropping and irrigation experiments, α-amino-nitrogen was again the impurity most highly correlated to the juice purity.

Discussion

Effect of treatments, design and soil

In an attempt to explain the differing amounts of variance accounted for by the regressions, the groups of experiments are ranked in Table IV in order of percentage of variance accounted for by the unrestricted equation. The variance accounted for by the regression decreased as (i) the number of replicates decreased, (ii) the experiment included more treatments and (iii) the experiment investigated treatments which had marked effects on yield and purity such as irrigation and farmyard manure.

The relationship between juice purity and impurities appeared to be non-linear at low purity values as the smallest amount of variance accounted for by either regression was on the peat soils, from which the crop is known to take up large amounts of nitrogen, potassium and sodium. In the nitrogen experiments, however, results from three specific groups of mineral soils (sandy, calcareous and clay loam) showed that the amounts of variance accounted for on each soil type were all about 90%.

Estimating juice purity from impurities either singly or in combination

The results show that α-amino-nitrogen gave the best individual estimate of juice purity and the amounts of variance accounted for ranged from more than 90% in the nitrogen experiments to only 50% on the peat soils. The relationships between clarified juice purity and two impurities indicated that Na + α-amino-nitrogen and K + α-amino-nitrogen were superior to K + Na. This is of small benefit analytically because sodium and potassium are determined simultaneously, whilst the estimation of α-amino-acids in beet is a separate analytical operation.

Overall, the results from the 84 trials in this investigation indicated that using an unrestricted linear multiple regression equation to relate juice purity to the three major impurities in beet gives similar results to those obtained by applying the regression containing restrictions on the individual coefficients as in the manner proposed by Carruthers & Oldfield[2]. The unrestricted equation did not improve the amount of variance accounted for either substantially or significantly. It would appear that the Carruthers & Oldfield formula is still the best equation from which to estimate juice purity but we have reservations about its use in crops of low purity, in experiments with few replications and certain agronomic treatments outlined in the first part of this discussion.

Future applications

There is no argument against simply summating the three major impurities in a sample of roots after multiplying each by the coefficients proposed by Carruthers & Oldfield[3], and using the total, expressed per 100 g sugar, as a ranking method for potential beet quality as is often done in variety trials.

Table II shows average values of a_2 and m obtained in this investigation for use in the regression equation: Clarified juice purity $= a_2 - m$ (2·5 K + 3·5 N + 10·0 α-amino-N). However, our experiments show that the constant a_2 and slope m have arbitrary values varying from site to site, within and between years, which renders calculation of clarified juice purity and absolute white sugar extraction unpractical.

Summary

The concentration of sugar in beet roots is readily measured polarimetrically but the amount of white sugar extracted in the factory is determined by root juice purity which can only be measured after a tedious clarification procedure. Three of the major impurities, sodium, potassium and α-amino-nitrogen, are, however, relatively easy to measure in a root extract. Roots from fertilizer experiments at Broom's Barn and in growers' fields during 1964–72 were analysed both for juice purity and for concentrations of the three impurities. These results have been re-examined to determine how the impurities are related, individually and together, to juice purity. The α-amino-nitrogen concentration usually gave the best individual estimate of juice purity whilst summating α-amino-nitrogen and sodium or potassium concentrations improved the estimate. The three impurities were also summated in two types of regression equation, one in which the coefficients were restricted to predetermined values and one in which they were unrestricted. Both forms of the equation accounted for similar amounts of variance in individual experiments and overall, but the regression coefficients of the three impurities in the unrestricted form changed in magnitude and sign, particularly those of potassium and sodium. When such an equation was used to estimate juice purity from the three impurities, the estimate was poor in experiments with few replicates, in those on highly fertile soils and in those where certain agronomic treatments were tested.

Acknowledgments

We are grateful to British Sugar Corporation agricultural staff for help with experiments on growers' fields and to the staff of its Central Laboratory for analysis of samples from those experiments. We also thank J. H. A. Dunwoody and A. D. Todd for their advice and making the statistical analyses.

The absolute determination of sucrose in mill and refinery products by isotope dilution

Part II. Procedures for the control of errors in source preparation and counting

By N. R. PIPER
(CSR Limited, 1 O'Connell Street, Sydney, N.S.W., Australia 2000)

Introduction

PART I of this paper dealt with the isolation and purification of radioactively-labelled sucrose from mill and refinery products. Experimental errors encountered in the chemical procedures are systematic, biasing the results in one direction or another. As indicated in the earlier paper, this type of error can be overcome by effective control of the procedures.

The errors involved in source preparation and radioactive counting are largely random, that is, they affect the precision rather than the accuracy of the result. Many of the sources of these errors and their magnitudes are not mentioned in published reports on the determination of sucrose by isotope dilution. Indeed, generally the only source of random error considered is the statistical error which is inherent in the nature of radioactive decay. This statistical error, dealt with in the previous paper, is in fact the least significant of the random errors involved in radioactive counting and represents the minimum error attainable in theory. However, careful attention must be given to the control of other sources of error if this minimum error is to be approached. The main emphasis of this paper is on the identification and control of other sources of error.

Radiation Counting

Equipment

The counting equipment used in this work was a Nuclear Chicago 4334 automatic gas-flow proportional counter incorporating a windowless gas-flow detector combined with an automatic sample changer with fifty-sample capacity. The sample changer was fitted with a gas-circulation jacket to maintain the samples in a dry argon atmosphere while awaiting counting. The changer was programmable to enable each sample to be counted up to six times in each cycle for a preset number of cycles. A printer unit provided a continuous record of the sample number, counting time and number of counts registered.

A mains filter was interposed between the mains supply and the counter to reduce the effects of voltage fluctuations which might have affected the stability of the counter.

Counter plateau

The counter plateau is a characteristic of each individual detector. When the count rate of a sample is plotted against the voltage applied to the detector, a plateau should be obtained where the count rate remains relatively constant while the voltage increases. A satisfactory plateau is regarded as one which has a minimum length of 200 volts and a maximum slope of 1% per 100 volts. The counter is usually operated at an applied voltage around the middle of the plateau to minimize variations in counting efficiency with fluctuations in the voltage.

Counter efficiency

The counter efficiency (i.e. the proportion of total radioactive disintegrations detected by the counter) is critically dependent on the counter geometry (i.e. the physical relationship of the source to the detector) and it is essential that this geometry be strictly reproducible for all samples. This was achieved in this work by preparing sources in washers using dies manufactured within very fine tolerances. This ensured that the surface area of the tablets did not vary by more than $\pm 0{\cdot}06\%$. The washers containing the tablets were themselves centred in the counting trays by close-fitting adaptor rings.

The variation in distance between the surfaces of the source counting trays and the detector is dependent upon the engineering tolerances of the sample changer manufacture and cannot be reduced further.

The radiation counting efficiency of the detector is not uniform over the whole face of the detector. Because the anode is a straight wire stretched over an annular space the area of maximum counting efficiency of the detector occurs in an ellipse with its major axis corresponding to the anode wire. If the activity of the source is uniform over its surface, this non-uniformity of counter efficiency is not important. If, however, the activity of the source is not uniform over the surface, the count rate of the source will depend on the angular geometry of the source with respect to the anode wire. The factors which control the source uniformity are discussed below under "Source preparation".

Counting gas flow

The operation of a gas-flow proportional counter depends upon the ionization of the counting gas by the radiation emitted by the source. For the low-energy radiation emitted by carbon-14, a gas mixture known as "P-10" gas is used, consisting of 90% argon and 10% methane. The efficiency of the counter is influenced by the rate of flow of the gas through the detector.

To maintain a constant, unattended gas-flow rate over periods of up to 4 days, it was necessary to connect three cylinders of gas in parallel with an adaptor. A diaphragm-type regulator ("Flowstat Minor AL") was inserted between the coarse regulator on the adaptor and the counter, in series with an accurate "Rotameter" to gauge the flow rate. This arrangement enabled us to maintain any given flow rate within ± 1 cm^3.min^{-1}.

Measurements of count rate against gas flow rate through the detector showed that a variation in the flow rate of 1 cm^3.min^{-1} produced a change in effici-

Tate & Lyle Engineering– the complete agro-industrial package.

Creating a complete new sugar project requires Tate & Lyle Engineering's unique agro-industrial package of skills, know-how and hardware.

Tate & Lyle Engineering can provide invaluable help at every single stage.

Preliminary surveys and feasibility studies. Cane cultivation, land clearance and irrigation. Civil engineering. Erection and commissioning of terminals, factories, refineries or distilleries. The manufacture and installation of plant. The provision and recruitment of management. The training of staff. Advanced products and electronic controls to maximise process efficiency. A continuing advisory service to monitor the project's technical and commercial progress. The promotion of loans and investments on your behalf. The supply of goods and services on medium/long-term credit at competitive rates of interest.

No other company has Tate & Lyle Engineering's experience. No other company has Tate & Lyle Engineering's complete package. You can use the total service or select those parts of it which you most need.

TATE & LYLE ENGINEERING LTD., Cosmos House, Bromley BR2 9NA, Kent, England. Telephone: 01-464 6556. Telex: 896368 TATELYLE BROMLY. Cables: TECSERVE Bromley.

TATE + LYLE Engineering

United States: Tate & Lyle Enterprises, Inc., Suite 530, 2121, Ponce de Leon Blvd., Coral Gables, Florida 33134. Tel: (305) 448-2845, Telex: 51-9390 TATE LYLE CGBL, Cables: TATELINC.

ency of 0·04% in the count rate. This was considered to be the maximum acceptable variation. A flow rate of 60 $cm^3.min^{-1}$ was chosen to give optimum efficiency after a flow rate of 70 $cm^3.min^{-1}$ produced intermittent instability in the counter owing to vibration of the anode wire.

Effect of ambient temperature variations

Changes in the ambient temperature influenced the electronic components and thus the counting efficiency of the proportional counter. The extent of the variation was found to be about 0·67% per 10°F. Our work was carried out in an air-conditioned room where the temperature was maintained at within ±2°F. The variation in count rate due to variations in the laboratory was thus limited to ± 0·13%. The effect of this variation could only be minimized by the design of the counting programme. This is described in detail under "Counting programme".

Electronic drift

When all parameters are controlled at near-constant levels, the count rate of the source may still vary beyond the expected statistical limits. This gradual drift in count rate may be as great as ± 0·5% over periods of 10–12 hours, but normally is of the order of ± 0·2% over 2–3 hours. This drift originates within the electronic components of the counter and cannot be eliminated. The effects of the drift on counting rate can be reduced using the counting programme outlined below.

Counter dead-time

The gas proportional detector is essentially a capacitor. Radiation entering the detector ionizes the gas, allowing the capacitor to discharge. The voltage drop is registered as a "count". Before the counter can detect another pulse, it must be recharged, a process which takes a finite time. During the recharging period, radiation entering the counter will not be detected. This period is therefore called the "dead-time" of the counter and an allowance must be made for the counts not recorded during the dead-time when calculating the count rate. The true count rate of the instrument is determined using the formula

$$R = \frac{r}{1 - rT}$$

where R = true count rate (counts.sec^{-1}), r = observed count rate (counts.sec^{-1}), T = counter dead-time (sec).

The dead-time of the Nuclear Chicago counter is stated by the manufacturer to be 10 microseconds. At the level of activity used in this work (approximately 300 counts.sec^{-1}) the relative error which would be incurred if no dead-time correction were made would be 0·3%. This error can be reduced by arranging that all samples and standards have approximately the same activity, but correction of the count rate for the dead-time is the most effective way of removing errors from this source.

Counter background

When no radioactive sample is in the counter, a count rate is still detected. This "background" has four sources:

(i) Traces of radioactivity in the components of the counter (most materials contain some slight traces of radioactive isotopes).

(ii) Radioactivity in the materials of construction used in the laboratory.

(iii) Cosmic radiation.

(iv) Electronic noise.

Although various means are used to reduce these sources of background (electronic and lead shields, carefully chosen materials and electronic components) they cannot be completely eliminated. As a result, every counter has a background counting rate which, unless corrected for, will produce a positive bias in the activity calculations in the same way that dead-time produces a negative bias.

Because background is also statistical in nature, it will introduce a random error into the calculations even when it is corrected for. It is essential, therefore, that the error introduced and thus the actual background count rate shall be small relative to the sample count rate and its attendant random error.

The counter used in this work had a background of around 0·5–1·0 counts.sec^{-1}, which is small relative to the sample count rates of 300–350 counts.sec^{-1} used. The random error introduced by the background is therefore negligible.

Counting programme

The effects of electronic drift, temperature variations, gas flow rate changes and background radiation can be reduced by increasing the activity of the sources to reduce the counting times. Three factors influence the extent to which this is possible or desirable: increasing the activities slightly increases the inaccuracy of the dead-time corrections, the cost of the radioactive sucrose places an economic constraint on the amount used, and the use of higher activities can begin to increase seriously the health hazards involved in the handling of the product. The danger involved in the last arises from the increased risk of ingestion, not from the amount of external radiation.

However, errors can be effectively reduced by the use of a well-designed counting programme. The purpose of such a programme is to simulate as closely as possible the simultaneous counting of all of the standard and sample tablets under precisely the same conditions for precisely the same period of time. The practice adopted for this work was to count each tablet for six 5-minute periods, then count the next tablet in a similar manner and so on for all of the tablets being measured. At the end of the cycle, the tablets were restacked and counted again. This approach was repeated for 6 cycles, providing 36 5-minute counts on each tablet measured over a total period of 600-1000 hours depending on the number of tablets to be counted. This approach tended to smooth out counting efficiency variations over all of the tablets. In addition, every second, third or fourth tablet was a standard, ensuring that standard counts were always made within an hour or so of any sample tablet count. Nine standard tablets were used, made up of three tablets from each of three separate but identical standard preparations. Generally five tablets were made from each sample being analysed.

A typical counting sequence for three standards, S1, S2 and S3 (3 tablets of each) and four unknowns, A, B, C and D (five tablets of each) was:

A(1), S1(1), B(1), C(1), S2(1), D(1), A(2), B(2), S3(1), C(2), D(2), S1(2), A(3), B(3), S2(2), C(3), D(3), S3(2), A(4), B(4), S1(3), C(4), D(4), A(5), S2(3), B(5), C(5), S3(3), D(5).

Counting precision

The efficiency with which drift effects were removed by the programme was tested using a static source technique. In this a single source was counted continuously for 5-minute periods until sufficient counts had been accumulated to represent a theoretical counting programme in which two unknowns of four tablets each and three standards of three tablets each were counted over six cycles. The theoretical counting programme was:

S1(1), A(1), S2(1), B(1), S3(1), A(2), S1(2), B(2), S2(2), A(3), S3(2), B(3), S1(3), A(4), S2(3), B(4), S3(3).

Under these conditions, all three standards and two samples should give sucrose results in the range 100·0% ± 0·13% for each of their tablets, while the average sucrose result of each set of standard tablets should be in the range 100·0% ± 0·09% and that for each sample group in the range 100·0 ± 0·07%, all errors being quoted at the 95% confidence level.

The actual results are shown in Table I. Ten of the individual tablet values lay outside the 95% confidence limits for the expected value of a single tablet. It is therefore apparent that the effects of counter drift are not entirely eliminated at this single tablet level. However, all but one of the group averages lay within the 95% limits of the group average, showing that the programme is reasonably effective in eliminating drift effects on group averages. Three tablets can be regarded as a minimum for which accurate counting results can be expected. Normal practice in our work has been to use five tablets for each sample, where practicable. The theoretical absolute precision using five tablets is ± 0·11% at the 95% confidence level for samples of this activity.

Table I. Effectiveness of counting programme on the reduction of counter efficiency variations

	Individual tablet results				
Sample	*Tablet* 1	*Tablet* 2	*Tablet* 3	*Tablet* 4	*Average*
Standard 1	100·12	100·32	99·75	—	100·06
Standard 2	99·81	100·32	99·78	—	99·97
Standard 3	100·16	99·92	99·82	—	99·97
Sample 1	99·88	100·20	100·12	99·88	100·02
Sample 2	100·11	100·22	100·07	100·19	100·15
Average of Standards 1, 2 and 3					100·00
Average of all tablets					100·04

Source Preparation

The efficiency of counting of a source will depend upon the nature of the source. Factors such as area, density and thickness of the tablet, grain size and moisture content of the sucrose, and surface irregularities will all affect the apparent count rate of a sample. To ensure accuracy and precision in all measurements, careful control must be kept on all of the variables mentioned above.

Source particle size and moisture content

The grain size of the sucrose being analysed will determine in large measure the quality of the tablet surface. The optimum surface for counting is one that is perfectly smooth. In this work, all sugar to be counted was ground very finely with a mortar and pestle until no trace of granularity could be detected with a spatula. This material proved fine enough to give a glass-smooth surface suitable for counting.

Moisture in the sucrose will act in precisely the same way as any other impurity, serving to dilute the activity in proportion to its weight contribution to the tablet. After crushing, the sugar was dried in a vacuum oven at 50 ± 2°C for sixteen hours. Samples were kept dry in desiccators after removal from the oven and, even after pressing into tablets, the tablets were kept in a desiccator until use. Dry argon gas was circulated through the sample changer to prevent uptake of moisture during the actual counting programme.

Source area

Since the measured activity of the source is proportional to its geometrical relationship to the detector, it is essential that the tablets not only be reproducibly placed beneath the detector, but that the surface area of all tablets be identical. A variation of ± 0·0005 inches in a tablet radius of 0·5 inches could give rise to a variation in the counting rate of 0·1%.

Sample tablets are formed in the die illustrated in Figure 1. The surface area of the tablet is determined by the internal diameter of the washer. The internal diameter of the rings used in this work was 1·0025 ± 0·0003 inches, producing a maximum error from this source in the determinations of ± 0·06%. The washers have been made from a high-quality steel which is proof against rusting, tarnishing and permanent distortion under pressure.

Source thickness

In this work, we have employed tablets of "infinite depth", i.e. a source thickness at which, owing to self-absorption by the sample, no further increase in activity is detected when the sample thickness is increased.

Sibley *et al.*[1] state that, for a one-inch diameter tablet, a weight of 0·6 g sucrose provides a tablet of infinite depth. Whilst our results agreed with this, we found that the minimum permissible weight of 0·6 g gave poor quality tablets in which ridging frequently occurred. We therefore chose a weight of 0·90 ± 0·01 g sucrose, which provides superior quality tablets.

Using a constant pressure during formation, we examined the counting rates of samples whose weights varied from 0·85 g to 0·95 g. An analysis of variance on the counting results confirmed that there was no significant difference between the tablets.

[1] *Anal. Chem.*, 1965, **37**, 1701.

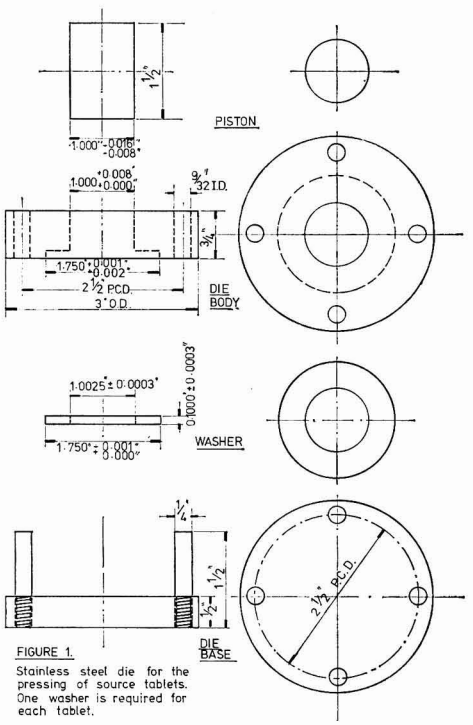


FIGURE 1.
Stainless steel die for the pressing of source tablets. One washer is required for each tablet.

Fig. 1

Forming the tablets

All tablets were formed in the die using a hand-operated hydraulic press. The crushed and dried sucrose powder was fairly evenly distributed over the area of the die before insertion of the ram. This was done to prevent the occurrence of faults and surface activity variations across the face of the tablet as a result of compaction density differences across the tablet.

A pressure of 18,000 psi was applied for 60 seconds to form the tablets. Tests showed that variations in the applied pressure of $\pm$ 2½% and variations in the time for which the pressure was applied of $\pm$ 25% did not affect the counting rate of the tablets. Tablets created under these conditions were robust and generally withstood a good deal of handling.

Tablet quality and uniformity

The lower face of the tablet, i.e. the face formed against the die base, was used as the counting face of the tablet. All tablets were inspected visually after pressing. Any showing surface faults such as ridging or pitting were crushed and re-pressed. All loose dust was blown from the surface using a short blast of compressed dry air.

Tests on 24 identical tablets produced a standard deviation of 0·25% of the individual sample count rates about the mean. Assuming that counter variations were equal to those obtained during the static source determination of counter precision, i.e. a standard deviation of 0·19%, the contribution of variations between sources to the experimental standard deviation was a maximum of 0·16%. Since there will be some variation in counting efficiency owing to minor variations in the sample changer planchet holders, the tablet variation is probably considerably less.

PRECISION OF SOURCE COUNTING

From a consideration of the above variables, and based on experiment, the practical limitation on the variability of count rate results arising from source preparation and counting procedures appears to be a standard deviation of 0·25%. Calculation of the sucrose content from the ratio of sample to standard rates would thus have an expected standard deviation of 0·35%. The 95% confidence limits on the mean sucrose value based on n sample tablets would thus be $\pm (2 \times 0{\cdot}35\%)/\sqrt{n}$. For five tablets, this would give 95% confidence limits of $\pm$ 0·3% relative.

Based on counting statistics alone where the 95% confidence limits on a single set of 4 million counts was $\pm$ 0·1%, the theoretical precision of a single determination against a standard was $\pm$ 0·07% relative (95% confidence limits on 5 tablets). The practical limits under the same conditions were $\pm$ 0·3% relative. There was no reasonable adjustment that could be made to the variables to reduce this figure further. Thus 0·3% relative should be considered the best precision obtainable for a single determination using 5 tablets.

Errors arising out of the chemical separation and purification will be additional to this.

RECOMMENDED SOURCE PREPARATION AND COUNTING PROCEDURE

Source preparation

The following briefly describes the procedure used in the analysis of samples for this paper.

(i) Weigh 0·90 $\pm$ 0·01 g recovered sucrose onto a watch glass.

(ii) Transfer the sucrose to the assembled die (see above) with the aid of a camel-hair brush and spatula, making sure that the powder is as evenly distributed as possible over the area of the base of the die.

(iii) Insert the die piston and apply a pressure of 18,000 $\pm$ 400 psi to the piston for 60 $\pm$ 5 seconds using a hydraulic press. This produces a hard tablet of about one inch in diameter and about 0·05 inches thick set in a washer. Crush and re-press any tablets which are ridged or pitted. Blow off loose dust with a blast of compressed dry air.

(iv) Store the tablets in a desiccator until ready for counting. Five tablets should be prepared, if possible, from each sample replicate for counting.

Source counting

(i) Load the tablets into counting trays using adaptor rings to centralize the tablet washers.

(ii) Load the sources into the sample changer in a suitable sequence of sample and standard tablets, such that each sample and standard is fairly evenly distributed over the entire sequence.

(iii) Count each sample in turn for six 5-minute periods until all sources have been counted. Repeat this for a total of six cycles. This will produce a total of three hours counting for each source, providing approximately 4 million counts.

Calculation of sucrose content

The calculation of results is normally done, in this company, by means of a computer programme. The following 5 points describe the manual procedure which the computer programme duplicates:

(i) Calculate the count rate, r, in counts.sec^{-1} for each source counted

$$r = \frac{\text{Total no. of counts recorded for sample over all counting periods}}{\text{Total counting time in seconds (normally 10,800 secs)}}$$

(ii) Correct each source count rate for dead-time

$$R_D = \frac{r}{1 - rT} \text{ counts.sec}^{-1}$$

where T is the dead-time of the counter (for our counter $= 10^{-5}$ secs).

(iii) Correct each source count rate for background counting rate (b counts.sec^{-1}). (Background rate is found by counting an empty source tray for an extended period of time.)

$$R = R_D - b \text{ counts.sec}^{-1}$$

(iv) Calculate the average count rate for each of the three standards from the corrected count rates of the standard's three tablets

$$S_t = \frac{R\text{ (1st tablet)} + R\text{ (2nd tablet)} + R\text{ (3rd tablet)}}{3}$$

counts.sec^{-1}.

(v) For each sample source, calculate the sucrose content against each of the three standards in turn, using the formula

$$\%\, S_i = \frac{100\, W_t}{W_m}\left(\frac{\gamma . S_t}{S_f} - 1\right)$$

where W_t = weight of active sucrose added to sample, W_m = weight of sample, S_t = count rate of standard [from (iv)], S_f = count rate of sample source [from (iii)], γ = dilution ratio of the standard $= \frac{W_{12} + W_{14}}{W_{14}}$ where W_{12}, W_{14} are the weights of inactive and active sucrose, respectively, in the counting standard.

(vi) Calculate the average sucrose content of each sample tablet from the results obtained against the three standards

$$\text{Av. Sucrose (\%)} = \frac{\%S_1 + \%S_2 + \%S_3}{3}$$

(vii) Calculate the average sucrose content of each sample replicate from the results obtained in (vi) from each of the tablets

$$\text{Mean } \bar{x}\% \text{ sucrose, } = \frac{\Sigma x_i}{n}$$

where x_i is the sum of all of the tablet sucrose values, n is the number of tablets (generally five).

The standard deviation of the sample results is given by

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n-1} - (\bar{x})^2}$$

where x_i^2 is the sum of the squares of the sucrose results for each tablet.

The 95% confidence limits on the single analysis are thus $\pm \frac{2\sigma}{\sqrt{n}}$ $\left(\text{more precisely } \pm \frac{1{\cdot}96\sigma}{\sqrt{n}}\right)$

The limits are based only on the counting statistics. The results between replicates would provide an estimate of the precision of the chemical procedure.

(viii) For mill mud, the actual sucrose content is given by

$$\%\text{ Sucrose} = \frac{S.W_m - 100A}{W_m}$$

where S = sucrose content determined in the previous step, W_m = weight of sample taken for analysis, A = weight of pure sucrose added to sample.

Precision of the Method

Earlier in this part of the paper, the experimental standard deviation of the results, arising out of the counting techniques, was found to be 0·35% absolute.

Analysis of 15 raw sugar samples in duplicate produced an average standard deviation in the results of 0·43% absolute. This implies that the standard deviation of the results arising out of the chemical separation alone was 0·25% absolute.

The average value for the 95% confidence limits on the mean results from five tablets of each of two duplicate analyses is therefore expected to be $\pm$ 0·27% absolute. This degree of precision was borne out by the analytical results from other sugar products.

Results of Analysis of Mill and Refinery Products

A range of samples representative of mill and refinery products were analysed in duplicate by the recommended procedure. The results are shown in Tables II and III for cane mill and refinery products, respectively. The results of single-pol and double-pol determinations of sucrose on the same samples are also shown for comparison. The double polarization method used was based on the Jackson & Gillis Method 2.

Table II. Typical results for some cane mill products

Sample	Sucrose content, %*			Difference	
	Single-Pol	Double-Pol	Isotope dilution	SP-ID	DP-ID
Mixed Juice A	14·5 ± 0·1	—	14·6 ± 0·0	0·1	—
,, ,, B	16·3 ± 0·0	—	16·1 ± 0·0	0·2	—
,, ,, C	11·3 ± 0·0	—	11·2 ± 0·0	0·1	—
,, ,, D	19·6 ± 0·0	—	19·2 ± 0·1	0·4	—
Mill Liquor A	61·7 ± 0·1	60·9 ± 0·2	63·1 ± 0·2	—1·4	—2·2
,, ,, B	57·4 ± 0·0	56·3 ± 0·1	57·2 ± 0·2	0·2	—0·9
,, ,, C	59·9 ± 0·1	59·7 ± 0·2	60·3 ± 0·1	—0·4	—0·6
Raw Sugar A	98·52 ± 0·12†	—	98·38 ± 0·21	0·14	—
,, ,, B	98·81 ± 0·12	—	99·10 ± 0·32	—0·29	—
,, ,, C	98·83 ± 0·12	—	99·23 ± 0·21	—0·40	—
Mill Mud A‡	3·0	—	2·86	0·14	—
,, ,, B	2·1	—	2·05	0·05	—
,, ,, C	1·2	—	1·13	0·07	—

* Errors quoted are the 95% Confidence Limits on the Mean.
† Results are based on a single determination. Limits are the standard limits applicable for the procedure in this laboratory.
‡ At this sucrose level, precision was ignored.

Table III. Typical results for some refinery products

Sample	Sucrose content, %*			Difference	
	Single-Pol	*Double-Pol*	*Isotope dilution*	*SP-ID*	*DP-ID*
Raw Washings A	62·2 ± 0·2	61·6 ± 0·3	61·3 ± 0·1	0·9	—0·2
,, ,, B	62·1 ± 0·1	61·8 ± 0·2	62·1 ± 0·1	0·0	—0·3
,, ,, C	61·9 ± 0·2	62·2 ± 0·3	62·9 ± 0·2	—1·0	—0·7
"ABO" Syrup A	45·4 ± 0·1	44·4 ± 0·1	44·8 ± 0·1	0·6	—0·4
,, ,, B	59·2 ± 0·1	58·2 ± 0·0	58·9 ± 0·1	0·3	—0·7
"BBO" Syrup A	36·1 ± 0·1	36·3 ± 0·1	36·4 ± 0·1	—0·3	—0·1
,, ,, B	49·7 ± 0·1	49·7 ± 0·1	50·2 ± 0·1	—0·5	—0·5
"CBO" Syrup A	42·0 ± 0·2	39·8 ± 0·3	39·5 ± 0·1	2·5	0·3
,, ,, B	31·9 ± 0·3	33·0 ± 0·3	30·8 ± 0·1	1·1	2·2
No. 3 Sugar A	91·6 ± 0·1	—	91·4 ± 0·1	0·2	—
,, ,, B	95·7 ± 0·0	—	95·7 ± 0·2	0·0	—
Brewers Liquid Sugar A	63·9 ± 0·0	—	63·5 ± 0·0	0·4	—
,, ,, B	64·9 ± 0·0	—	65·2 ± 0·2	—0·3	—
Golden Syrup A	24·7 ± 0·1	—	24·0 ± 0·1	0·7	—
,, ,, B	28·7 ± 0·1	—	27·9 ± 0·1	0·8	—
Treacle A	23·5 ± 0·2	—	23·0 ± 0·0	0·5	—
,, B	27·4 ± 0·1	—	27·2 ± 0·0	0·2	—
Fine Liquid Invert	—	18·9 ± 0·1	18·4 ± 0·0	—	0·5
Invert Blend	—	27·8 ± 0·1	27·9 ± 0·0	—	0·1

* Errors quoted are the 95% Confidence Limits on the Mean.

The most significant aspect of these results is the generally good precision of the isotope dilution method relative to the polarization methods. As expected, the precision of isotope dilution is inadequate for raw sugars and similar high-sucrose products. However, for low-sucrose products, the absolute precision of the method often surpasses that of the normal polarimetric procedures.

As in other published comparisons between polarization results and isotope dilution results, double polarization consistently overestimated the sucrose content of materials such as molasses, treacle, golden syrup and invert sugars. Contrary to the results obtained by BRUIJN & CARREYET[2] we found that sucrose in first expressed juices and mixed juices generally was not underestimated by single polarization. Analysis of a large number of such samples (not reported in the Table) gave a nil average difference between pol and isotope dilution results although there were significant variations between results in individual cases. However, similar analyses of mill liquors confirmed that sucrose in these was underestimated by averages of 0·5% relative and 0·15% relative by single-pol and double-pol methods respectively.

CONCLUSION

By careful control of the chemical and counting variables the procedure achieves a high degree of accuracy in the determination of sucrose, coupled with a typical precision of ± 0·4% relative expressed as the 95% confidence limits on a single determination or ± 0·3% based on duplicate analyses. This precision makes the method unsuitable for high precision work on high-sucrose products. For sucrose concentrations below about 65%, the procedure effectively fulfils the requirements of a reference method.

ACKNOWLEDGEMENTS

Some of the early experimental work reported here and the design of the tablet die were done by Mr. A. J. DARBY.

I would like to make grateful acknowledgement to CSR Limited for their permission to publish the results of this work.

SUMMARY

The suitability of the isotope dilution technique as an absolute method for the determination of sucrose in mill and refinery products depends on a number of variables which require strict control, both in the purification chemistry and in the preparation and counting of the radioactive sources. Details of the chemical procedure were published in the first part of this paper. This second part of the paper is concerned with source preparation and counting and the minimization of errors in these procedures. The control of changes in counter efficiency due to voltage fluctuations, detector irregularities, counting gas flow, ambient temperature variations, and electronic drift are discussed, along with the effects of dead-time and background counting rate. Factors involved in sample preparation include particle size and moisture content of the sucrose, source area and thickness and tablet making procedures.

The 95% confidence limits on the mean sucrose concentration determined on duplicate samples, using five sources prepared from each, is reported to be 0·3% relative. Variations in the factors affecting counting provide the major contribution to the precision figure.

Typical analytical results are given for cane mill and refinery products.

Poland sugar beet crop, 1976[3].—According to the Central Statistics Office in Warsaw, sugar beet production in 1976 was 16·3% below the production target of 17 million tons. This implies a crop not more than 14·2 million tons in 1976. Owing to the smaller crop, sugar production declined by about 6% against 1975, which gives a figure for calendar year production in 1976 of not more than 1,597,000 metric tons, white value. The beet production target for 1977 was recently set at 18·6 million tons.

* * *

Bagasse paper pulp factory in Venezuela[4].—A new company, Guanare Papelera, is to instal a pulp mill in Guanare at a cost of some 376 million bolívares (about $8·5 million); the mill will manufacture paper pulp from bagasse produced by the sugar factory at Río Guanare.

* * *

New Cuban sugar factories[5].—Preparatory work for the erection of two new sugar factories is reported to have started in Cuba, one each in the provinces of Cienfuegos and Camagüey. Cuba is also to modernize 21 existing factories at a total cost of 110 million pesos.

---

[1] *Proc. 47th Congr. S. African Sugar Tech. Assoc.*, 1973, 44–48.
[2] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (6), 8.
[3] *Bank of London & S. America Review*, 1977, **11**, 170.
[4] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (8), 15.

Sugar cane agriculture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

A water table study on an Everglades peat soil: effects on sugar cane and on soil subsidence. H. J. ANDREIS. *Sugar J.*, 1976, **39,** (6), 8–12.—Two cane varieties, which perform well in low-mineral organic soil in relatively cold areas and are reasonably tolerant to wet soil conditions, were planted in adjacent 40-acre fields, the soil of which had a pH of 5·7, an organic matter content of 87·5% and a mineral content of 12·5%, as well as given P and K contents. The water table was maintained at 16–20 inches below the soil surface in one field and 36–40 inches below the surface in the other during the 4-year period 1966–69. The effects of water table height on plant and 1st, 2nd and 3rd ratoon cane and on soil subsidence were determined. Results showed that the average 4-year % sugar yield was not significantly affected by water table level for either variety, both varieties giving slightly higher yields with the higher water table. In all cases, CI 54–336 gave higher values than CI 54–378 in the same crop. Water table level did not significantly affect the average cane yield of either variety; 2nd and 3rd ratoon yields of both varieties were higher with the lower water table. The average sugar yield (tons.acre^{-1}) was also unaffected by water table level, although, as in the case of % sugar yield and cane yield, differences did occur between the varieties and as a function of water table level, sometimes the lower level giving the better results and sometimes the higher level being more beneficial. Both varieties appeared to be relatively water-tolerant. Total root weight was greater with the higher water table. The average yearly subsidence was 1·41 inches with the lower water table and 0·60 inches with the higher level, but was lower in both cases where non-use of field equipment minimized compaction. The bulk density under low water table conditions was considerably greater in the top 4 inches of soil than in other layers investigated down to 18 inches, indicating a greater compaction of the dryer soil.

* * *

Water use by sugar cane. G. D. THOMPSON. *S. African Sugar J.*, 1976, **60,** 593–600, 627–635.—Data obtained during the last 20 years and reported in the literature on various aspects of cane water utilization are discussed and their application to South African conditions considered. The subject is examined under the headings of potential evapotranspiration, soil water availability, actual evapotranspiration and the relationship between water utilization and cane yield. Loss of water by evaporation in a field of cane is divided into five stages, viz. losses from fallow land, newly planted land and ratoon fields before leaf emergence of the new crop; losses from partially canopied cane; losses from fully canopied, erect cane; losses from lodged cane; and losses from fields of cane being dried off before harvest (when the cane is deliberately subjected to moisture stress). The value of a soil moisture "profit-and-loss" account for purposes of irrigation scheduling is demonstrated. Factors affecting soil water availability are examined; they include soil depth, moisture release characteristics and hydraulic and capillary conductivity, the depth of the cane roots and density and efficiency of absorbing roots in each soil layer, as well as the evaporative demand of the atmosphere. The importance of a "realistic" assessment of water loss by evapotranspiration is discussed and criteria suggested for prediction of cane water consumptive use. The mathematical representation of the relationship between cane yield and water use is not only of value in predicting and assessing crop yields but is also useful for establishing, in broad terms, whether an irrigated crop should be produced intensively on a small area or extensively on a large area. Where rainfall is the significant factor and water availability is more limiting than the land area factor, extensive cultivation will be more profitable, whereas where rainfall is of neglible importance in the programming of irrigation, significant deviations from the linearity of the yield:water use relationship become more important and the practical advantages of intensive cultivation may outweigh the advantage of greater yield from extensive production.

* * *

Better knowledge of fertilizers needed. J. V. WILKINS. *Producers' Rev.*, 1976, **66,** (11), 11–12.—The author, managing director of Consolidated Fertilizers Ltd., gives some advice on optimum fertilizer use on the basis of a survey conducted on 90 farms in the Bundaberg district of Queensland. It is pointed out that, while most of the farmers appreciated the role of fertilizers in obtaining maximum yields, some growers seemed to be unaware of the importance of a correct nutrient balance from both economic and agricultural viewpoints. It is stressed that the amount of fertilizer to apply is not the only factor to consider in aiming at high sugar yields, that the price per kg of nutrient is more important than the price per metric ton of fertilizer, and that the quantities and balances of N, P and K to apply should be checked, since the needs will vary between plant and ratoon crops, the latter requiring more N and K than does plant cane, which requires more P; N rates should generally be higher than K rates for both plant and ratoon cane. Mention is also made of the importance of soil testing.

* * *

Erosion threatens Mackay cane lands. M. SALLOWAY. *Producers' Rev.*, 1976, **66,** (11), 31.—A soil conservationist in a government department points to the serious and widespread erosion taking place on cane land in the Mackay area of Queensland. It is stated that the affected area is increasing and that there

would be risk to the stability of the industry if the situation continued. With expansion of cane growing, much of the new land is unsuitable because of steep gradients or because of the limitations placed on erosion control by the shape of the land. The establishment of guidelines for selection of suitable cane land is suggested. A maximum tolerable erosion rate of 12·5 metric tons of soil per ha (or 2 mm depth) per year is the rate of soil formation by weathering of rock; if the soil loss is greater than this, the area is being degraded. However, when rows are washed out with ruts about 9 inches wide and 8 inches deep, which is not unusual, the soil loss is 37 times the maximum permissible. The loss of topsoil causes a reduction in plant growth, a possible increase in fertilizer requirements, increase in working costs and hence a drop in returns. Cane land in the area is classified according to the gradient, showing that 40% needs some soil conservation measure, whereas to date only just over 2% has been so treated.

* * *

Side transfer system moves cane fast. ANON. *Producers' Rev.*, 1976, **66,** (11), 55.—Photographs demonstrate the system used to transfer 5-ton "Canetainer" bins to rail trucks from vehicles operating a shuttle service between harvesters and the sidings. Similar to that described earlier for 20-ton bins[1], the system is used to load bins onto three trains a day which haul the cane to Plane Creek factory. The "Freighter Side Transfer" system is also used for cane supplied to Mossman factory.

* * *

Transport on the farm. ANON. *Producers' Rev.*, 1976, **66,** (11), 45.—Cane harvesting and transport in Queensland should be considered from the standpoint of the industry as a whole and not by factory or grower organizations in isolation so as to ensure that results of research gain acceptance by the entire industry. There is therefore need for liaison between groups in order to avoid duplication of work and ensure that any research takes account of all factors and not just those of importance to a limited section. It is expected that the trend towards large bulk cane carriers built on special-purpose self-propelled vehicles with tyre ground pressure kept to a minimum will continue. Suitable transport systems are needed which can operate under wet conditions without causing soil compaction and damage to stools; although use of tracks has overcome some problems by spreading he load over a greater area and not allowing the vehicles to become bogged down, the units are expensive and relatively lacking in versatility. The use of large balloon tyres or aircraft tyres in tandem and of hydraulically-driven trailers has been moderately successful. The need is for a transport system which will effectively cope with large volumes of cane with a minimum of labour while keeping the costs of the haul-out units to "reasonable" levels. The value of the double-bin roll-on, roll-off system developed in the Burdekin area with large volumes of cane is questioned; the simple tractor-trailer combination has been modified to give greater manoeuvrability and permit handling of greater loads. While the use of special-purpose truck-type vehicles and modified commercial trucks is becoming accepted, particularly where longer carts are involved, the vehicles are limited to the capacity of the bins or multiples of bins they can carry, although the truck can carry loads over greater distances quicker than can the tractor/trailer combination. Problems associated with unloading of cane from bulk-bin infield transport onto rail trucks are briefly discussed. A conventional triple roll-on, roll-off arrangement has a quicker turn-round than a 16-ton bulk-bin unit. Side-tipping units are being used on an increasing scale, although the maximum capacity of commercially available units is 6 metric tons of cane.

* * *

Effect of lodging on the yield and juice quality of sugar cane ratoon. R. V. S. MATHURIA and M. L. AGARWAL. *Sugar News* (India), 1976, **8,** (6), 13–15.—Observations of the effects of lodging were made after a ratoon crop was exposed to heavy rain and high wind just before harvesting. It was found that lodging reduced cane yield and juice quality as well as sugar content; semi-lodged cane was superior to erect cane in terms of the average weight of 10 stalks and their juice as well as juice extraction because of regrowth.

* * *

Preliminary studies on the control of shoot borers. B. N. PANDEY, R. DAYAL and A. SINGH. *Sugar News* (India), 1976, **8,** (6), 17–18.—The effects on shoot borer mortality of 11 insecticides injected into the cavity left by removing the dead hearts from a crop of ratoon cane were evaluated and the results tabulated. These showed that maximum mortality (95·6%) was obtained with "Endrin 20%" injected as a 0·1% emulsion, closely followed by "Ekalux 25%" and "Birlane 24%". The least effective ("Sevin B.P.50%") still killed 75·8% of the borers, compared with only 6·5% mortality without treatment.

* * *

Studies on the effect of different levels of potash on the yield and juice quality of sugar cane. B. N. VERMA and J. N. SINGH. *Sugar News* (India), 1976, **8,** (6), 19–22. Different amounts of muriate of potash were applied in addition to basal dressings of ammonium sulphate and superphosphate in pot and field tests. Increase in the K application rate was accompanied by increase in cane yield, juice quality and sugar content up to 60 ppm, while further increase to 80 ppm gave little further improvement.

* * *

Farm practices to increase the PS/TC of milled canes. L. M. ARCEO. *Sugarland* (Philippines), 1976, **13,** (3), 6–7, 29–30.—The author examines the problem of decrease in sugar yield per ton of cane and discusses means by which it can be raised, viz. choice of suitable cane variety for the area, proper fertilization, use of hand refractometers to evaluate cane ripeness, reduction of trash content and removal of tops, termination of irrigation towards harvest time as an aid to cane maturation, and use of chemical ripeners.

* * *

Basic crosses for sugar cane improvement in Louisiana. P. H. DUNCKELMAN. *Sugar Bull.*, 1976, **55,** (4), 10–13. A report is presented on the basic crossing programme at Houma, Louisiana, in 1975 in which 118 crosses yielded 277,350 seeds. Included were a number of clones of *Saccharum officinarum*, 13 of which were induced to flower by artificial daylength control. Other groups of crosses included those in which one or both parents were frost-resistant, while basic

[1] *I.S.J.*, 1976, **78,** 336.

breeding stocks derived from *S. spontaneum* included borer-resistant clones as well as some resistant to mosaic, red rot and smut. The rest of the crosses were made with new US breeding clones and commercial interspecific hybrids selected for a number of characteristics.

* * *

Basis for the use of insecticide in management of populations of the sugar cane borer *Diatraea saccharalis* (F.) in São Paulo State, Brazil. W. H. LONG, J. M. M. WALDER, R. B. SGRILLO and F. M. WIENDL. *Sugar y Azúcar*, 1976, **71**, (12), 25–34; 1977, **72**, (2), 42. Spraying with "Gusathion" at the rate of 840 g a.i. per ha twice a month reduced the amount of cane bored by *D. saccharalis* by about 82%, giving 10% increase in the weight of cane compared with the untreated controls. On the other hand, the untreated plots showed only 8·5–9·4% boring and the treated cane suffered a 9% reduction in sugar content, so that treatment gave no significant improvement in sugar yield. "Heptachlor" granules applied on the soil surface at the rate of 2·25 kg a.i. per ha on three dates spread over an approximate 12-month period gave almost the same results as did lack of treatment. However, in another trial to determine the season and growth stage of the cane at which the crop is most susceptible to borer attack, application of "Gusathion", when infestation of cane stools by exposed larvae exceeded 5%, reduced the incidence of boring and increased both cane and sugar yields. The maximum sugar yield of 14·45 tons.ha^{-1} was obtained with application in December–January; this compared with 13·13 tons.ha^{-1} when continuous treatment was used (as in the first experiment) and with 12·77 tons.ha^{-1} in the untreated controls. The same pattern applied to cane yield, while continuous protection provided a smaller percentage of joints bored than did December–January treatment and no treatment, but also gave a lower sugar content than with the December–January treatment and controls. Treatment caused a significant reduction in the numbers of predaceous arthropods, "Heptachlor" being much worse in this regard than was "Gusathion". Claims made that insecticides have a stimulating effect on cane growth and various points raised in objections to the use of insecticides to control *D. saccharalis* are examined. The benefits of establishing a rational programme of control are discussed.

* * *

Development of sugar cane agriculture in Australia. G. GALVEZ. *ATAC*, 1976, **35**, (4), 12–23 (*Spanish*). A survey is presented of the Australian cane growing area with notes on soils, fertilization and drainage, irrigation, disease control, varieties and cane breeding and agricultural and factory research.

* * *

A newly-developed Cuban cane variety, TY 70-5. ANON. *ATAC*, 1976, **35**, (4), 24–25 (*Spanish*).—The new variety, Tayebito or TY 70-5, is a cross between Cuba 8751 and Jaronú 60-5 and has been grown in commercial quantities in Camagüey, initial factory trials having been arranged at the experimental factory Pablo Noriega. At 10 months of age a yield of 75,700 arrobas per caballería was obtained (64·9 metric tons.ha^{-1}) with a sucrose content of 14·23%. Fibre content is low but juice clarification presented no problems.

A comparative study of 56 sugar cane varieties. E. LOPEZ and A. DAVILA. *ATAC*, 1976, **35**, (4) 30–54 (*Spanish*).—A total of 56 varieties were examined in three groups, to determine those of greatest productivity under a set of standard conditions of soil cultivation, age at harvest, etc. The best in terms of tons of cane per hectare was My 5450, while that in terms of tons of sugar per hectare was Ja 60-5.

* * *

Integrated pest control surges ahead. R. P. HUMBERT. *World Farming*, 1976, **18**, (12), 20–21, 40.—For many years the cane borers *Diatraea saccharalis* and *D. magnifactella* have been kept in check by natural predators in the region of Ingenio Tamazula, Mexico. In the last 10 years there has been an increase in the numbers of yellow aphids in the region, but chemical control was satisfactory until 1973, when the pest spread widely throughout the region relatively quickly, necessitating aerial application of insecticide over some 7295 ha. The result was destruction of most of the borer predators, leading to a drastic drop in cane and sugar yield. An average 20% of cane internodes was infested with borers in 1973/74. Studies elsewhere in Mexico showed an average loss of 300 g of sugar per metric ton of cane for every 1% of internodes infested; this combined with a loss of 91,000 tons of cane to give a total sugar loss of nearly 15,000 tons from 900,000 tons of cane. Aerial spraying against aphids was suspended and tests carried out to find a suitable insecticide which could be applied locally by knapsack where small areas were affected. "Pirimor" at 250 g a.i. per ha killed all yellow aphids within 36 hours. In addition, ladybirds were released. For borer control, 100 million parasites of the *Trichogramma* genus were released, resulting in a marked reduction in internode infestation (to 6·8%). Juice quality in 1974/75 was considerably improved, but cane yields were still low.

* * *

Response of promising varieties to nitrogen application in Tamil Nadu. T. SUGUMARAN, K. V. DANIL and M. S. KUMAR. *Indian Sugar*, 1976, **26**, 299–301. Variety × nitrogen trials are reported, in which 250 kg N per ha was found to be the economically optimum of the three doses tested, although 300 kg.ha^{-1} gave the maximum mean cane yield for the four varieties and the same mean sugar content as did non-application of N.

* * *

Frost resistance in sugar cane leaves. Biochemical studies of some correlated characteristics. G. SINGH and S. SINGH. *Sugar y Azúcar*, 1977, **72**, (1), 29–37. Investigations on pot-grown cane of seven varieties exposed to low temperature (on some nights below 0°C) showed that the ribonucleic acid content of the leaves, sampled at an age of 4 months, was a suitable indicator of frost resistance; it rose with fall in the percentage of leaf injury as a result of frost. Six of the varieties were also field-grown and leaves sampled for total, reducing and non-reducing soluble sugars in December (before the onset of frosts) and in January (during the frosty period). Tabulated values show an increase in the reducing sugar contents in all varieties in January by comparison with relatively low contents in December. Non-reducing sugars increased in four varieties but fell in the other two, while the total sugar content in January was also higher than in December in four varieties. It is concluded that the increase is

mainly a result of the increase in non-reducing sugars in frost-resistant varieties, while fall in non-reducing sugars is indicative of frost susceptibility. A high concentration of total sugars in frost-resistant varieties is thought to be correlated with increase in the cell sap concentration which would help prevent freezing by lowering the freezing point in the cells.

* * *

The climatological basis for consumptive use of water by sugar cane. R. G. SHARMA. *Indian Sugar*, 1976, **26**, 303–310.—After a brief review of methods used to determine cane consumptive use of water, experiments are reported in which the consumptive use was determined over a 3-year period and the data compared with values calculated with the BLANEY-GRIDDLE formula. After substitution of monthly consumptive use coefficients established under the local conditions, the formula was found to give values in close agreement with true values for each month of the year and is thus recommended for use in irrigation scheduling.

* * *

Midrib infection of sugar cane by *Colletotrichum falcatum* **Went.** G. R. SINGH. *Indian Sugar*, 1976, **26**, 311–318.—Investigations were conducted on leaf midribs from two cane varieties after contact with a spore suspension of *C. falcatum* (the causal agent of the imperfect or asexual stage of red rot) to establish whether the pathogen can cause infection without showing any visible symptoms. Both injured and healthy midribs were exposed to infection after treatment with mercuric chloride, and counts were made of the fungal colonies after 1–5 days' contact. (Controls were treated with sterilized water only.) Results showed that the pathogen infected both injured and uninjured midribs, while apparently healthy leaves revealed the presence of the disease in a latent form. Microscopic examination revealed spore germination and formation of appressoria on the midrib surfaces, but in some cases the infection thread from the appressorium was seen to penetrate the waxy cuticle and the epidermal cells of the upper midrib without reddening of the tissues, reddened tissues being found only when a lesion had formed. All of the pieces from injured midribs yielded fungus, while the maximum isolation (after 4–5 days) from uninjured midribs was 93–94%. Pinpoint lesions appeared on the uninjured midribs after 15 days but did not increase in size even within 2 months.

* * *

CoS 633—a new promising sugar cane variety for waterlogged conditions in Uttar Pradesh. B. K. MATHUR, N. P. SINGH and A. K. SAXENA. *Indian Sugar*, 1976, **26**, 321–323.—The characteristics of this cane variety are described and 3-year trials reported in which its performance was compared with that of BO 17 and Co 1157.

* * *

A statistical evaluation of the technique for rating resistance to red rot (*Physalospora tucumanensis* Speg.) in sugar cane. S. B. L. SHUKLA and T. R. BUDHARAJA. *Indian Sugar*, 1976, **26**, 325–327.—Three methods of red rot resistance rating were evaluated statistically. In August fifty standing stalks of each of eight varieties were inoculated with isolate of the pathogen (in the third internode from the base) and the stalks split open in December for determination of (1) the linear spread of the infection and (2) number of nodes traversed by the fungus. A high correlation was found between (1) and (2). The length of stalk infected was found to be superior statistically to the number of nodes traversed by the fungus, but there was no statistical basis for expressing the length infected as a percentage of the total stalk length, since variation in the spread of the infection was unaffected by changes in stalk length.

* * *

Effect of "Glyphosine" on sugar cane quality. P. N. RAO, B. R. RAO and B. A. RAO. *Cane Grower's Bull.*, 1976, **3**, (4), 1–4.—Trials with "Polaris" are reported in which two varieties were sprayed in October with 2·5 or 5·0 kg a.i. per ha (or with water only in the case of the controls); the crop was to be harvested in the following February. Results indicated that the maximum mean sugar content (20·26%) was obtained in February with 5·0 kg.ha^{-1} "Polaris", although a peak of 20·36% was achieved at the start of January in one of the varieties. The maximum mean value for the controls was 18·77% in February. The higher dosage of N had no adverse effect on the role played by "Polaris".

* * *

Intensive cropping with autumn-planted sugar cane. M. L. AGARWAL and R. S. MATHURIA. *Cane Grower's Bull.*, 1976, **3**, (4), 5–8.—Advice is given on intercropping of autumn-planted cane with a number of different crops in Uttar Pradesh and on suitable rotation.

* * *

Sugar cane borers in India and their control. D. K. BUTANI. *Cane Grower's Bull.*, 1976, **3**, (4), 9–15, 23. A survey is presented of 11 cane borers found in India. Recommendations are given on control means for individual species, while a general control method for all borers is also described.

* * *

A note on the use of "Polaris" on sugar cane. A. S. ETHIRAJAN, K. C. RAO and S. MARIMUTHAMMAL. *Cane Grower's Bull.*, 1976, **3**, (4), 16–21.—Trials with "Polaris" chemical ripener in India and other countries are summarized, showing a generally favourable effect in terms of cane sugar content.

* * *

Alternatives of sugar production in the Peshawar Basin of Pakistan—cane and beet as rivals in crop rotation and as partners in the factory. B. ANDREAE. *Zeitsch. Zuckerind.*, 1977, **102**, 89–93 (*German*).—A detailed examination is made of the agriculture of the Peshawar Basin (situated in the north of Pakistan between Afghanistan and Kashmir) in which cane and beet play a prominent role. The economics of various crops are compared and the types of rotation followed are indicated. A 2-month beet campaign from 1st May to 30th June follows a cane campaign lasting from

1st November to 30th April, and three factories are able to process beet as well as cane. It is pointed out that about half of the area under cane in the Peshawar Basin is grown for processing to gur in small farm units.

* * *

Drainage and leaching effect of a tile drainage system in fine-textured saline soils. S. J. YANG and P. L. WANG. *Rpt. Taiwan Sugar Research Inst.*, 1976, (73), 1–15 (*Chinese*).—Tile drain laterals were installed at a depth of 2·16 m and 30 m apart, sufficient irrigation water then being applied to raise the water table to the soil surface. Drainage was allowed to proceed to a desirable depth, and measurements were made of the discharge rate and water table level during drainage. During the leaching period (June-October) soil was sampled periodically at three different depths and the conductivity, exchangeable Na^+ concentration and Na^+ adsorption ratio determined. The peak discharge rate was 8·7 mm per day; after 7 days it had fallen to about 2·6 mm/day. The water table fell so slowly that only 0·16 m of water was found at the midway point between the laterals even after 7 days' drainage. A linear correlation was found between the discharge rate:water table ratio and the water table level. Hydraulic conductivity calculation with a steady-state equation gave values close to measured values. Because of the absence of linearity between the discharge rate and water table, the unsteady-state theory is unsuitable for use in heavy clay soil calculations. Desalination proceeded rapidly with the drainage system; after 5 months' leaching the conductivity of the soil had fallen from >11 mmhos.cm^{-1} to <3 mmhos.cm^{-1}, while the exchangeable Na^+ concentration and Na^+ adsorption ratio had fallen from 16% and 13·6% to 7·6% and 4·4%, respectively. Soil pH changed very little.

* * *

The effects of herbicides on photosynthesis and respiration in sugar cane. H. J. YEH. *Rpt. Taiwan Sugar Research Inst.*, 1976, (73), 17–30 (*Chinese*).—The effects of three pre-emergence and three post-emergence herbicides on F 172 cane at the 4-leaf stage were determined with a CO_2 infra-red analyser. Effects varied with herbicide, both photosynthesis and respiration rates falling with increase in the application rate except for "Asulam" which caused the respiration rate to rise as its dosage was increased. Of the pre-emergence herbicides, "Atrazine" at 3 kg.ha^{-1} caused the greatest fall in photosynthesis rate (to 83% compared with the untreated control), while "Linuron" had least effect (a fall of only 8%); "Diuron" had almost the same degree of effect as "Atrazine" but caused the greatest fall (by 46%) in respiration rate, followed by "Atrazine" (a 31% reduction); "Linuron" had least effect (a 14% reduction). "Metribuzine" had the greatest negative effect of the post-emergence herbicides on respiration rate (a 76% reduction), although "Ametryne" had almost the same effect (a 72% reduction). "Asulam" had the lowest effect of all the herbicides studied on respiration. "Metribuzine" completely prevented photosynthesis at 2·1 kg.ha^{-1}, while "Ametryne" had almost the same effect. Slight-to-moderate cane injury resulted from contact with "Diuron", while "Metribuzine" and "Ametryne" caused moderate-to-severe injury.

Effects of sugar cane white leaf disease on photosynthesis and respiration. C. T. CHEN and L. KONG. *Rpt. Taiwan Sugar Research Inst.*, 1976, (73), 43–49. Investigations are reported in which white leaf was transmitted by leafhoppers to F 160 cane and the 0 leaves collected for CO_2 analysis when typical symptoms of the disease appeared. The respiration rate was greater in leaves completely discoloured by the disease than in healthy leaves, while the photosynthetic rate in the infected leaves was so small as to be undetectable, although a little chlorophyll was found. The mechanism by which white leaf-infected plants die is possibly suggested by the findings.

* * *

Compatibility and pathogenicity of two races of *Ustilago scitaminea* Sydow in Taiwan. W. H. HSIEH and C. S. LEE. *Rpt. Taiwan Sugar Research Inst.*, 1976, (73), 51–57 (*Chinese*).—Compatibility of two strains of the smut pathogen and induction of a new strain *in vitro* were studied. F 173 cane, highly susceptible to both strains, exhibited typical symptoms of culmicolous smut after inoculation with mycelia obtained by mating compatible sporidia of the two strains. Inoculation of N:Co 310 (immune to Strain 2) with teliospores caused symptoms to appear, as did inoculation of two other varieties, one immune to Strain 1 and the other immune to both strains. The results suggest that a new strain of *U. scitaminea* could be induced by artificial mating of the two strains.

* * *

Attempts to control red rot disease of sugar cane through heat therapy in Bihar. A. JHA, R. K. SINGH, R. H. PRASAD and C. S. JHA. *Indian Sugar*, 1976, **26**, 441–446.—Partly-infected cane of three varieties was treated for 8 hours at 54°C with hot air, followed by dipping in "Aretan" and planting of 3-bud setts cut from the cane. In other experiments, diseased 3-bud setts were treated in hot water for 2 hours at 52°C, followed by "Aretan" treatment and planting. Results showed that treatments not only reduced the % germination compared with untreated controls, but also failed to control red rot.

* * *

Screening of sugar cane cultivars for resistance to red rot caused by *Physalospora tucumanensis* Speg. in western U.P. M. R. GUPTA, S. C. GUPTA and R. KUMAR. *Indian Sugar*, 1976, **26**, 449–450.—Cane varieties found to be resistant, moderately resistant and susceptible to red rot as a result of screening trials are listed, and a selection is given of promising and outstanding varieties suitable for western Uttar Pradesh.

* * *

Classification and properties of Hawaiian sugar cane soils. H. W. HILTON. *Hawaiian Planters' Record*, 1976, **59**, 33–49.—Hawaiian cane soils are listed by series in alphabetical order together with their orders and groups, plantations featuring particular soils and the number of acres involved. Descriptions are given of the various soil orders, and a further list is given of the soils arranged by sub-groups. An appended table gives definitions and derivations of the prefixes and suffixes used in soil science words. Soil series of which more than 5000 acres is under cane are also indicated.

Sugar beet agriculture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Sugar beet and nitrogen. How small plot trials can give guidance to commercial growers. A. P. DRAYCOTT, R. F. FARLEY and N. V. TURNER. *British Sugar Beet Rev.*, 1976, **44**, (4), 30–31.—Fertilizer surveys carried out by the British Sugar Corporation have indicated that over 80% of the total beet area in the UK still receives more nitrogen than experiments have shown to be needed despite a fall in the average N dressing since 1971. Trials during 1973–75 in which five different quantities of N within the range 37–175 units per acre (1 unit = 1·12 lb) were applied to the seedbeds in commercial fields (used for demonstrations) showed that application of more than 70 units N per acre reduced the number of seedlings per yard and the number of plants per acre at harvest. The adverse effects were most marked at levels above 100 units.acre^{-1}. The response to N was almost the same whether manual or mechanical harvesting was used, i.e. an increase in yield up to 80 units.acre^{-1} with manual harvesting, and up to 95 units.acre^{-1} with mechanical harvesting, after which levels there was no further increase in yield. There was little difference in sugar content between manual and mechanical harvesting, increase in N application being accompanied by the usual decrease in sugar content. Maximum sugar yield was obtained with both forms of harvesting when 100 units of N was applied per acre, although maximum profit was obtained with 80 units.acre^{-1} (allowing for the N cost and beet value). A significant correlation was established between yield of manually harvested beet and yield of mechanically harvested roots, the latter being about 90% of the former.

* * *

The group that decided to built its own cleaner. P. COCK. *British Sugar Beet Rev.*, 1976, **44**, (4), 40–41. A group of eight farmers built their own beet cleaner (after deciding that no commercial cleaner would meet their requirements) for use with the Herriau 3-stage harvesting system. The cleaner, which is wider than normal commercial models to give it greater handling capacity and stability, comprises a hopper with steep sides (to prevent lodging of soil and beet) the floor of which is a horizontal endless web conveyor. The extra width is given by two webs running side by side. The beets are carried to the base of an inclined web conveyor which transfers them to the transport. All drives are hydraulic, and a 10-ton truck can be loaded in 5 minutes. Cleaning efficiency is described as very high.

* * *

Cutworms: a hazard to late-established crops. A. DUNNING. *British Sugar Beet Rev.*, 1976, **44**, (4), 42. It is likely that cutworms will be present in the soil in England almost the whole of the year, with maximum numbers in July-August and October; warm, dry weather favours their development. These pests, caterpillars of various nocturnal moths (mainly *Agrotis segetum*, but also other *Agrotis* species), feed at soil surface level at night, but usually just below the surface. The rate of maturation varies with the species. While damage to sugar beet in summer is usually negligible, some late-established crops in 1976 suffered considerably. Damage in the spring is rare because of the low rate of cutworm survival after winter, but when it does occur, establishment of crop is severely reduced. Preventive treatment is advisable where the beet crop follows crops that have suffered damage in the preceding summer and autumn. Recommendations include gamma-BHC worked into the seedbed, or DDT applied on the soil surface as a band spray, preferably before emergence. Control in late spring or early summer is very difficult, and DDT spraying should be carried out only if absolutely necessary, since there is risk of doing more harm than good, especially where there is an increase in virus yellows outbreaks.

* * *

Seed-borne *Phoma betae* as influenced by area of sugar beet production, seed processing and fungicidal seed treatments. L. D. LEACH and J. D. MACDONALD. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 4–15.—Laboratory and greenhouse trials were conducted on evaluation of the degree of infection of beet seed by *Phoma betae*, generally considered to be the most important disease of beet seedlings. The most suitable of three methods tested was one involving petri dishes carrying a shallow layer of water agar in which seeds were incubated for 7 days at 20°C (the other methods used a seed germination blotter and potato dextrose agar, respectively). Soil germination trials with seed lots from different climatic areas of the USA and Canada and from the same area but different years indicated that rain during the 60 days preceding harvest of the seed governed the accumulation of inoculum and its spread to the stalks and flower parts. Overhead irrigation during this period may also contribute to build-up of inoculum and to seed contamination or superficial infection, while deep penetration of seeds by the pathogen appeared to be associated with rainfall during the curing of the cut seed stalks in the field. In a proposed classification system, Type A seed lots are not or only very slightly infected, Type B has 5–20% infection which is mostly superficial and easily removed by treatment with sodium hypochlorite before the water agar method is applied, Type C is 30–60% contaminated and will cause 20–40% infection of seedlings in subsequent trials despite NaOCl treatment, while Type D seed lots are heavily infected and give more than 40% infection of seedlings. The percentage of infected seedlings from Types B and C seed lots was markedly reduced by rubbing the seed

to remove cortical tissue, whereas this treatment had no effect on seedling infection in the case of Type D. Seed lots in this category are only produced in areas of abundant rainfall shortly before or during the harvest period and their use should be avoided, particularly since treatment with fungicide provides only partial protection against infection.

* * *

Feeding preference and reproduction of the beet leafhopper on two Russian thistle plant species. A. C. MAGYAROSY and J. E. DUFFUS. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 16–18.—In the USA, curly top is transmitted by the beet leafhopper *Circulifer tenellus* which lays eggs on various host plants in areas infested with *Salsola* spp.; in an effort to control the disease, *S. iberica* (tumbleweed) growing on thousands of acres is sprayed with insecticide. However, changes have been observed in the vegetation of the leafhopper breeding areas in recent years, among them being replacement of *S. iberica* with *S. paulsenii* (barbwire thistle). Greenhouse investigations of the feeding habits of the leafhopper, in which the two weed species mentioned were placed in a special box with the top space open to both weeds but with their bases isolated from each other, showed that *S. iberica* was the preferred feeding host. On the other hand, studies on the breeding habits of the pest (with female leafhoppers placed in a standard cage for a pre-determined period and the resultant nymphs counted) revealed no differences between the two weeds as regards reproduction. Hence, spraying of *S. paulsenii* is considered unjustified, but treatment of *S. iberica* is recommended where it is the dominant *Salsola* species and where leafhopper numbers are high. It is also pointed out that other (unpublished) studies have shown that neither of the weeds is a good host for the vector in nature.

* * *

Sugar beet storage rot in the Red River Valley, 1974-75. W. M. BUGBEE and D. F. COLE. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 19–24.—Two beet samples were taken (at randomly selected 12-hour intervals on alternate days throughout the period November-March) from the picking table at Moorhead sugar factory (Minnesota). Samples were also taken from six factories (including Moorhead) on one January day (four samples taken in a 10-minute period). Investigations, in which the samples were weighed, quartered longitudinally, classified according to topping height, and the decayed portions and frozen tissue removed and weighed, showed that at Moorhead 1·22% of the roots (by weight) had rotted. About 71% of the beets had had part of the crown removed (compared with all or none removed), and this partial removal is considered probably to have contributed to the rotting. The samples from the other factories showed that the pattern of crown removal and the rotting percentage were similar for all. Three fungi involved in the rotting were found to be *Phoma betae*, *Penicillium claviforme* and *Botrytis cinerea*, their prevalence being in the order given, with *P. betae* being only slightly more prominent than *P. claviforme*. The tap root was found to have slightly more rot (associated with wounding) than did the crown early in the storage period; rotting in the crown region developed slowly but eventually accounted for the greatest proportion of rotted tissue compared with the tap root or tip of the tap root. It is suggested that sugar losses from rotting might be reduced if the crowns were not removed. The monetary losses from rotting are estimated.

* * *

Breeding sugar beet for resistance to yellow wilt. J. O. GASKILL and R. EHRENFELD K. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 25–44.—The economic importance of yellow wilt is briefly discussed. A list is given of plant hosts of the disease, the causal agent of which is a mycoplasma-like organism possibly associated with a virus. The only known vector is *Paratanus exitiosus*, which belongs to the same sub-family of insects as the beet leafhopper *Circulifer tenellus*. Field trials in Chile in 1972–73 and 1973–74 with a number of beet varieties showed that measurable progress has been made in breeding for yellow wilt resistance. In the past, because the disease affects seed production, infected plants with some evidence of resistance (as found at the end of the vegetative growth period) had generally produced very little or no seed under the most favourable agronomic conditions, whereas antibiotic treatment gave more promising results. It was also found in later work that some plants, earlier regarded merely as escapees because they showed no symptoms of the disease after exposure to severe attacks and thus thought to be unsuitable for resistance breeding purposes, may in fact possess genes for resistance; hence they should not be excluded from the breeding programme. One of three introductions of *Beta maritima* tested was found to have relatively high resistance to the disease.

* * *

The effect of sterile cytoplasm on curly top disease resistance. J. C. THEURER and D. L. MUMFORD. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 45–48.—It is stared that over 90% of the beet seed produced in the USA is hybrid and that such large-scale production of hybrid varieties has been made possible by the discovery of cytoplasmic male sterility. However, the fact that susceptibility to a severe outbreak of corn leaf blight was associated with T-type sterile cytoplasm focused attention on the genetic vulnerability of major crops. Beet breeders have shown concern about the existence of a narrow genetic base for resistance to curly top as well as about the sterile cytoplasm vulnerability. Greenhouse and field tests were conducted on cytoplasmic male sterile and normal fertile genotypes of varieties showing various degrees of curly top infection; results for 13 varieties revealed no difference between the equivalent normal and sterile genotypes as regards susceptibility to curly top, although a warning is given to beet breeders to be alert for new sources of sterile cytoplasm and for new, more virulent strains of curly top so as not to be taken unawares as in the case of the corn leaf blight epidemic.

* * *

Effect of early terminal irrigation and late nitrogen application on yield and incidence of root rot in sugar beets in the Imperial Valley. C. F. EHLIG, R. D. LEMERT, R. Y. REYNOSO and C. K. ARTERBERRY. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **10**, 49–54.—Experiments were conducted in the Imperial Valley (California) to determine the effects of additional, late-applied N and early irrigation termination on yield, sugar and nitrate concentration and incidence of root rot in late-harvested beet. Average weight, sugar and nitrate content of the harvested beets were

reader inquiry service

If you wish to receive further information on the products and services mentioned in the advertisements please fill in the inquiry section of this card and post it to us.

reader inquiry service

Please arrange for me to receive without obligation further details of the products referred to below which are advertised in your_____ 19____ issue.

Advertiser	Product	Page

*Signature*_____

Block Letters

NAME _____ Date_____

Position_____

Firm_____

Address _____

photocopy service

We are able to supply one photocopy, for research or private study purposes, of most of the original papers abstracted in this journal. It should be noted that these are *not* translations but are in the original language of publication, which may not be English. The charge of 40 cents per page includes air mail postage and payment should be sent with the order.

photocopy service

Please supply one photocopy of each of the following original papers, abstracts of which appeared in your_____ 19____ issue.

Page	Author(s)	Title

*Signature*_____

Block Letters

NAME _____ Date_____

Position_____

Firm_____

Address _____

Payment of $ _____ is enclosed

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of U.S. $15.00 for supply by surface mail.

additional subscription order

Please send a further copy of your journal each month to the address below, starting with the issue

_____ 19____.

Block Letters

_____

_____

_____

_____

_____

*Signature*_____

Date_____

I enclose cheque/draft/M.O./P.O. for $15.00.

Reader Inquiry Service,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.
England.

Photocopies Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks,
England.

Subscriptions Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.,
England.

equal with or without late N application and with irrigation termination on 17th May or 3rd June. Root rot incidence was negligible, although there was an early stage of crown rot in about 20% of the harvested beets regardless of treatment; this did not affect root yield. Termination of irrigation 5 weeks before harvest (on 24th June) did not cause as much root dehydration or increase in sugar content as had been expected. The late additional application of 160 kg.ha^{-1} urea on 3rd April was used in leaf production in April and May; it is concluded that the large green leaves photosynthesized sufficiently more sucrose than did the light green leaves to compensate for the extra photosynthate required to produce the additional leaves. While the nitrate concentration of harvested beet was relatively low and almost the same for plants receiving late N as for untreated ones, on 17th April the leaf petiole nitrate concentration had been extremely high after N application. However, in view of the brei nitrate concentration after harvest, late N application is discounted as a cause of the early high nitrate accumulation, which occurred in the sound beet found in fields having a high incidence of root rot. Nevertheless, on the basis of the results, late N application is not recommended.

* * *

Climatic periods and thresholds important to sugar beet production. K. J. FORNSTROM and L. O. POCHOP. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 55–64.—Details are given of investigations, using a specific statistical method, to correlate short-term weather patterns with beet yield and sugar content in three areas of Wyoming. The results, given in graph and tabular form, are discussed.

* * *

A growing mulch tillage system to reduce wind erosion losses of sugar beets. K. J. FORNSTROM and R. D. BOEHNKE. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 65–73.—In tests on soil erosion reduction in beet fields, the area between the future beet rows was seeded with spring barley about two weeks before beet seed drilling. The growing barley was removed by rotary cultivator when the beets had reached the 4–6 leaf stage. The % emergence in the barley-protected fields was 60% compared with 39% in unprotected plots. While beet yield in the protected plots averaged 16·7 tons.acre^{-1}, in the unprotected plots (in which only conventional tillage and overhead irrigation were applied) the average yield was 13·6 tons.acre^{-1}, although, where there was no need for replanting, the yields in the unprotected and protected plots were almost the same. Potential soil loss from the unprotected plots was considerably greater than where barley was used for protection. Total water utilization by the protected beet and barley was no greater than the amount used by the unprotected beet. Rotary cultivation in the protected system increased the energy requirements. While the barley protection system did reveal a number of advantages, further study is considered necessary, since it was found that inadequate growth of the barley will result in insufficient wind protection, while excessive growth will lead to removal and competition problems, as had happened in earlier tests.

* * *

Cultivar blends for buffering against curly top and leaf spot disease of sugar beet. R. E. FINKNER. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 74–82.—In studies to determine whether seed mixtures could be used as a buffer against both curly top and leaf spot, seed from varieties resistant to one or other of the diseases was mixed in ratios of 1:3, 1:1 and 3:1. Field tests were then conducted on beet from the mixed seed, from the resistant varieties and from two commercial varieties, one of which was resistant to both diseases while the other was resistant to curly top and virus yellows. Results of the 3-year tests showed that the mixtures had limited success, the beets from the 1:1 mixture having 14% less curly top and those from the 3:1 (curly top-resistant:leaf spot-resistant) mixture 13% less leaf spot than results expected with the resistant varieties in a "pure" stand. Yields and sugar contents were erratic.

* * *

Results of three years of tests on weed control in sugar beet using a single pre-emergence treatment. J. M. BELIEN, A. NOLF, J. F. SALEMBIER and M. GOMAND. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1976, **44**, 141–164 (*French*).—Trials at four sites in Belgium in 1973 showed excellent control of grasses and dicotyledons with one pre-emergence application of "Ethofumesate" + "Pyrazone" (at 1·5 and 3·2 kg.ha^{-1}, respectively) or "Ethyl Diethacine" + "Pyrazone" (at 1·44 and 3·2 kg.ha^{-1}, respectively), the latter mixture being somewhat less effective than the former against *Sinapsis arvensis*. On the other hand, the same mixtures in 1974, when climatic conditions did not favour their activity, were less successful, the degree of control varying with weed species. In 1975, grasses were poorly represented, so that their control could not be evaluated. Mixtures of "Ethofumesate" + "Lenacil" (with and without "Isocarbomide") or "Ethofumesate" + "Pyrazone" in varying proportions were successful in controlling *Matricaria chamomilla*, *Stellaria media* and *Anagallis arvensis*; various mixtures of "Ethyl Diethacine" + "Lenacil", "Pyrazone" or "Isocarbomide" (the last together with "Lenacil") gave excellent control of *M. chamomilla*; control of *Chenopodium album* was satisfactory with all except the "Ethyl Diethacine" + "Lenacil" mixture. Despite some phytotoxicity of "Ethofumesate", none of the treatments affected final plant population, sugar content or yield, with the exception of "Ethyl Diethacine" + "Isocarbomide" + "Lenacil" (4+5·6+0·8 kg.ha^{-1}) which had a serious negative effect on beet growth, sugar content and yield. The effectiveness of pre-emergence treatment was considerably dependent on rainfall at application and after drilling.

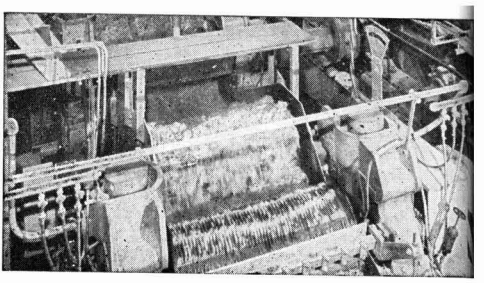
* * *

Results of thinning precision-drilled plants in sugar beet cultivation. S. KRASUCKI and S. SIWICKI. *Gaz. Cukr.*, 1976, **84**, 257–260 (*Polish*).—Tabulated data are given which demonstrate the effects of increasing the beet spacing from 6 cm to 9 and 12 cm in rows drilled to a stand, and of replacing thinning with precision drilling at 9 cm spacing on the final plant population, beet and leaf yields and number of hours of work required per ha. The data are the result of observations conducted in 1975 on plantations in a major beet-growing area of Poland.

* * *

Nitrogenous fertilization and the processing quality of sugar beet. J. MALEC. *Gaz. Cukr.*, 1976, **84**, 260–261 (*Polish*).—The author summarizes the literature on N fertilization to demonstrate the adverse effect of high N dosage rates on beet sugar content and processing quality.

Cane sugar manufacture



Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Applications of ion exchange resins in decolorization of sugar juices. B. S. JOSHI. *Indian Sugar*, 1976, **26,** 187–194.—Colour removal from cane juice by treatment with resin is discussed with 47 references to the literature. Aspects covered include resin fouling and its prevention, forms of resin, regeneration and the merits of macroporous resins.

* * *

The use and development of cane tracking equipment. F. CALBOUTIN. *S. African Sugar J.*, 1976, **60,** 576–585.—See *I.S.J.*, 1977, **79,** 23.

* * *

The W. R. Cowley Sugar House. ANON. *Sugar y Azúcar*, 1976, **71,** (11), 74.—Details are given of the apron-type main cane carrier at this Texas sugar factory. The carrier, manufactured by FMC Corporation, is 120 ft long and 84 inches wide, operates up to 45 ft per min and permits a grinding rate of 425 tch.

* * *

Studies on the design of resistance heaters for improving the fluidity of polycomponent saccharine systems in sugar factories. R. C. SHARMA. *Sugar News* (India), 1976, **8,** (5), 10–12.—*C*-massecuite reheating is discussed, and resistance heating considered to be the only practical means. Factors to be taken into account are examined, including those concerning the electrodes as well as heating control and safety.

* * *

Comparison and application of tracers lithium chloride and I-131 isotope in sugar factories. C. H. CHEN, Y. C. CHENG and J. F. TONG. *Rpt. Taiwan Sugar Research Inst.*, 1976, (72), 49–58 (*Chinese*).—Investigations are reported in which LiCl and I-131 were used as tracers for a number of purposes, viz. to measure juice residence time in a multiple-effect evaporator, to determine the flow pattern of massecuite in a continuous crystallizer and to estimate the relative volume of the gas phase in a carbonatation vessel. Traces are reproduced and data tabulated. Results were considered satisfactory. Details are given of the procedure used, and advantages of the two tracers mentioned are listed. Comparison is made between the two.

* * *

Compromise boiling system. C. R. TOCA. *Sugar J.*, 1976, **39,** (5), 34–35.—A boiling scheme, described as a compromise between the conventional 3-massecuite and 3½-massecuite schemes, was first used at Osceola factory in Florida and subsequently adopted by St. Mary Sugar Cooperative factory in Louisiana. In it, the *B*-massecuite is boiled on a footing of *C*-sugar magma plus *A*-molasses, and the sugar from this used as footing for *A*-massecuite boiling from which all the commercial sugar is produced. The results obtained are discussed and details given of the additional equipment required.

* * *

Losses in milling of P6.6 m were avoided. A. BALCELLS. *Sugarland* (Philippines), 1976, **13,** (4), 8, 12–14, 17. The author describes how the amount of trash accompanying cane delivered to First Farmers Milling and Marketing Cooperative Association Inc. at Talisay, Negros Occidental, was reduced from an average of 7·7% in 1974–75 to 3·5% in 1975–76 after introduction of a new scheme of penalties and incentives. The amount of money that could be saved throughout the Philippine sugar industry, assuming the same levels of trash as at First Farmers, is roughly calculated.

* * *

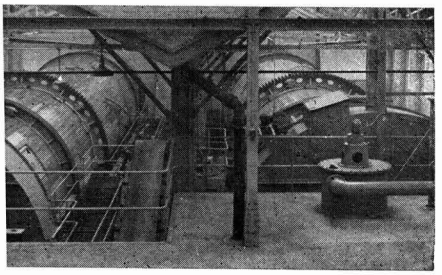
Improvements in mill feeding. D. WRIGHT. *Sugarland* (Philippines), 1976, **13,** (4), 10, 16, 18.—It is pointed out that for maximum mill extraction it is necessary to provide fine cane preparation, low roller speeds and high imbibition rates. Also of importance is the feeding of cane at a constant rate and of even blanket thickness across the width of the feed chute. To ensure zero slip and provide a regular cane feed, the continuous pressure feeder is of advantage, especially when coupled with a gravity feed chute. The author briefly describes the Walkers chain-driven two-roller continuous feeder, available in light- and heavy-duty versions; use by a Queensland factory of the heavy-duty type is reported. A chain-driven 30-inch diameter underfeed roller carrying heavy chevron bars was also installed to compact the cane feed before it enters the feeder and to permit the use of an enclosed vertical chute. During crushing of 3 million tons of cane there has been no need for roller re-grooving and it is considered that there will be no need for it for some years. The roller surface is maintained in a rough condition by arcing. In 1975 the factory recorded the highest No. 1 mill extraction in Queensland as well as the highest final pol extraction (96·46%). The benefits of imbibition recycling, as used at the factory, are discussed, and a diagram of a typical scheme for a 3-mill tandem is presented.

* * *

Evaporator scale formation. I. S. NANDAGOPAL and R. RAMAMURTHY. *Indian Sugar*, 1976, **26,** 437–439. The composition of scale which forms in the 4th evaporator effect is discussed and the reactions involving cane juice constituents whereby scale formation takes place are described. The effect of evaporation of a mixture of clarified juice and juice from the filter presses on scale silicic acid content and the influence of calcium and magnesium contents in juice on the scale deposition rate and composition are examined. Conditions under which scaling can increase and means by which it can be minimized are indicated.

---

[1] *I.S.J.*, 1975, 77, 182.



Beet sugar manufacture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Effect of beet cossette quality on the performance of a twin-scroll diffuser. V. A. LUPASHKO. *Sakhar. Prom.*, 1976, (12), 12–14 (*Russian*).—The adverse effects of excessively thin and thick cossettes on diffuser performance and losses are discussed and the optimum cossette length given for a juice draft of 115–118% in a twin-scroll diffuser. The negative effect of too high a diffusion temperature on cossette quality is also examined, and recommendations are given on how to ensure best possible slicer performance to give a requisite cossette quality.

* * *

Raw juice purification with bentonite. A. A. LIPETS, R. V. MIKHALYUK and A. S. KOSTENKO. *Sakhar. Prom.*, 1976, (12), 14–18 (*Russian*).—Laboratory experiments are reported in which raw, 2nd carbonatation and thick juice was treated with bentonite. Results showed that juice purity was increased by treatment, the extent being governed by temperature, Brix, time of contact and quantity added. Optimum conditions were established as a temperature of 85–90°C, as low a Brix as practical (at 9–11°Bx raw juice purity rose by 1·8–2·2 units), a contact time of 5 minutes and 1% bentonite on weight of juice. Activation of bentonite by boiling with sulphuric acid did not improve the purification efficiency, so that natural bentonite is recommended. While addition of the bentonite in dry form does not dilute the juice, there is need for heat treatment and special dosing arrangements under factory conditions. Hence, it was found preferable to add it in the form of a 20% suspension. It is recommended to mix the bentonite with lime before feeding the mixture to the preliming tank. The bentonite particles, agglomerated with $CaCO_3$, are removed by filtration after carbonatation. It has been found that bentonite reduced 2nd carbonatation juice colloid and reducing matter contents.

* * *

Determination of 2nd carbonatation juice pH and optimum alkalinity. G. K. POSESSOR. *Sakhar. Prom.*, 1976, (12), 33–36 (*Russian*).—Unsatisfactory performance figures (including excessive molasses losses) obtained from Elan'-Kolenovskii factory were attributed to the processing of low-quality beet and to treatment of intermediate products (particularly in evaporation) at unsuitably low pH values; this was blamed on 2nd carbonatation control based on titratable alkalinity. Apart from the need to determine the pH as well as titratable alkalinity, it is also considered necessary to determine the pH at the process temperature and not at 20°C, since increase in temperature may be accompanied by numerous association and dissociation reactions which can influence pH. Tabulated pH values determined at 20 and 80°C for factory products from raw juice to molasses at 10-day intervals illustrate the differences. To overcome evaporation problems encountered at the factory, among which was considerable tube corrosion, it is recommended that the 2nd carbonatation juice pH be such as to permit a thick juice pH_{20} no lower than 8·5.

* * *

Rational water feed to a DDS-30 diffuser. M. I. YANITSKII. *Sakhar. Prom.*, 1976, (12), 25–26 (*Russian*). It is stated that instructions accompanying Polish-built DDS diffusers do not indicate the most suitable side on which water should be fed into the trough as governed by the exhausted cossette discharge point. The author points out that the water should be fed on the side opposite to that on which the cossettes are discharged in order to avoid loading of the discharge scoop wheel with water and to prevent excessive sugar losses.

* * *

Application of approximation equations in heat engineering. A. ILLYÉS. *Zeitsch. Zuckerind.*, 1976, **101,** 763–765 (*German*).—Approximation equations are presented for water, steam and sucrose solution parameters necessary for heat calculations. The equations are based on tabulated material in the literature and are intended for use with desk and pocket calculators. Advantages of the equations, which give the various parameters as functions of temperature, pressure and concentration, are listed. A formula is also derived for calculation of sucrose solution heat transfer coefficients in tubular heat exchangers based on extrapolation of an equation developed by MICHEJEW[1] for calculation of the Nusselt number in terms of the Reynolds and Prandtl uumbers.

* * *

Knife sharpening: its effects on diffuser draft and sugar loss. A. E. DREIBHOLZ and J. J. HANSSENS. *Sugar J.*, 1976, **39,** (5), 39–40.—Information is given on dressing and sharpening of Koenigsfelder beet knives to meet requirements for the best possible cossette quality. Details are given of the methods used for cossette sampling to determine quality and percentage of "V" slices, and empirical formulae are given for calculation of diffusion draft and of sugar losses in RT and tower diffusers based on experience in Ireland and the UK. Results of tests showed that suitable treatment of a 23-division knife during the campaign gave a loss of 0·21% and a draft of 120% compared with target values of 0·20% and 118% set at the start of the campaign.

* * *

Microprocessor control of sugar boiling. R. J. BASS and J. DONOVAN. *Sucr. Belge*, 1976, **95,** 421-434. See *I.S.J.*, 1976, **78,** 375.

[1] "Grundlagen der Wärmeübertragung" (Verlag Technik, Berlin), 1968.

The formation of nitrite in the sugar factory, its behaviour during processing, and its effect on alcohol and yeast production from molasses. N. TAYGUN. *Şeker*, 1976, **26**, (101), 24–66 (*Turkish*).—The formation of nitrite in beet juice and of potassium imidosulphate as a result of thin juice sulphitation is explained, and descriptions are given of juice nitrite determination by colorimetric means and by use of the nitrite test papers manufactured by C. F. Boehringer u. Söhne GmbH. Investigations conducted at Ankara sugar factory showed that the average nitrite content of raw juice (16·75 ppm) increased in preliming to a maximum at about pH 10·5 and 65°C (averaging 21·43 ppm) after which there was a slight fall during main liming, followed by a rise to 23·37 ppm in 1st carbonatation, while the thin juice NO_2^- content averaged 22·56 ppm. Comparison of results at all 17 Turkish factories showed that conditions in BMA tower diffusers favoured greater nitrite formation than in other diffuser systems, the lowest NO_2^- contents occurring in juice from DDS, RT and De Smet diffusers, while even battery diffusers performed better than BMA towers as regards NO_2^- formation. The nitrite content of crystal sugar was governed by boiling efficiency, while by far the greater proportion of the nitrite was discharged with the molasses. While it did not affect yeast production, it did have considerable influence on ethanol fermentation as indicated by experimental results in which there was little difference in yield (approx. 77% on weight of initial sucrose) after 72 hours' fermentation up to a molasses nitrite content of 74 ppm, after which there was a slight fall to about 70% yield at 305 ppm, bu_t a sharp drop to zero yield at 409 ppm NO_2^-. Alcohol specific gravity, volume and gravity tables are appended.

* * *

Computer application to boiling control in crystal production from standard liquor based on balances of unit production parameters. J. BURIÁNEK, Z. SCHNIDEROVÁ and M. KMÍNEK. *Listy Cukr.*, 1976, **92**, 226–235 (*Czech*).—An algorithm has been developed which describes the boiling process and which is based on an extension of the numbered system described earlier[1]. Application of the scheme is illustrated by a study of a sugar house balance as a function of the quantity of wash water and steam applied during curing in the centrifugal; the effect of this variable on white sugar yield is indicated.

* * *

The quality of air for appliances in a low-pressure pneumatic system. V. HROMEK and J. ZÁRUBA. *Listy Cukr.*, 1976, **92**, 236–237 (*Czech*).—The importance of clean, dry air for use in a pneumatic control system is stressed, and the adverse effect of impure air on a nozzle demonstrated by photographs. Extreme fouling after seven years' use led to inaccurate control of various parameters, including flume water level, limestone and coke feeding to a kiln, etc. Installation of a cyclone and silica gel drying unit directly after the air compressor is recommended.

* * *

Identification of the dynamics of the 1st carbonatation process and optimization of the regulator adjustment. J. OLEDZKI. *Gaz. Cukr.*, 1976, **84**, 251–253 (*Polish*). Tests were conducted at Khoy factory (in Iran) on 1st carbonatation pH control by three closed-loop systems based on (i) the pressure of the air actuating the gas valve in the second of the carbonatation vessels, (ii) the pressure of the air actuating the gas valve in the first of the carbonatation vessels, and (iii) the pressure of air actuating the motor operating the baffle plates in the milk-of-lime tank feeding the main limer. Traces are reproduced indicating the time taken for adjustment in the pH within a difference range of 0·75–1·49 units. Variant (i) proved to be the most suitable for pH control.

* * *

Trials on addition of air to juice in the main limer. H. ZAORSKA. *Gaz. Cukr.*, 1976, **84**, 248–250 (*Polish*). See *I.S.J.*, 1977, **79**, 173.

* * *

The concept of mass flow control in the sugar factory. M. SZYMAŃSKI. *Gaz Cukr.*, 1976, **84**, 253–254 (*Polish*). The problems involved in mass flow control throughout a sugar factory are briefly discussed and a control scheme for the overall process is described in the form of a diagram.

* * *

The effect of feed water quality on the corrosion stability of metal in a diffuser. N. V. KULININ and V. G. YARMILKO. *Sakhar. Prom.*, 1977, (1), 9–11 (*Russian*).—Laboratory tests were conducted to determine the corrosive effects of three types of diffuser feed water (as well as distilled water) on samples of low-carbon steel; the samples were immersed in the water and raw juice for 120 hours at 70°C (corresponding to the diffusion temperature). Results showed that after distilled water, deammoniated condensate caused the lowest metal weight loss and corrosion rate.

* * *

The effect of cossette liming on juice quality. L. D. BOBROVNIK, G. P. VOLOSHANENKO and A. R. SAPRONOV. *Sakhar. Prom.*, 1977, (1), 11–13 (*Russian*). With the aim of reducing the content of high-molecular compounds (albumin and pectins) in raw juice, GOODBAN & MCCREADY have suggested cossette liming[1]. The effect of alkaline conditions on pectin behaviour is described and laboratory trials reported in which cossettes were treated with lime (0·5% CaO by weight) for 20 minutes at 25°C. Treatment reduced the juice pectin content by comparison with that for untreated cossettes but increased the apparent colloid content (the latter effect being attributed to lack of suitable method for colloid determination, so that the coagulate obtained by alcohol precipitation included calcium and various anions in addition to colloids). Addition of milk-of-lime to the feed water for cossette pre-treatment gave better results than did addition of dry lime. Pre-treatment at 20° and 45°C did not confirm the earlier findings[1] that at a treatment temperature below 45°C pectin is not hydrolysed and only deesterification takes place. At the lower temperature, the lime salts, colloid and pectin contents were lower and the juice purity slightly higher than at 45°C; the lime salts and colloid contents were still somewhat higher than in juice from untreated cossettes. However, in further experiments in which the cossettes were pre-treated with milk-of-lime for 20 minutes at 40°C and the raw juice treated by one-stage

[1] BURIÁNEK & KMÍNEK: *I.S.J.*, 1976, **78**, 311.
[2] *ibid.*, 1967, **69**, 119.

simultaneous carbonatation to pH_{20} 9·25 (with addition of 0·8% CaO), the cossette pre-treatment gave a juice of higher purity, lower filtration coefficient, higher settling rate, lower colloid and pectin contents but of slightly higher lime salts content by comparison with juice from untreated cossettes.

* * *

Effect of cold-hot liming temperature on purified juice quality. N. A. ARKHIPOVICH and M. P. STORCHEUS. *Sakhar. Prom.*, 1977, (1), 14–16 (*Russian*).—Raw juice of given purity, pH and composition was divided into two fractions, one of which was processed to 1st carbonatation juice followed by settling, while the other was sub-divided into five aliquots each of which was submitted to preliming in the presence of 70% (by weight) recycled mud from the 1st carbonatation juice in the first main fraction, followed by main liming and eventual processing to 2nd carbonatation juice. The main liming was divided into cold and hot processes (although the first two samples were treated at the same temperature, viz. 50° and 60°C in both sections). The pH of the prelimed juice was constant (11) as was the duration of preliming and cold and hot main liming (15 minutes each). After cold liming, the juice (where appropriate) was heated to the required hot liming temperature during 1–2 minutes and maintained at that temperature for the next 15 minutes. From determination of juice quality factors it was concluded that the temperature of hot liming (varied from 50° to 90°C in 10° intervals) had little effect on purification, although reducing matter degradation was inadequate at 50–60°C (65% of the content in raw juice by comparison with 89–90% degradation at 80–90°C). Optical density fell with rise in hot liming temperature. While the colloid content was almost the same in juice after liming at 60, 70 or 80°C, it rose sharply when the temperature was increased to 90°C. Juice ash content tended to be unaffected by the liming temperature. Non-pectin irremovable and amido-amino N contents fell with rise in liming temperature. On the basis of the results it is recommended to carry out the second ("hot") stage of liming at 80–85°C, with a total pre- and main liming duration of 45 minutes.

* * *

The significance of pH in purification of juices and syrup. K. P. ZAKHAROV, R. G. ZHIZHINA, V. Z. SEMENENKO and V. V. CHERNELEVSKAYA. *Sakhar. Prom.*, 1977, (1), 16–21 (*Russian*).—Investigations of the pH of juices up to and including evaporator thick juice showed that the pH-temperature relationship at temperatures in the range 20–80°C was linear, the fall in pH with rise in temperature being greater the higher was the pH of the juice at 20°C. The relationship was studied in the case of juices from seven factories, and an empirical equation derived for rapid calculation of ΔpH_t (the temperature coefficient of pH) which is given as $k_1(pH_{20} - 7) + k_2$, where k_1 is a constant equal to the tangent of the angle of slope of the straight line to the abscissa, and k_2 is a constant given by the point on the ordinate cut by the straight line. Given the values of k_1 and k_2 it is possible to determine optimum values of pH_{20} for sulphitation and evaporation.

* * *

Technology of crystallization treatment of low-grade massecuite. I. G. BAZHAL *et al. Sakhar. Prom.*, 1977, (1), 25–29 (*Russian*).—The mechanism of crystal formation and growth in pan boiling is briefly explained and a description given of a scheme in which low-grade massecuite is subjected to periodical temperature fluctuations through changes in the pressure of reheat steam by means of a control valve operating according to a pre-set programme. When dropped, the strike is split into two halves, one of which is cured straight away in the centrifugals and the molasses heated to 80°C and mixed with the other half of the massecuite which is sent to a battery of crystallizers. Warm water is passed through the hollow disc elements of three troughs and cold water through the elements of another three in counter-flow to the massecuite. The massecuite then passes to a distributor where it is heated before centrifugalling. Pilot-scale experiments showed that the new method gives lower molasses yield, purity and sugar content than conventional low-grade treatment.

* * *

Kinetics of thermal dissociation of limestone in sugar factory kilns. II. Temperature of the heating medium variable. N. P. TABUNSHCHIKOV, A. V. KAPATS, N. N. MARUTOVSKAYA and A. M. AIZEN. *Sakhar. Prom.*, 1977, (1), 42–45 (*Russian*).—The kinetics of limestone dissociation during calcination were calculated by computer, assuming a given nuclear radius, a temperature in the range 900–1300°C and external heat transfer coefficients in the range 20–120 kcal.hr. m^{-2}.°C. Graphs are given of concentration change and of change in radius of the non-degraded nucleus and temperature of the particle surface as a function of temperature and time.

* * *

The effect of severe mechanical damage of the sugar beet on its storage properties. N. N. GORBUNOV. *Sakhar. Prom.*, 1977, (1), 46–49 (*Russian*).—Comparison was made of losses resulting from storage of beet damaged in various ways. While highest daily and total sugar losses occurred with those beets having damaged crowns, followed by those having marked lateral injuries and then slight lateral injuries, undamaged beets suffered more losses than did damaged roots with tails removed. On the other hand, apparent drop in sugar yield was lowest in the case of the undamaged beets; it was highest with the beets having considerable lateral damage, followed by those with slight lateral damage, those with damaged crowns and then the beets with tails removed. Tabulated data also include beet composition, press juice purity and non-sugars, and molasses sugar content.

* * *

Mechanization and automation of the lime kiln at Brodek sugar factory (Czechoslovakia). V. LOCHMAN. *Listy Cukr.*, 1976, **92**, 254–260 (*Czech*).—Details are given of the automatically-operated lime kiln of 80 m^3 effective capacity which started operations at Brodek in 1975, as well as of the new slaker and limestone/coke storage unit.

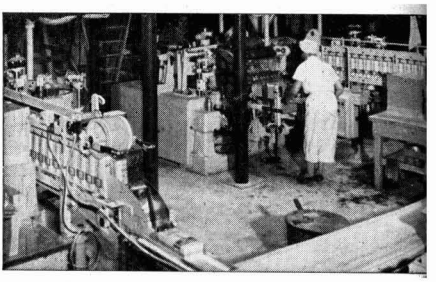
* * *

Sugar circulation calculation. Ö. KRIEGER. *Cukoripar*, 1976, **29**, 179–185, 225–229 (*Hungarian*).—Equations are given for calculation of parameters involved in drawing up sugar house balances, and their application is demonstrated in the case of 3- and 4-massecuites boiling schemes.

* * *

Centrifugal pumps in the sugar industry. H. RIES. *Zeitsch. Zuckerind.*, 1977, **102**, 22–26 (*German*).—The advantages and various types of centrifugal pumps applicable in the sugar industry are surveyed.

Sugar refining



Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Application of statistical methods as used in experiments for the evaluation of flocculants. E. G. JONES and J. V. LOPEZ-OÑA. *Sugar y Azúcar*, 1976, **71**, (10), 17–21.—Statistical evaluation of phosphate-lime clarification of refinery liquor with flocculant addition at Philadelphia refinery is reported. The tests involved 15 anionic flocculants manufactured by seven companies. They were classified in groups based on viscosity, average molecular weight and anionic charge density. Laboratory evaluation using the jar test showed that only four were effective at an optimum dosage level not exceeding 10 ppm (the maximum permitted by the Food and Drug Administration); emulsion-type flocculants were unable to give flocculation at less than 30 ppm. Refinery tests with those flocculants which proved best in the laboratory tests were aimed at determining the optimum feed point, comparison of flocculant performances and comparison of clarification with and without flocculants. The flocculant feed point was found to be of utmost importance since it governed the uniformity of mixing. The differences between the three points studied showed that the lowest clear liquor turbidity (taken as criterion of clarification efficiency) was obtained by adding the flocculant to a mixing chamber in the pipeline preceding a flocculating chamber before the clarifier. The two other points were between the flocculating chamber and the clarifier. The best flocculants were those of highest molecular weight having insoluble matter contents below 5% (above this level they produce dilute solutions with a high concentration of sharp-edged insoluble particles known as "fish-eyes" which cause blockages after the clarifier); the best would be potable-grade flocculants which meet Food & Drug Administration specifications of $<0{\cdot}05\%$ residual acrylamide, but these requirements cannot be met by regular industrial-grade polymers. It is stated that while anionic charge densities are not to be ignored, the importance of electrostatics has been over-emphasized to the exclusion of chemical forces. All polymers of very high molecular weight are not equally effective with certain raw sugars, so that each raw sugar should be individually tested to establish the most effective polymer for its liquor clarification. A recommended solution strength of 0·05–0·10% by weight is recommended; under normal storage conditions a new batch should be prepared at least twice a day to maintain polymer activity. Use of flocculants can reduce average clear liquor turbidity by about 75% and has permitted a reduction in the number of clarifiers from six to four at Philadelphia.

* * *

Mechanical crushing of crystal sugar. E. HEIDENREICH and W. HUTH. *Die Lebensmittelind.*, 1976, **23**, 495–499 (*German*).—The theory of sugar crystal size reduction for the production of icing sugar is discussed and the various methods compared. The most suitable method is that based on impact between crystals, as applied in commercial mills. Tests conducted on East German mills showed that none gave satisfactory results, from which it was concluded that only combining crystal size reduction with separation of the unwanted large crystals would satisfy the requirements of the sugar and confectionery industries. The "Pulvochron PC 38" mill of the Strong Scott Mfg. Co., Minneapolis, USA, is mentioned as being a highly suitable mill of the combined type. Experiments on crystallization of sugar of required fineness and size distribution from thick juice showed that the process would require considerable energy consumption, that the required supersaturation could be achieved only by replacing the juice water with ethanol (so as to prevent dissolution of fine crystals), and that agglomeration increased with reduction in crystal size.

* * *

Sucrose losses in cane raw sugar storage. M. MURO, L. P. REVA and A. P. KOZYAVKIN. *Sakhar. Prom.*, 1976, (12), 36–41 (*Russian*).—Mathematical expressions are developed for calculation of various raw sugar storage factors. A generalized equation is then derived for calculation of sugar loss in storage as a function of initial moisture content, pH and pH change with time, storage temperature and time. Experiments showed that the fall in pH with time during prolonged storage of bulk sugar was a linear relationship characterized by two distinct sections. In the first section, the rate of pH fall is a function of temperature and purity, whereas in the second section it is governed only by temperature.

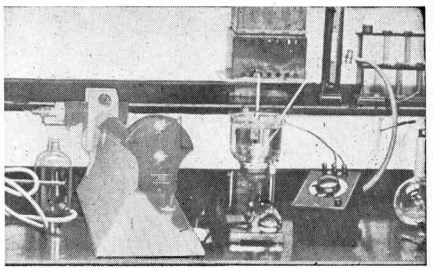
* * *

Sugar solution decolorization with bone char. R. ŠTENGL. *Listy Cukr.*, 1976, **92**, 281–285 (*Czech*). From the mass transfer equation of CRANK[1] expressions have been derived for calculation of colour adsorption by bone char. They were found to give values in close agreement with experimental data obtained in laboratory investigations of remelt liquor decolorization. The system of equations is thus considered suitable for establishment of the diffusion coefficient of colorants in the solid phase and the coefficients of mass transfer and permeation. The expressions are also applicable to any granular adsorbent for calculation of process parameters.

* * *

Devices for directing and feeding pressed refined sugar to automatic wrappers. YU. F. TSYUKALO, V. T. RUD', E. A. ZHURAVSKII and B. I. KRAMARENKO. *Sakhar. Prom.*, 1977, (1), 33–37 (*Russian*).—Details are given of a system for automatic feeding of cube sugar to an automatic wrapping unit at the authors' refinery.

[1] "Mathematics of diffusion" (Clarendon Press, Oxford) 1956.



Laboratory methods & Chemical reports

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Determination of invert sugar in technical sugar juices. II. Comparative tests on different analytical methods with particular reference to thick juice control. E. REINEFELD, A. EMMERICH, H. VAN MALLAND and D. MIEHE. *Zucker*, 1976, **29**, 657–664 (*German*). Comparisons were made between the method of SPENGLER *et al.* (using Müller's solution), enzymatic determination[1] and photocolorimetric methods involving the use of dinitrophthalic acid and triphenyl tetrazolium chloride, respectively, as well as that described earlier[2] for invert sugar determination in beet raw juice, thick juice and molasses. The enzymatic method was found to give by far the lowest values. The method of SPENGLER *et al.*, in which allowance has to be made for the effect of readily oxidizable substances, gave lower values than the dinitrophthalic acid and TTC methods; the triazole method[2] gave higher values than the method of SPENGLER *et al.* only in the case of thick juice; with raw juice it gave lower values and about the same values with molasses. The other two photometric methods gave highest values of the methods tested. The triazole method has the advantage, however, of a colour reagent which is specific for aldehydes and the absence of need for clarification of the test solution. On the other hand, it is unsuitable for invert sugar determination in raw juice containing formalin because of the strong colour formation consequent on reaction with the latter. There were no marked differences between reproducibilities. The TTC method was of lower sensitivity than the other colorimetric methods and would not permit detection of invert sugar at a concentration below 100 μg. The photometric methods studied took about the same time (15–20 minutes). With use of lead reagent, the triazole method can be carried out at room temperature; on the other hand, the colour reagent used in the dinitrophthalic acid method is more stable. Both methods are considered suitable for thick juice invert sugar determination and can be simplified for use as approximation methods (by using colour comparison). Further investigations were conducted on invert sugar determination in molasses based on use of Müller's solution with the method of SPENGLER *et al.* and a method using EDTA as complexing agent. So-called "hot" and "cold" values (obtained with heating and at room temperature, respectively) were determined and the resultant adjustments for the two methods found to be closer than indicated by the "hot" values, although the method of SPENGLER *et al.* gave higher values. However, very close agreement was found between the two methods in terms of % invert sugar. While the reducing components had a marked effect on iodine consumption, the compensating effect of determination at room temperature was considered sufficient, and no further advantage would be given by a more involved method to separate the cuprous oxide.

* * *

Temperature-dependent behaviour of D-fructose in aqueous solutions and melts. W. MAUCH and E. O. FARHOUDI. *Zeitsch. Zuckerind.*, 1976, **101**, 766–771 (*German*).—See FARHOUDI & MAUCH: *I.S.J.*, 1977, **79**, 85.

* * *

Filtering quality of raw sugar. J. P. MURRAY, F. M. RUNGGAS and M. VANIS. *Sugar J.*, 1976, **39**, (5), 14–20.—See *I.S.J.*, 1975, **77**, 124.

* * *

Determination of nitrogen, phosphorus and potassium in plant tissue and vinasse by sulphuric digestion. N. A. DA GLÓRIA and J. O. FILHO. *Brasil Açuc.*, 1976, **88**, 298–304 (*Portuguese*).—Although digestion with sulphuric acid is used for nitrogen analysis, plant tissue and vinasses are usually digested with nitric and perchloric acids for analysis of P and K. A series of tests have shown that the last two elements may be determined with comparable accuracy in a sulphuric acid digest which thus saves time and cost in the analysis by comparison with two separate digestions.

* * *

Is it possible to predict molasses sugar from simple measurements carried out on beets? P. DEVILLERS, R. DETAVERNIER, P. GORY, M. LOILIER and J. ROGER. *Sucr. Franç.*, 1976, **117**, 437–448 (*French*).—Correlation between molasses sugar content (S_m) and the main impurities K, Na and N is discussed and an empirical formula derived from three years' experiments which takes the form $S_m = 0{\cdot}146K + 0{\cdot}117Na + 0{\cdot}197N$ (g % g). Values of melassigenic coefficients are given, highlighting the considerable melassigenesis of nitrogenous compounds. The relationships between beet and molasses K, Na and N were investigated at seven factories during four campaigns. It was concluded that the rate of K extraction in diffusion is variable and changes in the content may occur as a result of juice deliming by ion exchange. The amount of Na found was generally double that introduced with the beet, but the amounts added during processing could range from zero to very considerable quantities, depending on the processing technique used by the individual factory. The ratio of total N in molasses to α-amino-N in beet averaged 2·07. Where the alkalinity coefficient is greater than 2·1, the new formula takes the form $S_m = 0{\cdot}124K + 0{\cdot}117Na + 0{\cdot}408\alpha N$ where K, Na and αN are the contents in the beet; where the alkalinity coefficient is <2·1, the formula takes the form $S_m = 0{\cdot}007K +$

[1] KUBADINOW: *I.S.J.*, 1974, **76**, 348.
[2] REINEFELD *et al.*: *ibid.*, 1976, **78**, 380.

0·654N. (If the Quentin ion exchange process is used, the formulae are further modified.) Comparison is made between results obtained with the new formulae and with those of WIENINGER & KUBADINOW[1] and REINEFELD *et al.*[2]. Discrepancies between the values given by the new formulae and factory figures as well as by the other formulae are discussed for each of the three constituents. While the errors resulting from use of average values for K and Na in the formulae are on the small side, that based on determination of α-amino-N in beet rather than total molasses N is considerable, and the authors consider that, until a suitable automatic means of estimating the total soluble N in beet is found, it is preferable to use the WIENINGER & KUBADINOW formulae which are as accurate as the new formulae; the latter may be of value for factories wishing to determine the molasses N:beet α-amino-N ratio and the coefficient of alkalinity which they wish to maintain by sodium addition.

* * *

A viscosity equation for concentrated, pure and impure sucrose solutions. K. WAGNEROWSKI and C. DABROWSKI. *Gaz. Cukr.*, 1976, **84**, 241–246, 256 (*Polish*). Investigations on Polish molasses from three factories are reported, in which linearity was established between log viscosity η and molar concentration n, between log $\eta(n)$ and temperature and between log $\eta(n)$ and Brix. An empirical formula is given for calculation of log η at concentrations greater than 70°Bx which is applicable to both molasses and pure sucrose solutions; it takes the general form $\log \eta = (n - n_w)(\frac{m}{t + a} + b) + \log \eta_w$, where a, b, m and n_w are constants and t is temperature. Substituted values of the constants have been calculated for the particular cases of Polish molasses and highly concentrated pure sucrose solutions. For concentrated impure solutions, viscosity is given by $\frac{\eta_m (100 - Cz_r) + \eta_s (Cz_r - Cz_m)}{100 - Cz_m}$ where η_m is the molasses viscosity, η_s is the viscosity of pure sucrose solution, Cz_r is the solution purity and Cz_m is the molasses purity. The formulae are considered of value for calculations involved in low-grade massecuite boiling and molasses exhaustion.

* * *

The chemical composition of beet from different beet-growing areas of the Ukraine and its effect on processing. A. D. GOLUBEVA *et al. Sakhar. Prom.*, 1977, (1), 22–25 (*Russian*).—Tabulated details are given of the chemical composition of beet from six areas of the Ukraine harvested in 1975. Also tabulated are values of (i) 1st carbonatation juice titratable and natural alkalinity and pH_{20}, (ii) 2nd carbonatation juice titratable alkalinity, pH_{20} and lime salts content, and (iii) thick juice pH_{20} and lime salts content corresponding to the beet from the specific regions as processed at an experiment station. Recommendations are given for optimum processing on the basis of the findings.

* * *

Fractionation and differential determination of high polymers in dark coloured products. I. F. BUGAENKO and A. I. LAPKIN. *Sakhar. Prom.*, 1977, (1), 37–41 (*Russian*).—The high-polymer compounds in e.g. molasses are fractionated by diluting to a required dry solids concentration and the pH adjusted to 3·1–3·3 with HCl to precipitate irreversible colloids which are soluble in weak NaOH solution but insoluble in water. After filtration or centrifuging, the separated colloids are determined quantitatively by drying and weighing the precipitate or photometrically after appropriate dissolution. The filtrate is treated with alcohol or ether to precipitate reversible colloids which are readily soluble in water. The precipitate is filtered and dissolved in distilled water to give a mixture of pectins and colorants, which is passed through anion exchange resin on which the colorants are adsorbed while the pectins are precipitated with alcohol for quantitative determination. The colorants are eluted with alkali and then measured photometrically. Use of a calibration curve simplifies and accelerates determination of the reversible colloids. Full details are given of the quantities involved in the procedures, and some sample results are given for molasses from four factories.

* * *

pH measurement in sugar factories. B. TICHÁ and M. FRIML. *Listy Cukr.*, 1976, **92**, 241–247 (*Czech*).—The fundamentals of potentiometric pH measurement are explained and the suitability of various types of electrodes discussed. Factors of importance in use of electrodes were investigated. In the pH ranges 4–7 and 7–9 the potential of commercial glass and combined electrodes varied by up to 10% from the nominal value of 59 mV for the overall pH range 4–9 with unit change. Immersion of electrodes in alkaline buffers (borax, calcium carbonate or calcium hydroxide) for up to 12 days, with a pair of electrodes used as control, was found to cause deviations in the measured values from the initial pH of the solutions, the discrepancies increasing with time of immersion, while the actual pH of the solutions changed only very slightly over the entire period. During the campaign, the dependence of pH on temperature was investigated in the case of thin, thick and 1st carbonatation juices, remelt liquors and syrups. It was found that in all cases pH fell with rise in temperature. The temperature coefficients were calculated in each case. The importance of pH determination in factory processes is discussed, and advice is offered on suitable procedures.

* * *

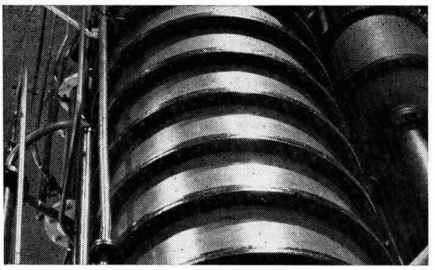
New automated assay for the direct analysis of D-fructose-D-glucose mixtures. J. F. KENNEDY and M. F. CHAPLIN. *Carbohyd. Res.*, 1975, **40**, (2), 227–233; through *Anal. Abs.*, 1977, **32**, Abs. 1C11.—The method is based on the formation of coloured products when D-fructose is heated with HCl; optimum settings for sample, air, HCl and H_2O in the proportioning pump used are given. The mixed solution is heated at 85°C for 3 minutes, then cooled, and its extinction measured at 470 nm in a flow-through cell. Other ketose-containing carbohydrates (sucrose, raffinose and inulin) also react and can be similarly determined. Glucose, when present in equimolar amounts to the fructose, interferes only to the extent of 0·05%. The method is therefore particularly suited to the quantitative control of D-fructose during its industrial production by enzymic isomerization of 50% glucose solution.

* * *

Sucrose nucleation. I. Derivation of a general equation for nucleation rate. R. BRETSCHNEIDER and M. SVOBODOVÁ. *Zucker*, 1977, **30**, 16–22 (*German*).—See *I.S.J.*, 1975, **77**, 381.

---

[1] *I.S.J.*, 1972, **74**, 88.
[2] *ibid.*, 1974, **76**, 347.



By-products

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Preparation and characterization of dextran from sucrose by the action of a locally isolated strain of *Leuconostoc mesenteroides*. J. JAFRI, R. ZUBERI and S. A. H. ZAIDI. *Pak. J. Sci. Ind. Res.*, 1974, **17**, 219–222; through *S.I.A.*, 1976, **38**, Abs. 76–1494. Dextran was produced by growing a strain of *L. mesenteroides* in a medium containing 100 g sucrose per litre plus tryptone, yeast extract and salts. Culture conditions, the precipitation and purification of the dextran and its properties are described. The maximum yield, obtained after 18 hours' culture at 25–27°C, was 29% on initial sucrose or 58% on available glucose. Equally good results were obtained when rice-polishing or wheat bran was substituted for the tryptone + yeast extract.

* * *

Budget with basic fodder after a dry year. ANON. *Die Zuckerrübe*, 1976, **25**, (6), 12–13 (*German*).—Advice is given on various suitable combinations of beet leaf silage and dry beet pulp with other materials in basic rations for dairy cattle and fat stock. The feed value of dry pulp is further indicated in a table comparing a number of fodder materials, and the benefits of replacing 80% cereal mixture with 30% cereal plus 50% pulp in a ration also containing soya meal are demonstrated, including a considerable reduction in the calcium deficiency.

* * *

A comparison between oats and dried molasses sugar beet pulp for dairy cows. B. FRANK, I. ANDERSSON and C. PIRA. *Socker Handl.*, 1976, **28**, (1), 1–16. Feeding trials conducted on dairy cows in the winter of 1966-67 are reported. Three groups were fed the same quantity of roughage (grass silage and barley straw); Group A was fed 72% "betfor" (a dry 1:1 beet pulp:molasses mixture), 25% oil cake and 3% mineral ration; Group B received 38% "betfor", 38% oats, 21% oil cake and 3% minerals, while Group C was fed 80% oats, 17% oil cake and 3% minerals. Each group was split into two sub-groups: one of older cows and the other of first-calf heifers. The rations fed to Group B cows provided the highest milk yield in both sub-groups and the highest milk fat yield from the older cows. "Betfor" had a more positive effect on milk fat content than did oats, but oats gave a softer fat. "Betfor" had no laxative effects.

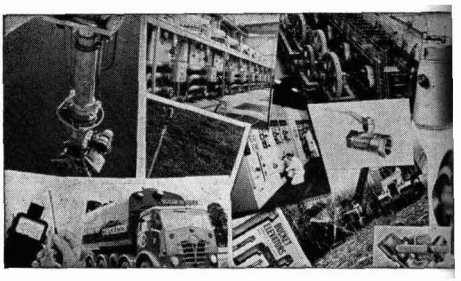
* * *

Wet dedusting in pulp drying. F. DANZER. *Zucker*, 1976, **29**, 670–672 (*German*).—The pressed beet pulp at Tulln is mixed with about 30% molasses before drying in two drums, the vapour from which is passed through a cyclone. After numerous complaints from the residents of the local town, which lies to the east of the factory and is thus in the path of the cloud of dust from the cyclone when a westerly wind is blowing, measurements were made by a number of firms specializing in determination of gas dust contents. Close agreement was found between the measurements. One set of values indicated a dust content which was lowest at 158·7 mg.Nm^{-3} for pulp with about 11% molasses and exhausted cossette addition; with only molasses added, the dust content was 174·5 mg.Nm^{-3}, while addition of only 6–7% molasses gave a dust content of 201 mg.Nm^{-3}. Most of the dust comprised very fine cellulose and molasses particles; particle size ranged from 3 to 100 μm, with 20% of the dust below 10 μm. The factory was ordered to restrict the dust content to a maximum of 100 mg. Nm^{-3} on the basis of the findings. A Büttner-Schilde-Haas multiaxial cyclone was not suitable since the suppliers could not guarantee a dust content below 126 mg.Nm^{-3}, so that the choice fell on a Heimpel & Besler wet deduster, which operates on the Venturi jet principle using the Keller system. Details are given of the equipment and its operation. Measurements of the exhaust gas dust content obtained in trials indicated a final concentration of 20–30 mg. Nm^{-3}, so that it was decided to install four such dedusters; however, it was necessary for the steel plate used in construction to be stainless and acid-resistant in view of considerable quantities of SO_2 and SO_3 found in the vapours from the dryers (giving a pH of 5–6). A constant water level must be maintained in the deduster in order to provide maximum efficiency. Possible ways of doing this are briefly indicated. The dedusting unit was first put into regular operation in 1974/75, and measurements indicated a final dust content of 4–6 mg.Nm^{-3}.

* * *

Study on protein requirements and sugar utilization in starter diets for ducks (0 to 3 weeks). R. GUTIÉRREZ. *Cuban J. Agric. Sci.*, 1976, **10**, 57–62.—While duck fattening on molasses diets has been successful at the Instituto de Ciencia Animal, with the ducklings being started on a cereal diet and then converted to a molasses ration at the age of 2–3 weeks, a certain reduction in performance has been observed with the change in diet. Experiments were carried out to determine the optimum protein level in the starter rations and to see if sugar in the diet during the initial stage could reduce the adverse effect of the molasses. The optimum protein level was found to be 18% of the dry matter intake. Replacement of maize with up to 60% raw sugar improved the live weight gain, although it did not give any improvement in subsequent performance with the molasses diets.

Trade notices

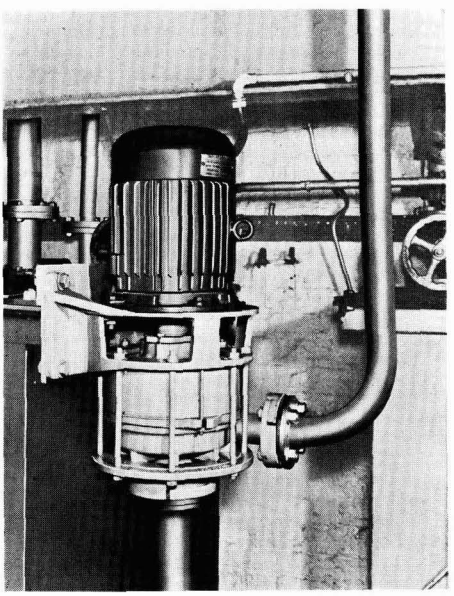


Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Kestner pumps in refining. A.P.V.-Kestner Ltd., Greenhithe, Kent, England.

The Fluid Handling Division of A.P.V.-Kestner Ltd., of Greenhithe, Kent, England, specializes in the design and manufacture of centrifugal pumps for handling corrosive, abrasive or otherwise difficult liquids.

One of the most widely used of their range of pumps is a vertical glandless unit. This pump, while similar in hydraulic design to most conventionally sealed centrifugal pumps, differs in that it is installed in the vertical position and is directly coupled to the driving motor, which forms the pump bearing assembly. The need for any form of mechanical seal or packed stuffing box is removed by allowing a controlled leakage of the liquid being pumped to return to the suction tank through an overflow connexion in the upper body of the pump. As there are no bearings or rubbing surfaces whatsoever in the pump, it can be allowed to run completely dry for indefinite periods; as the overflow or controlled leakage acts as a "built-in" by-pass, the pump will operate against a fully closed discharge valve, the liquid continuously circulating from the vessel through the pump and back into the vessel.



In 1964, A.P.V.-Kestner were approached by Tate & Lyle Ltd., the major UK cane sugar refiners, who were interested in glandless pumps to handle sugar solutions at various stages in the refining process at their Liverpool refinery. The problem they were experiencing was that of leakage from the glands of conventional centrifugal pumps, which caused the refinery floors to be covered with sticky syrup. Costs involved in re-packing glands or replacing mechanical seals were considerable. Initially, Kestner supplied two cast iron vertical glandless pumps for trial purposes, one to handle milk-of-lime used in carbonatation, and the other to handle a straightforward 70°Bx sugar solution. The original milk-of-lime pump was in daily use for 12 years before requiring any maintenance, and as a result of the initial trials the customer now uses over 100 Kestner glandless pumps in the Liverpool refinery.

From the user's point of view, the main advantages of glandless pumps in sugar refining, may be summarized as follows:—

(1) No leakage of sugar solutions onto refinery floors.

(2) No dilution of the product, as often happens when a pump is fitted with a seal or packed stuffing box requiring clean water flushing.

(3) No floor space required, since the glandless pumps are located at the top of the tank.

(4) Very big savings in maintenance, both in labour and material cost, as well as no loss of production resulting from pump failure.

A good example of the changes brought about by using Kestner glandless pumps in the sugar industry is to be seen in the handling of raw syrup in a UK refinery. Until two years ago the customer had been using two very large duplex ram pumps occupying a floor space of about 40 m^2 to handle the syrup. The ram pumps were removed and replaced by a single 80-mm discharge Kestner pump, leaving the floor space, previously taken up with the ram pumps, completely clear and clean. It was estimated that the capital cost of the single Kestner pump was less than half the annual maintenance cost of the two ram pumps. The Kestner glandless pumps are often seen by overseas visitors to the refinery, and as a result of one such visit, orders were placed for a number of large stainless steel glandless pumps for a cane sugar refinery in the Middle East.

The pumps are made in all machinable metals and alloys and are capable of flow rates up to 300 $m^3.hr^{-1}$ and discharge heads up to 80 m.

Table of Contents

ICUMSA 17th Session, 1978

The 17th Session of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) will be held, by courtesy of the Canadian National Committee of ICUMSA, in Montreal, Canada, in June 1978. The programme will begin with a reception on the evening of Sunday, 4th June and conclude with a banquet on the evening of Friday, 9th June.

Working sessions will be held on mornings (0900 to 1230) and afternoons (1400 to 1700) on Monday, Tuesday, Thursday and Friday and on the morning only of the Wednesday, in the Bronfman auditorium of McGill University, where simultaneous interpretation (English, French and German) will be available. An alternative programme for ladies will be arranged.

The main hotel will be the Quatre Saisons where special rates have been negotiated. Alternative accommodation at the Quality Inn and in student rooms at McGill University will also be available.

Registration forms and further information will shortly be available from Chairmen of National Committees or from the General Secretary, P.O. Box 35, Wharf Road, Peterborough, England PE2 9PU.

* * *

Somalia sugar industry expansion[1].—The Government of Somalia and Booker McConnell Ltd. recently signed a contract for the development of a sugar complex on the Giuba River in Bardera. The production capacity of the sugar complex is to reach 50–60,000 tons per annum, and the total project is understood to involve some $100 million. The project is to come on stream at the end of 1978. In addition to the erection of a new sugar factory, the existing factory in Jowhar is to be modernized and expanded, production having dropped markedly during the past few years. Total production in 1970 reached 45,953 tons and fell to 30,600 tons in 1975, so that Somalia had to import 12,600 tons.

* * *

Cuba sugar production plans[2].—Cuba has set a target of at least 5·5 million tons of sugar for the 1976/77 season. Since the area under cane is only 1·3 million ha, there is need for considerable rise in efficiency in order to reach the target. The Cuban Government has allotted 110 million pesos for modernization of existing factories, and three new factories are to be built in 1978.

* * *

US mainland sugar production 1976[3].—Production of cane sugar in Florida in 1976 totalled 1,023,453 short tons, raw value, as against 964,611 tons in 1975. Production in Louisiana totalled 644,100 tons against 653,948 tons in 1975, while the Texas production fell from 100,956 tons in 1975 to 86,695 tons last year. Total mainland cane sugar production was 1,754,248 tons against 1,719,515 tons in 1975. Domestic beet sugar production totalled 3,987,133 short tons, raw value, against 3,472,676 tons in 1975, giving a total 1976 production of 5,741,381 tons against 5,192,191 tons in 1975.

* * *

Bolivian bagasse paper project[4].—Ingeniería Politécnica Americana has carried out a feasibility study for the Comité de Desarrollo de Tarija for construction in Bermejo of a $40 million (equivalent) paper factory which will use bagasse as raw material and will be initially capable of producing 16,000 tons/year, later to be expanded to 30,000 tons/year, of newsprint, kraft and writing papers. Production is to begin in 1980.

* * *

New South African cane variety[5].—A promising new variety of cane has become available for pre-release this spring. Designated N11, the variety is a CB 40-35 × N:Co 293 cross and produces a fairly large proportion of stalks of average height and diameter. Occasional flowering has been observed. With the exception of slight rust, no diseases have been recorded on N11 in four selection crops, a smut screening trial or a disease screening trial at the South African Sugar Experiment Station. Although essentially a variety for irrigated areas, it is being evaluated for rain-fed conditions. In irrigated trials its yield of sucrose has been similar to, and recoverable sugar higher by 0·9% than, that of N:Co 376.

US sugar imports 1976[6]

	1976	1975
	—(*short tons, raw value*)—	
Domestic		
Hawaii	985,120	954,847
Puerto Rico	204,540	96,093
Foreign		
Argentina	86,729	112,318
Australia	469,528	479,172
Belgium	1,129	0
Belize	14,349	46,155
Bolivia	52,990	3,507
Brazil	0	197,131
Canada	50,568	39,990
Colombia	84,454	159,065
Costa Rica	65,075	56,240
Dominican Republic	971,309	775,147
Ecuador	28,440	46,770
France	13,340	0
Germany, West	990	1
Guatemala	330,756	60,606
Haiti	6,218	11,622
Holland	1,501	22
Honduras	7,483	6,073
India	188,506	187,624
Korea	777	10,615
Malagasy Republic	13,400	13,022
Malawi	17,659	26,585
Mauritius	29,811	26,741
Mexico	551	41,130
Mozambique	31,847	15,090
Nicaragua	165,633	57,962
Panama	95,031	98,250
Paraguay	10,187	3,328
Peru	312,772	215,679
Philippines	915,124	413,034
Salvador	143,154	107,466
South Africa	98,472	134,082
Surinam	0	1,296
Swaziland	45,805	35,795
Switzerland	745	0
Taiwan	86,533	139,963
Thailand	70,059	123,512
Uruguay	5,229	0
West Indies	243,978	237,537
Other countries	100	59
	4,660,232	3,882,589
Acquired for reprocessing and samples	3,121	3,139
Domestic imports	1,189,660	1,050,940
Total	7,536,493	6,316,917

* * *

Sudan sugar project problems[7].—It was recently reported that the Kenana sugar complex[8] is running into difficulties; the estimated cost has more than doubled to over $500 million. A meeting has been called in Khartoum to discuss the scheme's cost and management and the need for additional finance. Despite the cost over-run it was expected that the project will be given the go-ahead essentially as it was conceived originally, but certain details of the scheme may be subject to change. A plan expected to be discussed at the Khartoum meeting is for a substantial increase in the Kenana share capital from $100 million to $260 million. A modification to the scheme that may be proposed at the meeting is to raise its annual refining capacity from 350,000 to 500,000 tons. This, it will be claimed, would improve its operating economics but also add a further $30–$50 million to its capital costs. The modification would enable the sugar factory to operate for 11 months a year instead of 7–7½ months, and would probably require extra plant to permit part-processing to syrup and storage. The estimated date for the start of production has been put back to November 1978.

---

[1] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (6), 12.
[2] *Die Lebensmittelind.*, 1977, **24**, 141.
[3] *U.S.D.A. Sugar & Sweetener Rpt.*, 1977, **2**, (3), 9.
[4] *Amerop Noticias*, 1977, (41), 12; *Bank of London & S. America Review*, 1977, **11**, 204.
[5] *S. African Sugar J.*, 1977, **61**, 123.
[6] *U.S.D.A. Sugar & Sweetener Rpt.*, 1977, **2**, (3), 9.
[7] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (9), 14.
[8] *I.S.J.*, 1976, **78**, 237.

Australia sugar exports 1976[1]

	1976	1975	1974
	——(*metric tons, raw value*)——		
Canada	463,624	473,884	338,717
China	225,471	36,965	30,949
Japan	805,347	265,803	256,847
Korea, South	184,242	218,059	110,152
Malaysia	213,606	266,803	210,616
New Zealand	58,196	59,869	109,572
Oceania	9,249	9,736	9,288
Papua & New Guinea	20,342	5,591	19,800
Singapore	85,484	111,977	81,476
UK	178,241	16,569	383,095
USA	377,186	496,703	221,808
USSR	0	0	53,311
Other countries	0	0	2,118
Total	2,620,988	1,961,959	1,827,749

* * *

EEC farm prices 1977/78.—After failure to agree in March, the Agriculture Ministers of the EEC member countries met again on the 25th–26th April. Earlier, the UK Minister had refused agreement in the hope of achieving a higher butter subsidy and smaller devaluation of the "green pound", but in April he accepted virtually the same offers as made previously. The agreed minimum beet price is 25·43 units of account per metric ton while the intervention and target prices for white sugar are 34·59 and 36·33 u.a. per 100 kg. The earlier proposal[2] to restrict quota B to 25% (instead of 35%) of quota A production was not carried, while the proposed levy on HFCS, originally proposed as the same as on B-quota sugar, was cut by about half, from 9·8 to 5 u.a. per 100 kg.

* * *

Panama sugar project.—The start-up has been announced of Ingenio de Chiriqui near David, Panama, a $42,000,000 facility of Corporación Azucarera La Victoria, which will produce raw sugar from 6000 metric tons of cane per day. F. C. Schaffer & Associates Inc. of Baton Rouge, La., U.S.A., was consultant for the project from feasibility study through design, engineering and construction supervision to start-up. A substantial part of the construction materials and boiling-house equipment were purchased in Louisiana and financing was arranged by Schaffer from sources including the US Export/Import Bank and Wells Fargo Bank, N.A.

* * *

Argentina sugar production 1976[3].—Final figures for the 1976 season show that a total of 8,738,965 metric tons of cane was crushed in Tucumán to yield 824, 245 tons of sugar, raw value, a net yield of 9·432%. In Jujuy, 3,727,666 tons of cane yielded 416,477 tons of sugar (11·173% yield) while the corresponding figures for Salta and Litoral were 1,380,013 tons, 149,958 tons (10·864%) and 660,942 tons, 69,178 tons (10·467%), respectively. Overall figures for Argentina are 14,507,920 tons of cane crushed to yield 1,459,857 tons of sugar, raw value (10·062%).

* * *

Ivory Coast sugar projects.—In addition to the new sugar factories at Ferkessedougou II, Borotou and Zuenoula[4], a plant at Serebou and another at Katiola Marabadiassa, beside the river Bandama, are to come into operation in 1978/79[5]. A number of other projects are under study; they are planned for Sorotona, Mankono-bere, Nzi Dabakala. Dimbokro and Bondoukou, all in the centre of the country. Each would involve an investment of around 800 million French francs and have a production capacity of 50,000 metric tons a year. The aim is to produce 600,000 tons/year by 1990, compared with 35,000 tons in the 1976/77 season. SOFRECO (Société Française de Réalisation, d'Etudes et de Conseil) has been appointed consultant to the Ivory Coast sugar industry SODESUCRE, in the establishment of requirements and comparison of tenders for the sugar complex at Borotou which is to include a 3500 t.c.d. cane sugar factory, a 5000 ha plantation, an irrigation network with pumping stations and the infrastructure and villages. SOFRECO is also to coordinate the establishment of the Borotou complex with those of Katiola and Serebou in order to ensure some standardization of plant and equipment.

* * *

Chile beet area decrease[6].—The area sown to beet in Chile for the 1976/77 campaign was 56,230 hectares, 7570 ha less than the 1975/76 beet area of 63,800 ha.

Brazil sugar exports[7]

	1976	1975	1974[5]
	——(*metric tons, raw value*)——		
Afghanistan	0	13,439	0
Algeria	225,817	172,786	279,476
Burundi	425	0	0
Cameroun	2,165	0	0
Chile	0	38,874	51,880
China	0	71,942	0
Cyprus	0	0	1,065
Dubai	650	0	0
Egypt	125,477	2,131	62,962
EEC—Belgium/Luxbg.	0	11,243	0
France	89,433	73,075	76,470
Germany, West	0	5,361	0
Holland	0	4,825	0
Italy	0	30,815	0
UK	101,000	100,475	135,982
Finland	46,133	11,735	0
Ghana	9,562	5,314	0
Greece	0	0	10,663
Hungary	0	0	19,324
Iraq	153,204	277,225	247,310
Iran	9,724	38,602	62,298
Israel	0	36,328	21,005
Ivory Coast	0	7,177	0
Japan	210,087	346,594	234,994
Jordan	23,818	0	0
Kuwait	2,923	18,216	0
Lebanon	0	9,548	32,064
Libya	0	0	11,148
Malta	0	2,186	0
Morocco	13,650	12,802	61,078
Pakistan	0	11,181	0
Paraguay	8,406	0	0
Portugal	13,200	40,066	11,000
Qatar	0	0	5,933
Saudi Arabia	0	11,774	0
Senegal	6,300	7,789	40,088
Spain	0	23,384	79,864
Syria	36,249	61,048	70,217
Tunisia	21,428	11,952	47,830
Turkey	0	0	11,037
Uruguay	0	0	12,740
USA	0	154,673	699,028
USSR	0	95,494	0
Venezuela	60,088	0	12,153
Yemen	0	0	5,047
Yemen Dem. Rep.	5,954	5,867	0
Yugoslavia	75,782	15,677	0
Zaire	10,904	0	0
	1,252,389	1,729,598	2,302,656

* * *

Guyana sugar production target 1977[8].—The Guyana sugar industry has set a target of 330,000 long tons, raw value, for 1977. An industry spokesman described this as a realistic target which reflects a slight reduction of 2457 tons on the amount actually produced last year. The spring crop, which started in February, will be affected by the prolonged rainfall last year followed by sudden drought-like conditions. The target for this crop has been set at 113,000 tons, as compared with 149,000 tons actually produced in 1976 for the spring crop. However, it is expected that weather conditions will return to normal later in the year and the autumn crop should do better than last year's which yielded 183,000 tons.

* * *

Indonesia sugar consumption[9].—The Indonesian Minister of Agriculture has forecast that sugar consumption in his country, once a major world sugar exporter, might rise to 1,350,000 metric tons in 1978 from 1,200,000 tons in 1977. He also said that the Government is renovating 54 sugar factories in Indonesia in a bid to boost domestic production from the present annual 1,100,000 tons.

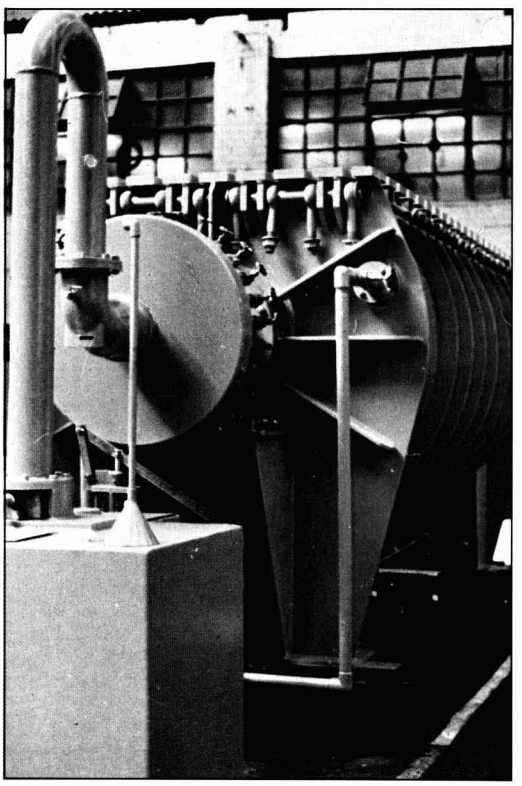
---

[1] *I.S.O. Stat. Bull.*, 1977, **36**, (3), 20.
[2] *I.S.J.*, 1977, **79**, 122.
[3] *La Ind. Azuc.*, 1977, **84**, 60.
[4] See *I.S.J.*, 1977, **79**, 156, 180.
[5] *Reuters Sugar Rpt.*, 21st March 1977.
[6] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (10), 10.
[7] *I.S.O. Stat. Bull.*, 1977, **36**, (4), 24.
[8] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (6), 12.
[9] *Public Ledger*, 23rd April 1977.

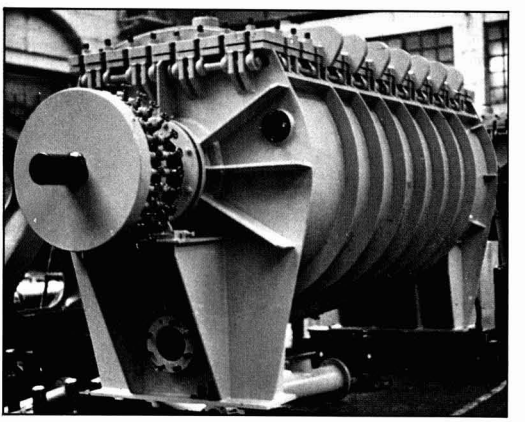
Index to Advertisers

SMITH MIRRLEES

ROTA FILTERS



The latest Smith Mirrlees design gives you all the outstanding features of the previous model and are custom built to meet specific operational demands



Produced in three sizes
720-900-1260 square feet area

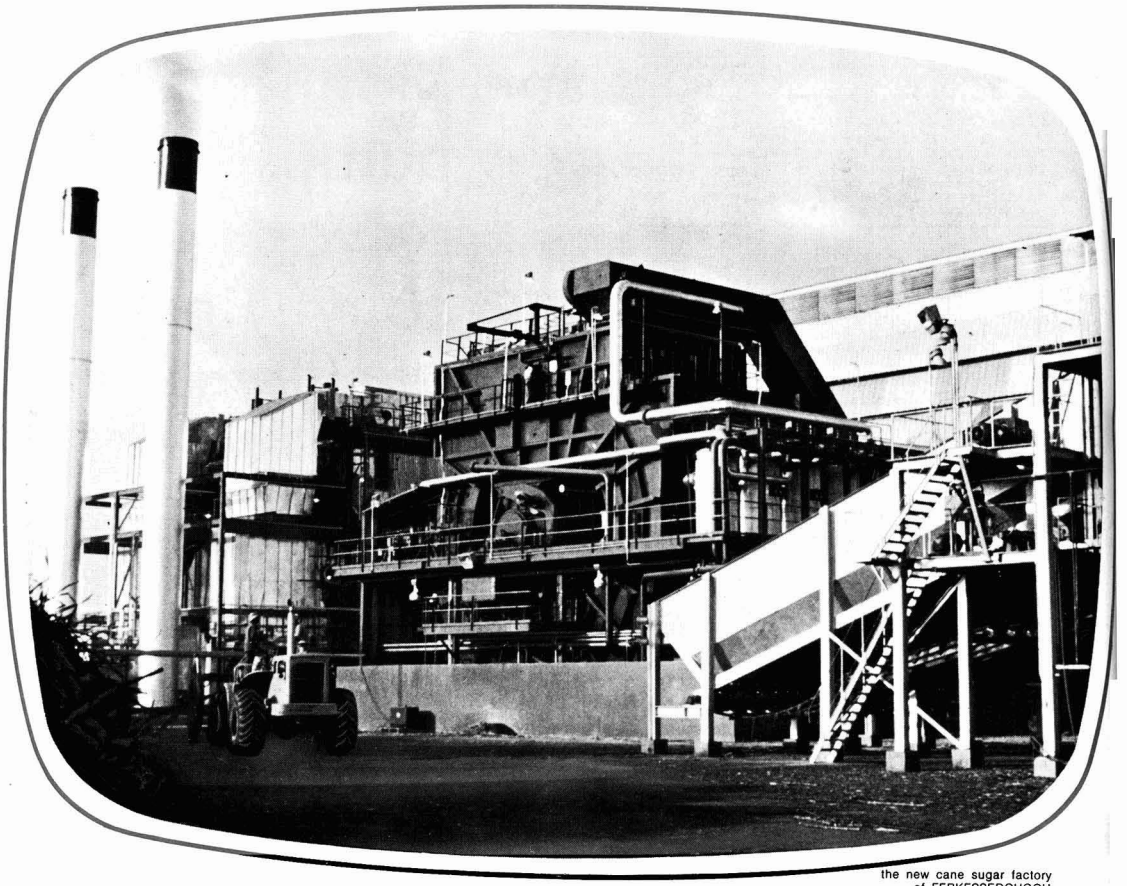
TATE + LYLE Engineering

SMITH MIRRLEES
Sugar Factory and Refinery Engineers

TATE + LYLE Engineering

No1 COSMOS HOUSE BROMLEY COMMON, BROMLEY BR2 9NA GREAT BRITAIN
Cable Address: TEC SERVE BROMLEY, KENT. Telex 896368. Telephone 01-464-6556

Works: COOK STREET, GLASGOW G5 8JW. Telex 77137. Telephone 041-429-5441



the new cane sugar factory
of FERKESSEDOUGOU
(IVORY COAST)
5 000 TC/D
equipped with the modern
extraction process:
THE SATURNE DIFFUSER
(French patent SUCATLAN).

modernization or extention of a sugar mill
and especially the construction of a new factory
are not conceivable without taking into consideration
1) the technology developments
2) a better research of rentability

The new conception of the continuous maceration process

saturne

guarantees through a simple and sturdy equipment:

- a complete fiability
- a totally automatic operation
- a better extraction compared to a 18-roll mill tandem, giving a mixed juice of high purity

A GREAT SAVING OF POWER

- SATURNE diffusers are in operation in Mauritius, South Africa, Ivory Coast, soon in India and many other sugar countries.
- Before engaging any responsability on your extraction plant, we recommend to study seriously the advantages offered by the SATURNE

free brochures upon demand

SUCATLAN ENGINEERING

Department IS
18, Av. Matignon - 75008 PARIS - FRANCE
Phone: 266.92.22 - Telex: 29017 (SUCATLAN-PARIS) - Cables: SUCATLAN-PARIS

SAGAL Publicité - Paris - N° 1030

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.

-4.MAR 25