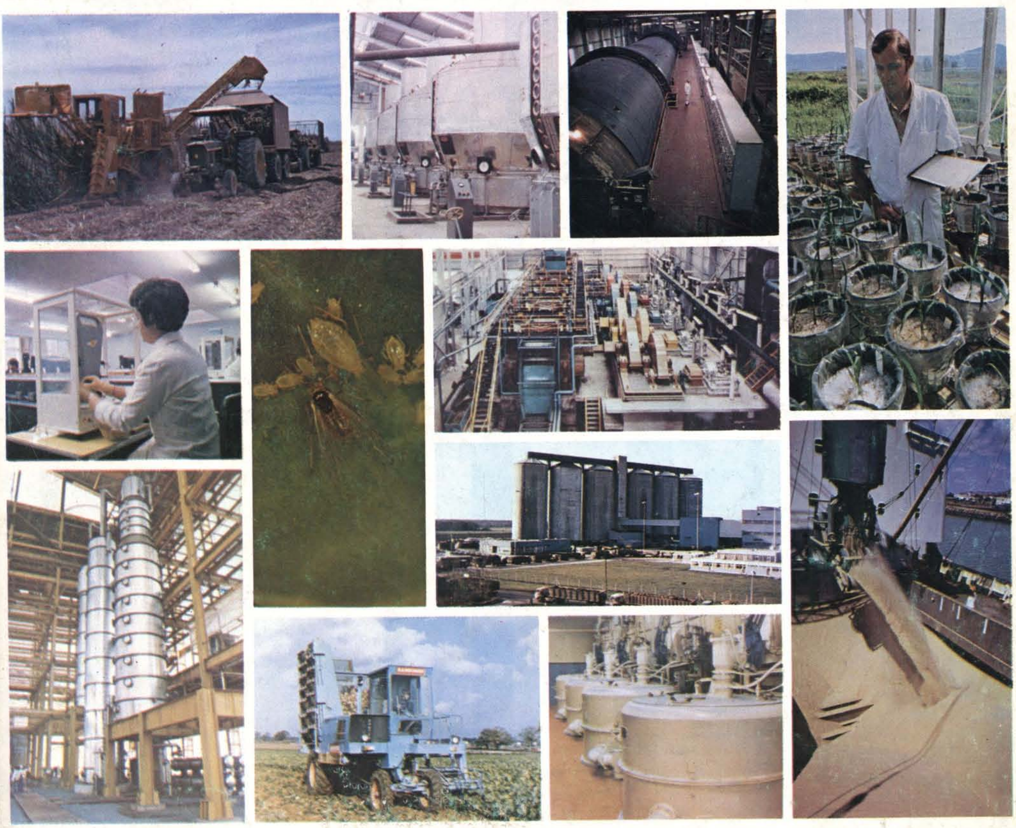
INTERNATIONAL SUGAR JOURNAL

VOLUME LXXX
SUPPLEMENT



SIT 37th Annual Meeting

MAY 1978

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SUGAR INDUSTRY TECHNOLOGISTS INC. 1978 MEETING, LONDON.

Published by
International Sugar Journal Ltd.

23a Easton Street,
High Wycombe, Bucks.,
England HP11 1NX.

INTERNATIONAL SUGAR JOURNAL

Volume 80
Issue No 953

SUPPLEMENT

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Message from the President

"Oh to be in England". It is doubtful that the sugar industry was among the attractions Browning had in mind when he wrote that famous line. But in May 1978, London, in addition to its standard attractions, will have another—the 37th Annual Meeting of the Sugar Industry Technologists Inc., better known by its initials SIT. This, the first meeting outside the North American Continent for SIT, reflects the growing international composition of its membership.

SIT, founded in 1941 as an organization for technologists employed in refining raw cane sugar, today still remains primarily oriented toward sugar refining. However, in these days of increasing involvement by various Corporations with more than one type of carbohydrate sweetener operations, some of its members may wear more than one hat. Although the bulk of its membership is made up of technologists from the United States, Canada and England there are memberships by companies and technologists from fourteen other countries scattered literally in every area of the world where raw cane sugar is refined. In addition to its sugar refining members SIT has many allied members drawn from those industries supporting the cane sugar refining industry with supplies, equipment and services.

The individual steps of the sugar refining process as we know it: affination, defecation, filtration, adsorption, crystallization and granulation were developed somewhat over one hundred years ago through developments by technologists from many countries. These steps, along with improvements in materials handling and energy transmission were combined to form the basis of today's large scale sugar refineries. All during this period there have been discussions before various societies on the chemical and physical operation of these refining steps. Recently, there has been an increasing number of papers discussing their chemistry and physics.

The SIT Annual Meetings are built around the presentation of papers on these same subjects. This year technical papers and seminars will take up three days of the session instead of the usual two but, as always, they will deal with various phases of sugar refining. The authors represent a wide selection of practice as they come from different countries. On Monday afternoon, there will be a symposium on Energy in Sugar Refining. As one of the more energy-intensive industries, sugar refining has always been concerned with the importance of energy, an importance which grows more and more as energy prices continue to climb. The papers will be technically complex but highly informative. As Shakespeare said,

"Your fair discourse hath been as sugar. Making the hard way sweet and delectable".

Following the Technical Session, SIT will become guests of Tate & Lyle Limited with a trip to its Thames Refinery scheduled for Thursday, May 25 and to the Philip Lyle Memorial Research Centre on Friday, May 26.

Nor have the wives of members been overlooked. Tate & Lyle has several interesting trips planned for them as well as maintaining a hospitality room at the London Hilton Hotel where the Ladies may go to obtain information and socialize in general.

Kenneth R. Hanson
President,
Sugar Industry Technologists Inc.

Message from the Chairman, Local Arrangements Committee

LONDON is proud to welcome the Sugar Industry Technologists for their first annual conference outside the North American Continent. For many of you this may be the first trip to Europe, so I make no excuses for starting by extolling the virtues of our city and of our country. London can offer something for everybody and we hope that while you are here you will take the opportunity, not only to enjoy the standard tourist attractions but also to seek out what London has to offer in the sphere of your particular interest.

Indeed, London has so many attractions that there is a temptation to spend the whole time in and around the capital. Many other towns and cities will repay a visit, but particularly those who come to the United Kingdom in May should get out into our countryside. The variety of scenery has to be seen to be believed and such comparatively far-away places as Scotland and Cornwall will fascinate you. Closer to London, the county of Kent is known as the "Garden of England" and with its fruit blossom out it presents a lovely picture.

However, it is for a technical conference that you are in London and, while the format will be familiar to regular attendees at SIT, I am confident that you will find the technical content more stimulating than ever. Many fine papers are to be read but the symposium on energy may well prove to be the highlight.

This year is the centenary year for Thames Refinery. It is therefore particularly appropriate that delegates should be visiting there. The methods of refining sugar have changed somewhat over the hundred years but we believe we have moved sufficiently with the times to have a cost-effective unit of which we can be justly proud.

The Tate & Lyle Research Centre, which you will also be able to visit, may not have such a long history but it does have quite a record of achievements. The fruits of this research will certainly give Thames Refinery a good start for its second century and should also provide the base for a widening of Tate & Lyle's activities.

I hope you enjoy this conference to the full, both technically and socially. I am sure my organizing committee and all the other helpers are going to enjoy looking after you. Whether this is your first trip to London or not, I hope it will not be your last and that you will leave with many happy memories.

Alan M. James

LOCAL ARRANGEMENTS COMMITTEE

Chairman	Alan M. James	Programme	Ervin G. Muller
General Administration ...	Enid M. Barratt	Movements	John F. Felstead

Sugar Industry Technologists Inc.
37th Annual Meeting

London May 21 — 26, 1978

MEMBERS' PROGRAMME

May 21		Assemble at the London Hilton
	6.30 p.m.	Mixer and buffet supper
May 22	9.05 a.m.	Address of Welcome by Kenneth R. Hanson, President, S.I.T.
	9.10 a.m. — 12.00 noon	Technical Sessions
		Luncheon
	2.15 p.m. — 5.00 p.m.	Technical Sessions
May 23	9.00 a.m. — 12.00 noon	Technical Sessions
		Luncheon
	2.15 p.m. — 5.00 p.m.	Technical Sessions
	7.00 p.m. — 8.00 p.m.	Reception
	8.00 p.m.	Banquet
		Presentation of S.I.T. Achievement Awards in Sugar Technology
		Presentation of George & Eleanore Meade Award for the best paper presented at the 1977 Meeting
May 24	9.00 a.m. — 12.00 noon	Technical Sessions
		Luncheon
	2.15 p.m. — 4.30 p.m.	Technical Sessions and Business Meeting
May 25	9.00 a.m.	Buses leave London Hilton for visit to Thames Refinery
		Luncheon at the refinery
	4.00 p.m.	Return to London Hilton
	6.30 p.m. — 8.30 p.m.	Cocktail party given by Tate & Lyle Ltd. at their new headquarters at Sugar Quay
May 26	9.15 a.m.	Buses leave London Hilton for visit to Tate & Lyle Research Laboratories at Reading.
		Luncheon at Reading University
	4.00 p.m.	Return to London Hilton
May 27		Depart

LADIES' PROGRAMME

May 21		As for Members
May 22	9.00 a.m.	Buses leave London Hilton for sightseeing tour of London including luncheon at an English "Pub"
	4.00 p.m.	Return to London Hilton
May 23		Free
	7.00 p.m.	Reception and Banquet
May 24	9.30 a.m.	Buses leave London Hilton for visit to Hever Castle
		Luncheon at Edenbridge
	4.30 p.m.	Return to London Hilton
May 25		Free
	6.30 p.m. — 8.30 p.m.	Cocktail party given by Tate & Lyle Ltd.
May 26	9.00 a.m.	Buses leave London Hilton for visit to Windsor Castle
		Luncheon at Reading University with Members
	4.00 p.m.	Return to London Hilton
May 27		Depart

Abstracts of Technical Papers

Large-scale chromatography of cane molasses
H. G. Schneider (*Pfeifer & Langen, Euskirchen, Germany*)

Cane molasses behaves quite differently from beet molasses on large-scale chromatography. The differences are pointed out and technical steps in pre-treatment, decalcification by ion exchange and recovery of sucrose and invert product fractions from molasses are explained. The decalcification resin is regenerated using the desugarized, concentrated molasses from the process so that no other regenerants are needed. Considerations on the use and further purification of the product fractions are presented.

Desugarization of refinery molasses
H. Hongisto, H. Heikkilä and H. Paananen (*Finnish Sugar Co., Ltd., Kantvik, Finland*)

Desugarization by means of a chromatographic separation process can be applied to beet as well as cane molasses. As to refinery molasses, no significant difference exists by comparison with final cane molasses. Pretreatment consists of phosphate precipitation and centrifugal clarification as well as deliming in ion exchange softening columns. The sucrose purity of input molasses greatly influences the results. Practical procedure on the factory scale is described. Up to 88% of the sucrose can be recovered as crystal sugar "in the sack". Different invert syrups and liquid sugars can be produced. The use of residual molasses for animal feed is recommended. Some economic aspects are discussed.

Treatment and recycle of ion exchange regenerant
H. R. Delaney, A. M. Kennedy and L. J. de Souza (*CSR Limited, Sydney, Australia*)

The introduction of decolorizing resins into the refining process is raising increasingly important effluent disposal problems because of the spent regenerant liquid waste produced. The strong-base anion exchange decolorizing resin system used by CSR produces a spent regenerant stream of high colour, BOD and chloride content. Regulatory bodies are becoming increasingly reluctant to accept this stream into their liquid waste disposal systems. After a preliminary survey of methods for treating this stream, extensive work was conducted on the recycling of the resin regenerant after decolorization with granular activated carbon. Extensive laboratory trials and pilot plant work have led to the development of a process for treatment and recycling of spent regenerant. Long-term operating experience will be required to quantify the degree to which harmful impurities are accumulated in a recycle system. However, preliminary work indicates that the bleed rate, if required at all, will not exceed 5–10%.

The Talofloc process at Supreme
W. Simoneaux (*Supreme Sugar Co. Inc., Supreme, LA, USA*)

A pictorial description is given of the construction and start-up of a new plant utilizing phosphatation and the Talofloc/Taloflote process. The plant is fully automated as to liquor flow rate, chemicals addition, pH control and waste mud removal. Details are given as to components in the plant, process operating costs, and some modifications to original designs. Plant operations based on approximately eleven months' experience are discussed.

Energy savings in cane sugar refineries
W. G. N. Buckland (*Tate & Lyle Ltd., London, England*)

The world's energy demand is outlined in relation to British reserves and the present policy of conservation. Cane sugar refineries have led the world in private power generation and the concept of "Total Energy". Thames Refinery's conversion from coal to natural gas is discussed and related to the maintaining of good boiler efficiencies. Power:steam ratio problems are studied and methods suggested for cures. The importance of all service costs is stressed in order to aim for the energy audit. Regression analysis for production targets are derived in relation to a weekly energy balance. Speed control of simple electric drives is described in relation to computerized refinery control. The hourly production rate should be optimized in relation to the production required to minimize costs. An attempt is made to assess energy usage by various evaporation methods, and how to launch an energy saving campaign is described. Concerning the future, combined district heat and power cycles, and possible other energy sources are discussed.

Filter experiments in a carbonatation refinery
J. E. Morton (*Redpath Sugars Ltd., Toronto, Canada*)

A series of experiments was carried out on a typical 72-leaf 1000 sq. ft. Sweetland filter for the purpose of assessing how variations of carbonatation conditions, both controlled and uncontrolled, would affect filter performance. The filter was modified so that alternate leaves were connected to separate discharge manifolds, which permitted one set of 36 leaves to be run at a fixed rate while the other set was run with a fixed upstream pressure. Whilst the mathematical models based on the data were not highly significant in the statistical sense, a new awareness was obtained of how the filter station could be operated and some valuable improvements were subsequently achieved.

A look at Savannah sugar refinery's energy conservation programme
C. R. VanTreese (*Savannah Foods & Industries, Savannah, GA, USA*)

The efficient use of energy has always been a topic of conversation in the sugar industry but, until recent years, the unlimited availability and low cost of fuel has made conservation economically marginal. At the Savannah sugar refinery, we have always been energy conscious but, with today's fuel costs continually rising, fuel economy has become a crucial issue. In April 1976, the Savannah sugar refinery established a special department to handle evergy conservation. Since this department's inception, the refinery has made excellent advancements in energy conservation. Contrary to popular belief, most of the savings can be attributed to the continual "watch-dogging" of the plant's daily refining operation. This technical paper stresses the extreme importance of accurately monitoring the plant's daily energy usages throughout the refining process. With this type of approach we are able to pinpoint any abuses and make the necessary changes before their cost becomes prohibitive.

Sugar losses by inversion

M. A. Clarke and M. A. Brannan (*Cane Sugar Refining Research Project Inc., New Orleans, LA, USA*)

Inversion of sucrose to glucose and fructose accounts for some sugar loss in processing. An analytical method has been developed using high pressure liquid chromatography (HPLC) for direct determination of sucrose and invert sugar in aqueous solution. Results for inversion under various ranges of temperature and pH are presented, and applications to refinery losses are discussed.

Continuous recording of sugar losses in refinery waste waters

H. Eichhorn (*Pfeifer & Langen, Elsdorf, Germany*)

A direct, polarimetric system is described for measuring continuously the sugar losses in refinery waste water. The system consists in principle of the following steps: (1) measurement of the waste water streams coming from the Quentin ion exchange process, the ion exchange decolorizing plant and the sweetening-off of activated carbon (Carboraffin), (2) make-up of the sample, using a special filter designed by Pfeifer & Langen, (3) continuous measurement of the sugar content using an automatic polarimeter, (4) printing of the results, and (5) processing of the results by a computer.

Trends in the manufacture of raw sugar which might affect the technology of sugar refining

M. C. Bennett (*Tate & Lyle Ltd., Bromley, England*)

Three technological trends in raw sugar manufacture are noted: the long-term steady increase in raw sugar polarization up to the level of VHP raw, the increase in production of "plantation white" sugar and the increase in the number of "white-end refineries" attached to mills. Examination of these trends suggests that the economic dividing line between raw and refined operations might well be raised from below 98° Pol to a point somewhat above 99° Pol. For the independent refiner, the consequences of such a change would be dramatic, leading to a simplification of plant and process, and a substantial saving in energy.

A continuous process for the production of Transformed Sugar

W. M. Nicol, G. W. Vane and M. J. Daniels (*Tate & Lyle Ltd., Reading, England*)

By a coincidence of the physical characteristics of sucrose which include high solubility, the ability of aqueous solutions to remain supersaturated without nucleating, high rate of crystallization and a positive heat of crystallization, dehydration can be readily effected by a method which is thermodynamically very favourable. The simplicity and flexibility of the technique offers many opportunities for exploitation. One such opportunity being commercialized is a continuous process which is simple in its elements and easy to control. Syrups of a wide range of purity can be dried in the equipment giving a flexibility of product characteristics. It offers an opportunity of reducing sugar processing costs, for example by reducing recirculation in the refinery.

New biological waste water treatment process at Domino refinery, Chalmette, Louisiana

D. E. Tippens, C. C. Chou and L. Hayes (*Amstar Corporation, New York, NY, USA*)

During early 1977, American Sugar Company's Chalmette refinery put on stream a modified oxidation ditch-type activated sludge biological waste water treatment plant applied to char waste water. Concerning the subject process, this paper describes (*a*) the evolutionary engineering and research effort leading to its selection, (*b*) theoretical considerations, (*c*) a one-year process treatability study employing an on-site 1/50th-scale pilot plant, (*d*) design and construction details of the full-scale facility, and (*e*) one year's operating experience with the completed commercial-scale unit.

Dust formation in the attrition of granular carbon adsorbents

V. R. Deitz (*Naval Research Laboratory, Washington, DC, USA*)

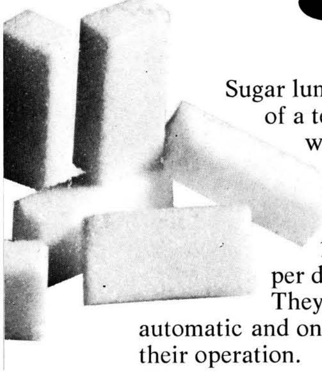
A new procedure has been developed to determine the rate of dust formation on passing air flows through beds of granular carbon adsorbents. Two factors observed in plant operations were selected as relevant: (1) the characteristic structural vibrations in plant-scale equipment (motors, fans, etc.) that are transmitted to the carbon particles and cause them to rub against each other, and (2) the interruption or variation in the air flow that results in air pulses which can move the carbon particles. In the test a 2-inch diameter container for a carbon is vibrated at a fixed frequency and at a constant energy input manually controlled with a vibration meter. Simultaneously air pulses are applied beneath the support of the carbon, and the air exits through an overhead 2·5-inch diameter filter paper. The quantity of dust deposited on the paper is then determined, either optically or gravimetrically. The quantity of dust formed per unit time (dusting coefficient) approached a constant value. The plateau values were found to vary with the source of the carbons; a five-fold difference was found among a large variety of commercial products. New bone char, CANE CAL carbon and Nuchar are compared with service and regenerated material from refinery operations. The results are also compared with those obtained for the same carbons using older test methods which were based on other mechanical devices. A correlation was found with the Ball and Pan Hardness prescribed in ASTM D28.04 (1978).

Hazard analysis in the assessment of sugar dust explosions

D. H. Napier and H. W. Cerda (*Imperial College, London, England*)

The occurrence of a sugar dust explosion depends on the coincidence of a dust mixture of adequate composition with an ignition source of sufficient energy. Variation of these parameters in practical systems

Sugar in lumps. A



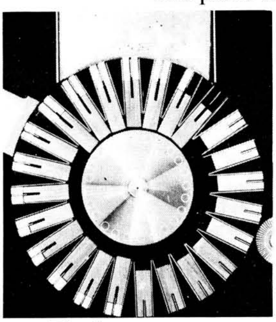
Sugar lumps are at present produced throughout the world by means of a technique perfected and modernised by MACHINES CHAMBON, who today offer entirely automatic lines for the moulding and conditioning of sugar lumps of all sizes.

The CHAMBON plants mould, dry and put into boxes according to type, 12, 24, 55, 80 or 100 tons* of sugar per day.

They are strongly built, reliable, completely automatic and only a few people are required to supervise their operation.

PLANT	PRODUCTION/24 h
EMR	12 or 24 t
1 DM	55 t
1 DMH	55 t
3 DM	100 t
4 DM	80 t (hard sugar)

A rotary moulding unit.



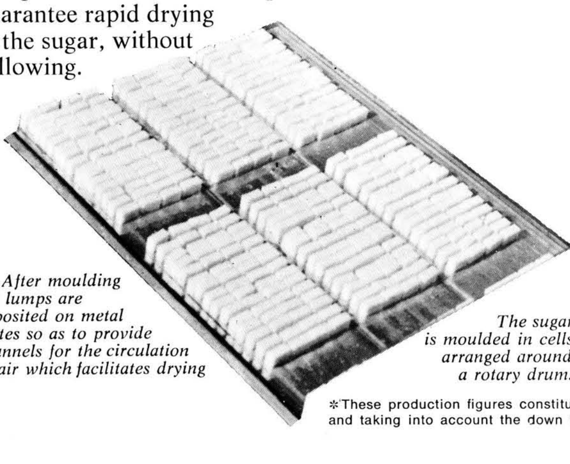
The plant is supplied with dry or humid sugar. Suitably mixed so as to be perfectly homogeneous, the sugar is fed evenly into moulds spead out around a rotary drum. The dimensions of these moulds vary according to whether one wishes to produce lumps of sugar of size 3, 4 or 5 or cubes.

A system of compression by mobile pistons produces lumps perfectly regular in shape and weight and of variable hardness according to the rate of compression.

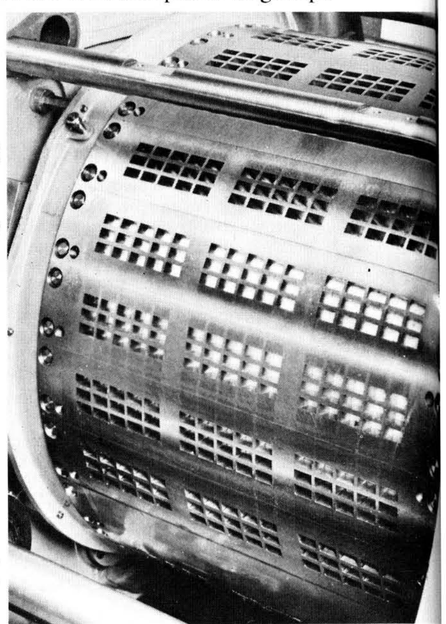
Rapid and perfect drying.

After moulding, the lumps are deposited on metal plates in groups corresponding to one horizontal layer (1/3 kg) of the finished box. The lumps are arranged to provide channels for the circulation of air which facilitates drying.

Driven by an endless chain, the plates are carried into a vertical or horizontal drying unit according to the power of the plant. The relatively low temperature, the good distribution of the air heated by low-pressure steam and the permanent renewal of this air guarantee rapid drying of the sugar, without yellowing.



After moulding the lumps are deposited on metal plates so as to provide channels for the circulation of air which facilitates drying



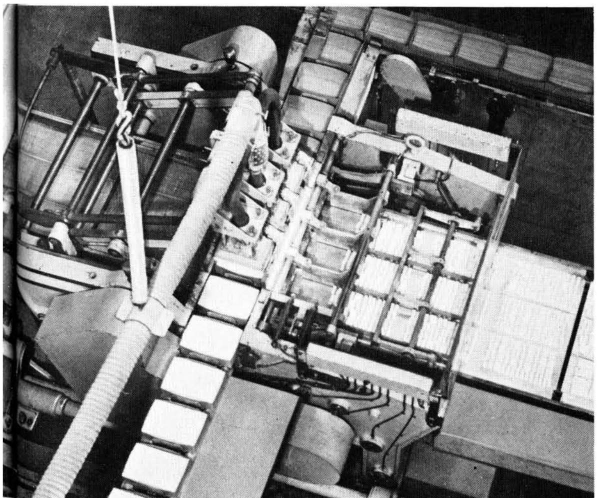
The sugar is moulded in cells arranged around a rotary drum.

*These production figures constitute minimum tonnages guaranteed under normal operating conditi and taking into account the down time for weekly cleaning.

simple product.

Automatic conditioning.

On leaving the drying units, the lumps are gathered and deposited by pneumatic fingers

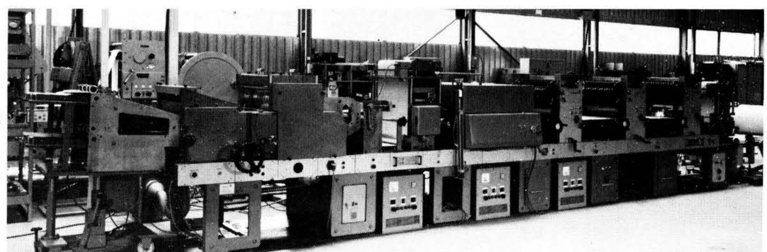


in three successive layers in the boxes, which are formed on a connected machine and automatically supplied to the conditioning line.
The full box is conveyed to the closing machine, which forms and glues the lid of the box.

A well-designed production unit.

A moulding and conditioning unit comprises certain basic inseparable elements synchronised with each other, all the functions of which are automatic, and optional elements (such as the machine for printing and forming the lids or the one-piece boxes, and the machine for parcelling in packets of 5 or 10 boxes).
Entirely automatic, it allows the production f 500 to 4,500 boxes of 1 kg per hour, according to the unit, without any manual intervention.
Four persons are sufficient to supervise all the operations.

To increase production, minimize costs, meet rising charges, while at the same time nsuring the supply of a product f exceptional quality, it is ecessary to have automatic quipment, designed and nanufactured by specialists. It is herefore not by mere chance hat more than 95 % of the vorld production of lump sugar carried out on CHAMBON lants. Today, more than 150 HAMBON plants throughout e world each produce from 12 to 100 tons of moulded and packed sugar per day.



The boxes are printed and formed in a single operation.

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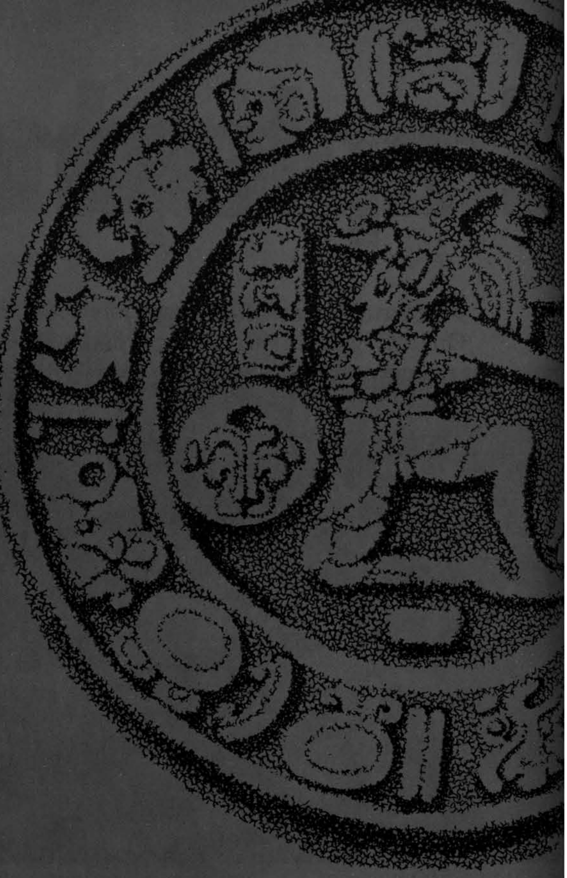

A new and exciting feature has emerged in the landscape at the foot of Chinchontepeque, a volcano near San Vicente in El Salvador.

In a region famous for the architectural feats of the ancient Maya peoples this present day monument is a tribute to the technology and skills of modern man.

It is a cane sugar factory designed, engineered, supplied, installed and commissioned by Fletcher and Stewart Limited for the Instituto Salvadoreño de Fomento Industrial. The factory is capable of processing 3500 short tons of cane per day and is suitable for future expansion to 6400 short tons of cane per day. A refinery is attached for the initial production of 125 short tons of refined sugar per day to be extended to 250 tons per day at a later date.

The entire programme of work incorporating stringent provisions against earthquake damage was completed in two years, and the production of commercial sugar began on schedule in January 1977. Fletcher and Stewart Limited is pleased to have been associated with this important development project, of which the Salvadorean people can be justly proud.

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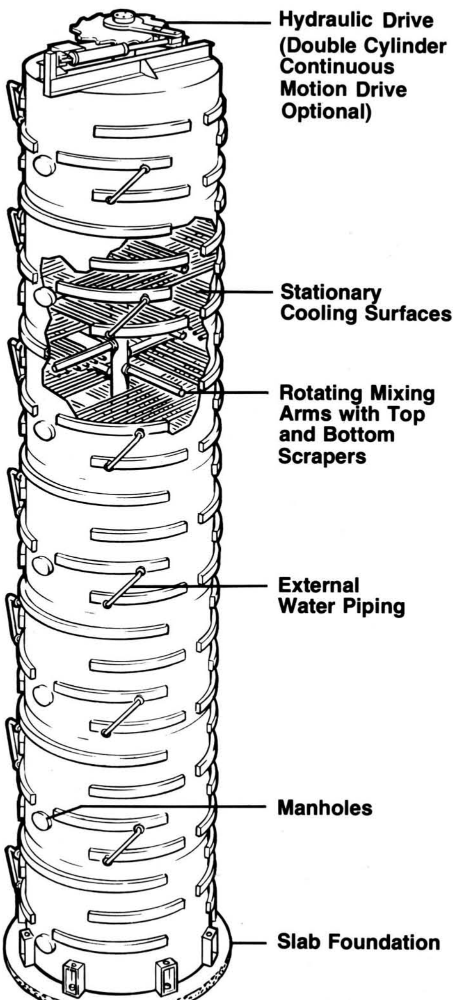

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It is common knowledge that lengthening retention time in crystallizers under controlled conditions improves molasses purity. A decrease of one point will provide at least 12 extra bags of sugar per 1000 tons of beets sliced per day.

The highly efficient Silver Continuous Vertical Crystallizer is the best choice, whether adding a single unit or an entirely new station.

Compared with horizontal types, the Silver units are superior:

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- Require much less floor space.
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influences the probability and development of the explosion. Sources of dust and of ignition and the related reliability of items of plant and control equipment are considered; the importance of maintenance records is discussed. The principles of fault tree analysis are outlined and the application to dust explosions is described. Information from sugar plants is inserted into a model fault tree concerned with explosion in a bucket elevator. The value of this approach and its wider applications are discussed.

A practical solution to the acid beverage floc problem

N. Dunsmore, M. J. Heal, M. Matic and F. Runggas
(*Sugar Milling Research Institute, Durban, South Africa*)

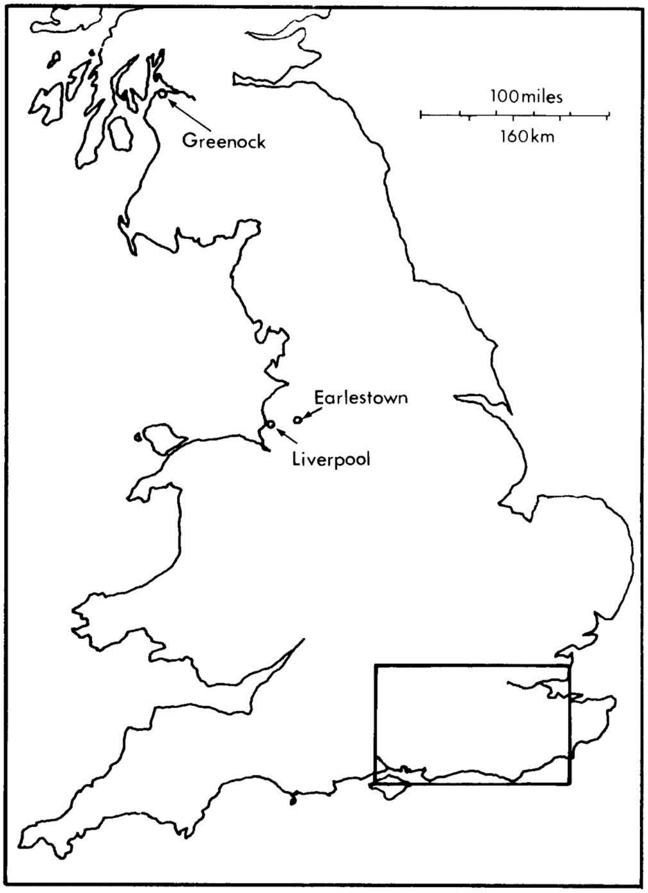
The ability of carbonatation, melt phosphatation and Talofloc processes to prevent acid beverage floc formation was tested on a laboratory scale. Several potentially useful methods for removal of floc forming substances were examined and filtration has been found to be effective, even at temperatures of up to 80°C, provided a suitable filter medium is used. The implication of these experiments on refinery operations is discussed.

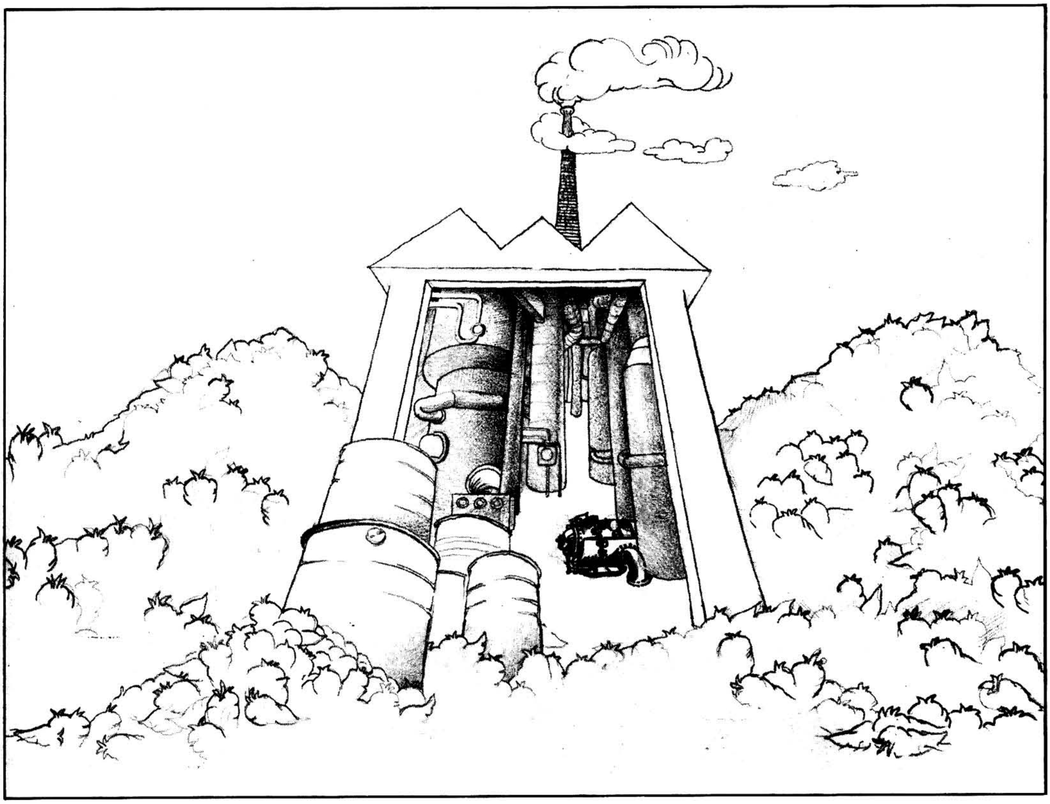
Sugar refining in Britain, 1978

For many years the cane sugar refiners of London, Merseyside and Greenock produced the majority of the refined sugar consumed in the UK and built up healthy export markets. Under the Commonwealth Sugar Agreement, the UK provided the sugar producers of the former British Empire with a stable market for their raw sugar, employed over 7000 people in the UK refineries and provided a high-quality product to both the housewife and the food and drink industries.

When Britain was negotiating to become part of the European Economic Community there was a conflict between this state of affairs and the ideal of the Community which has been, wherever possible, to seek self-sufficiency in agricultural products. The compromise reached was to allow continued preferential access to raw sugar from the developing former Colonies and Dominions as well as from other developing countries of Africa, the Caribbean and Pacific (ACP) areas. Australian sugar was excluded from this preferential supply and the total with guaranteed access dropped from about 1·7 million tonnes, white sugar equivalent, in 1973 to 1·225 million tonnes in 1978. At the same time the Government restraints on expansion of sugar production by the British Sugar Corporation Ltd. were removed so that the UK beet sector was no less favourably treated than the Continental beet sugar companies. The UK demand for sugar is fairly static and the net result of the changes was a considerable fall in the refining capacity needed in Britain.

Rationalization was obviously necessary and, as a first step, Tate & Lyle Ltd. acquired the sugar refining interests of the Manbré Group in 1976. Total capacity of the six refineries was 1,970,000 tonnes, white sugar equivalent, and, with exports estimated at about 200,000 tonnes, this meant a surplus capacity of some 545,000 tonnes. Operations had to cease at some plants but political considerations meant that this should not be in regions where unemployment was already high.





«Hydro»pumps you through

It took them ages finding the "Hydro" when the men from B Mill came across and asked to see it ("... hear it's the most dependable vacuum and gas pump available... apparently works round the clock, 100 days on end"). They'd have been quicker if they'd found Joe. He'd installed it years ago and nobody had thought of it since. Joe said afterwards : "No point in sticking it right out there in the middle. I only need to get at it every 2 or 3 years to clean it up."

Sugar factories the world over have their "Hydros" and "Hydro" Joes. This is simply because "Hydros" cut costs. Frictionless water-ring, low rpm, simple design, and wear-resistant, sturdy construction all this means low power requirements and practically no maintenance. And none of that downtime with cane or beet rotting in the yard and profits evaporating. "Hydros" pump you right through the harvest. The're quiet too.

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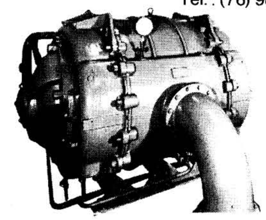
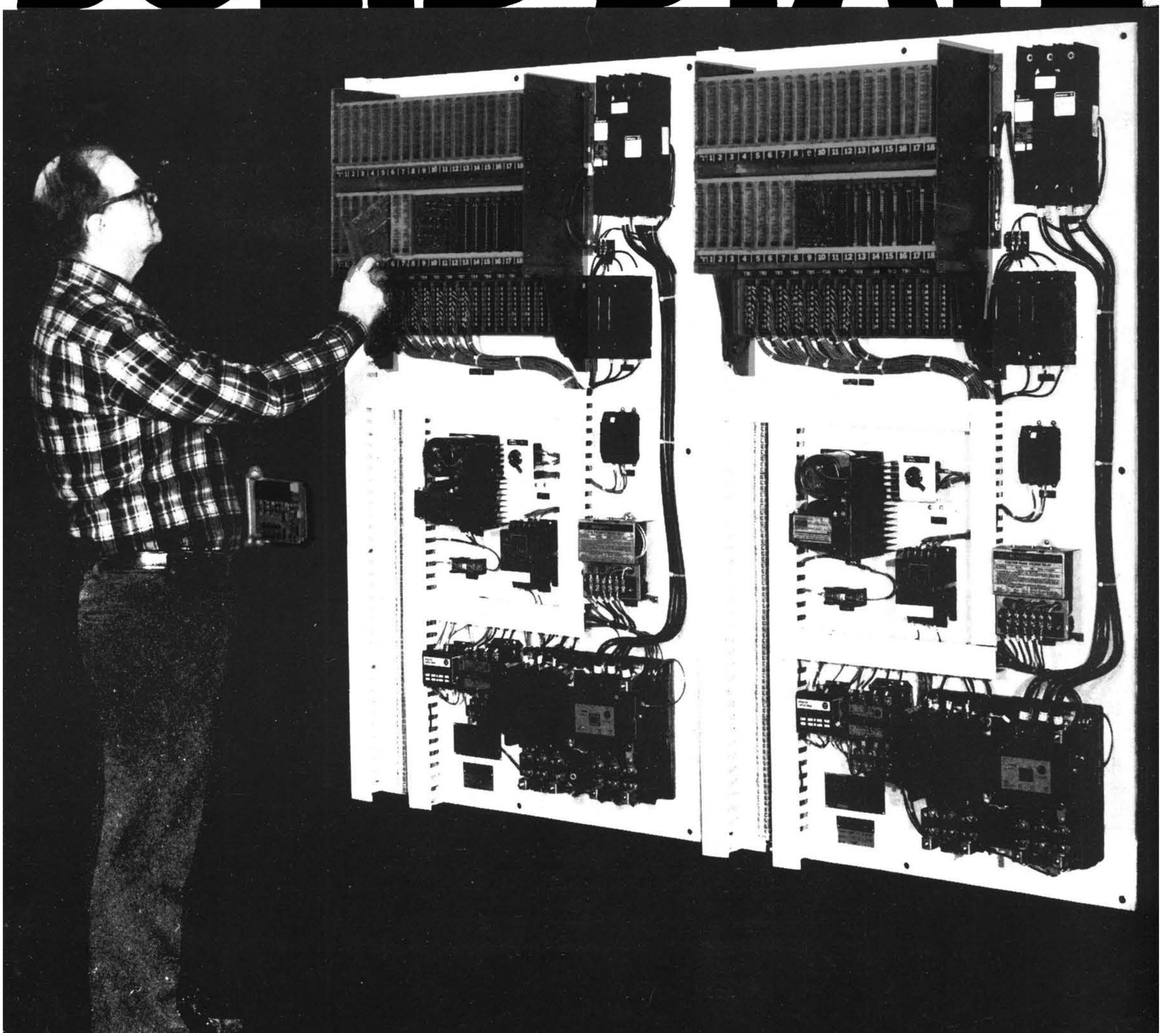
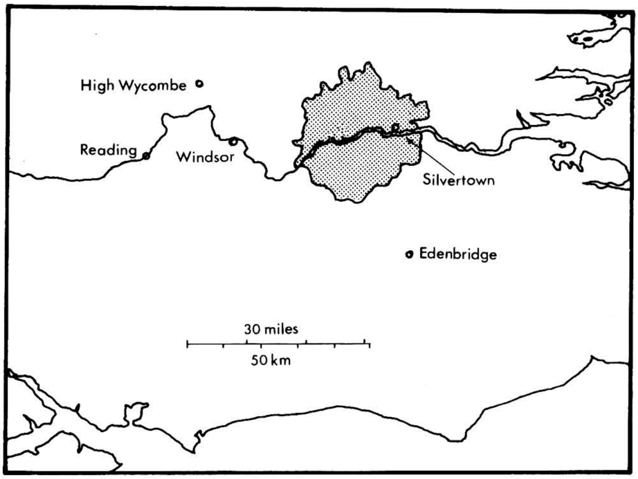


Synthese F1-76



As a consequence, the 130,000-tonnes Hammersmith refinery ceased melting after September 1977 and is now closed. From September 1979 the Liverpool refinery is to reduce production from 550,000 to 300,000 tonnes, while the 160,000-tonnes Sankey refinery at Earlestown stopped melting in September 1977 and has become a syrup, treacle, liquid sugar and mixes station, although packing of granulated sugar and milled products will continue to September 1979. Thames refinery at Silvertown has remained at its melt capacity of 900,000 tonnes but its product mix has changed somewhat.



There has been some rearrangement of the smaller liquid sugar, syrups and treacle plants in the London area and the Fowler plant will close in 1980 when its production will have been transferred elsewhere. Similarly the Merton Grove plant will close by the end of 1979, with its business transferred to the Sankey facility.

The Scottish refineries in Greenock (Walker and Westburn) are continuing to refine about 110,000 and 120,000 tonnes/annum, respectively, with some rationalization of product lines and reduction of the work force by natural wastage. This policy will be subject to review if the supply of ACP raw sugar should be reduced after 1980.

S.I.T. at T.&L.

IT is a happy chance that brings Sugar Industry Technologists Inc. to London for its 37th Annual Meeting in 1978, for this year also marks the Centenary of the Thames sugar refinery in the heart of Britain's capital city.

Production of refined sugar at the refinery began in June 1878 although the proprietors, then Henry Tate & Sons, were already refining sugar at the Love Lane plant In Liverpool. The new refinery, built on the site of a former shipyard in Silvertown, was originally intended to make cube sugar by the Langen process but this was supplanted by the Adant process in 1894. Adant cubes were made right up to 1961 at Thames, although the machinery was replaced by new in 1946. When the refinery first opened, all its motive power was transmitted from steam engines using belt drives; all lighting was by gas. There was no electricity until 1883, when a 12 kW steam-driven dynamo was installed for lighting. Electric motors were not introduced into the refinery until about 1905.

The original site occupied about 3½ hectares; further land to the east was acquired in 1908 and some more on the western side in 1935, to bring the site up to its present 9 hectares. A sloping foreshore of some half a hectare was reclaimed to provide wharf facilities for unloading sugar and coal from barges.

The steadily increasing throughput of Thames refinery during the past 100 years may be seen from the following figures:

Year:	1878	1882	1901	1911	1927	1934	1937	1955	1978
Tonnes/ hour:	2	8	15	25	36	92	102	117	143

Products of Henry Tate & Sons (Early 1920's)

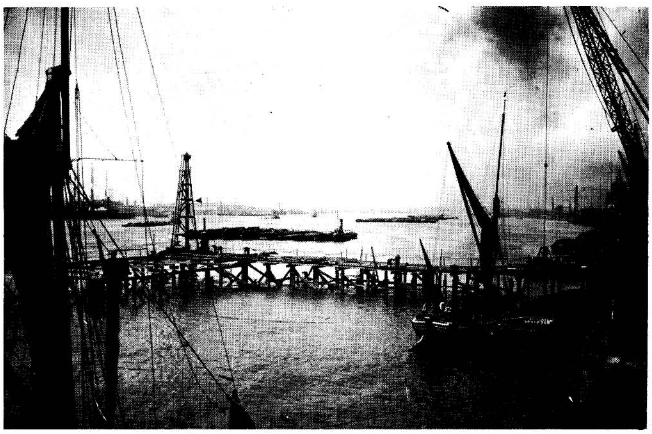
In 1968 the change was made from 5-day, 3-shift working to the 7-day week, continuous working on 12-hour shifts, which has continued ever since. Capacity is now 24,000 tonnes a week, or well over one million tonnes a year.

Although the refinery was originally built to make cube sugar, by the year 1900 granulated sugar was also being produced. A centralized boiler and power house was built about 1911; this was coal-fired and a very large brick chimney was erected, 91 metres high, to carry the furnace gases well above all buildings. This remained a landmark for more than 60 years until its demolition in 1975. By that date all the boilers had been converted to natural gas-firing and each had its individual steel chimney.

In 1922, Henry Tate & Sons, specialists in cube making, combined with Abram Lyle and Sons to form Tate & Lyle Ltd. The Lyle company, at Plaistow Wharf refinery, little more than a mile away, had specialized in making a high-quality table syrup. Even after the amalgamation, a keen and competitive rivalry continued for many years, although the Plaistow Wharf plant ceased refining to become a packaging and storage unit at the time of the reorganization in 1968. There is a tradition of employment among local families and many employees in 1978 had forefathers working at the refinery a hundred years ago, while some employees have a dozen or more relatives working for the Company.

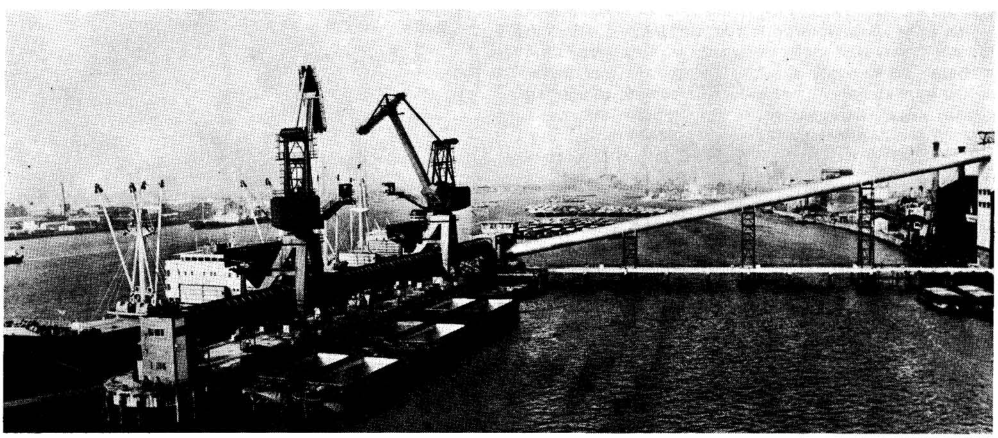
A century of operation has seen very many changes in the refinery equipment, processes and products, the last now including dry and liquid bulk sugars as well as packeted granulated and specialty sugars, sachets, etc. in addition to the original product—cube sugar. The Thames refinery is the world's largest in terms of annual production, while Tate & Lyle Ltd. is the world's largest independent sugar company, operating other sugar refineries in Liverpool, Earlestown and Greenock, as well as having interests in sugar projects outside the UK.

At Thames, raw sugar supplies are normally received in bulk and mostly carried by the Company's own vessels. These are unloaded at a deep-water jetty specially built for the purpose and opened in 1967. Previously sugar had had to be transferred from ocean-going ships to barges and brought to the refinery; the savings in time and cost covered the cost of the bulk reception installation in three years. The sugar is unloaded by two travelling jib cranes with grabs of about 6 tonnes capacity and can be discharged at up to 900 tonnes per hour. The grabs discharge to a covered belt conveyor system delivering the sugar either direct to melt or into storage in a 35,000-tonnes bulk silo which also receives raw beet sugar brought to the refinery by road tanker.

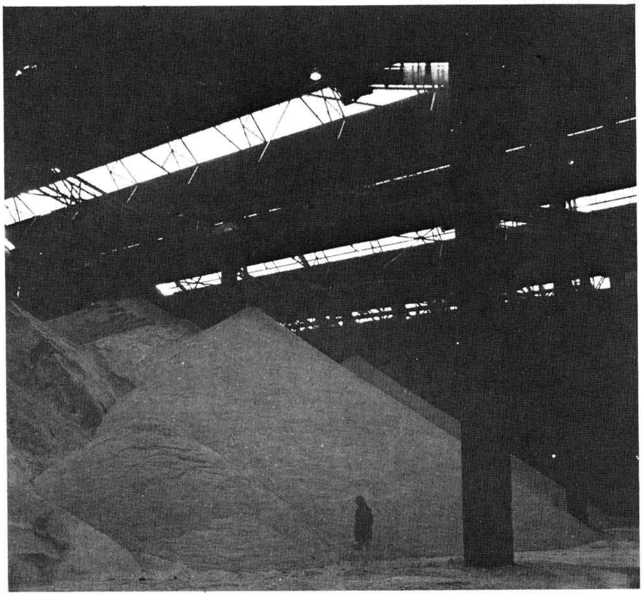


The original raw sugar jetty at Thames refinery

The raws entering the process direct, or reclaimed from the silo, are conveyed to affination minglers, and the magma spun in a twenty-machine centrifugal battery. The affined sugar is melted and the raw liquor purified



The present-day raw sugar jetty



Inside the raw sugar store at Thames refinery

by carbonatation and filtration through Sweetland filters before passage through a bank of 32 30-tonne bone char cisterns. The fine liquor is pre-concentrated in an evaporator and sent to the white sugar pans station. This comprises four 140-tonne pans which permit boiling of very high density strikes to which lubricating syrup is added to facilitate discharge.

After cooling in a mixer, the first crop white sugar is spun in a battery of automatic batch centrifugals and a second crop boiled from the separated liquor (known in Tate & Lyle at Jet 1). This yields a second white sugar crop and a Jet 2 syrup.

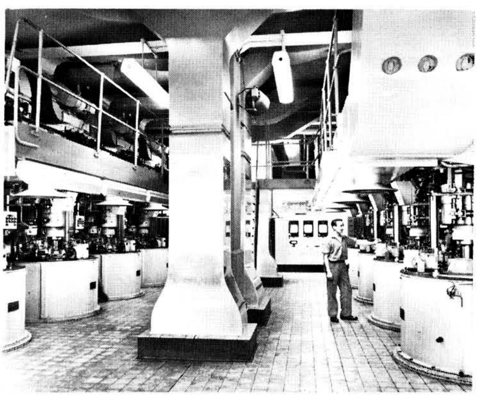
The latter is again passed through bone char and reboiled to a third strike from which more white sugar and a Jet 3 liquor are separated. This liquor is used to boil a fourth strike yielding sugar of somewhat lower quality than the first three but still acceptable for industrial purposes. The syrup, mixed with affination syrup, passes to the recovery house where, in four 70-tonne pans, three crops are boiled using the "double-einwurf" system in which unwashed sugar is used as grain for the preceding crop and no mixing of mother liquors takes place. The recovered sugar is then returned to the raw melter for white sugar production.

After drying, the granulated white sugar is sent to the

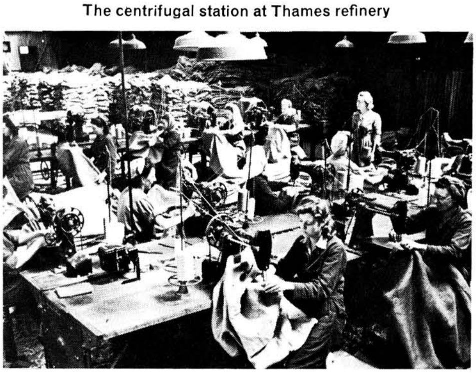
Visit of H.M. King George V to the refinery in 1917 packing departments or stored in a 10,000-tonne Weibull bulk silo from which it is drawn for dispatch in tankers or for packaging. Some sugar is re-dissolved and sold as one of the wide range of liquid sugars available from the refinery (others are formulated from intermediate liquors and syrups, according to the specification). The granulated sugar may be coated with various amounts and grades of refined molasses to give a range of brown sugars.

The present-day pan floor at Thames refinery

The whole process is subjected to very close control; in the raw sugar end, affination, melting, carbonatation and filtration are governed by a computer while production control is centred in a location with continuous access to data on stocks, production and sales of all the refinery's lines.



The centrifugal station at Thames refinery



The bag-making department at Thames (1946)

The visit to Thames promises to be one to be remembered by SIT members as an outstanding part of the London meeting.

Research at Tate & Lyle


Professor A. J. Vlitos, Chief Executive, Group Research and Development

The Philip Lyle Memorial Research Laboratory is named after a Director of Tate & Lyle Ltd. who was responsible for setting up the Company's first separate Research Department in 1938, initially at Plaistow Wharf refinery, afterwards moving to Ravensbourne in 1949. The Ravensbourne team, under H. C. S. de Whalley, carried out work largely to improve the techniques of refining raw cane sugar so as to lower unit costs of operations while also developing improved methods of laboratory control and analysis. The name "kestose" is that of a sugar discovered at the laboratory which was located near the village of Keston, in Kent.

After 1967 the objectives of research effort changed and this was reinforced by the relocation of the department in 1972. The Philip Lyle Memorial Laboratory at Whiteknights, Reading, is one of the few industrial research establishments to be located in the grounds of a university, and it is well integrated with its academic environment, as one of several Associated Institutions of the University of Reading.

A large number of university students, both undergraduates and postgraduates, are attracted to the Laboratory from Reading and other universities in Britain and from abroad. Mutual benefit has been derived by both the University and the Laboratory from their association, with research programmes undertaken which are compatible with both the interests of the Tate & Lyle Group and with academic interests. These multidisciplinary programmes have developed markedly during the past six years and the scientific, development and information services staff now totals about 160, of whom more than half are graduate scientists and engineers.


The Philip Lyle Memorial Research Laboratory

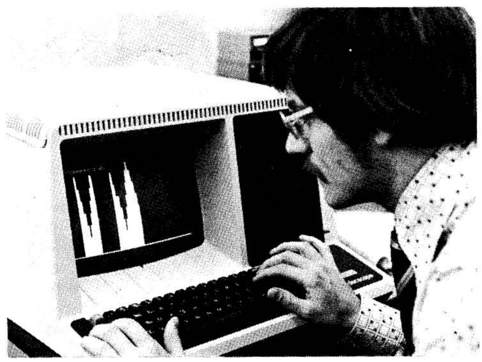
Research has been directed at finding new industrial uses for carbohydrate materials such as sugar, glucose and molasses, seeking a better understanding of the molecular basis for sweetness, including a systematic search for "sweet proteins" and for other novel foods, investigation of novel fermentation and/or enzymatic processes for products of use in the food, textile, paper or chemical industries, the production of microbial proteins from agricultural wastes and studies on nitrogen fixation in soils and photosynthesis in sugar cane and sugar beet. At the same time there have been programmes developed and sugar beet. At the same time there have been programmes developed to seek entirely new and/or more effective means of extracting, purifying and crystallizing sugars and other products from natural sources.

As Professor A. J. Vlitos, Chief Executive, Group Research and Development, observes, "Obviously, a programme of research which is varied but with clearly defined objectives offers ample opportunity for longer-term fundamental as well as for short-term and more applied studies. Some important outcomes of the programmes have been (*a*) the development of a range of sucrochemicals with considerable potential now that petrochemicals are becoming more scarce and expensive, (*b*) the development of fermentation processes for certain ploysaccharides, such as alginates and xanthans, (*c*) the development of a process for producing animal feeds (i.e. microbial proteins) by the fermentation of fruit and vegetable residues, and (*d*) an entirely new process for producing sugars and syrups without the production of molasses".

Thaumatococcus danielli growing in the laboratory's greenhouse

Current research at the Laboratory includes the study of a number of plants providing renewable energy resources—among them sugar cane—which uses sophisticated techniques for investigation of photosynthetic fixation of carbon dioxide and the roles of nitrogen, enzymes and cane ripeners. The West African plant *Thaumatococcus danielli* is being grown as a plantation crop in Ghana and its agriculture studied while further work is being carried out at Reading on the extraction of its sweet protein Thaumatin. Low-cost processes are being developed for manufacture of microbiological control agents for use against weeds, insect pests and plant diseases.

A new team has been established, under the leadership of Dr. Riaz Khan, to undertake a long-term research programme to examine existing and hitherto unexploited

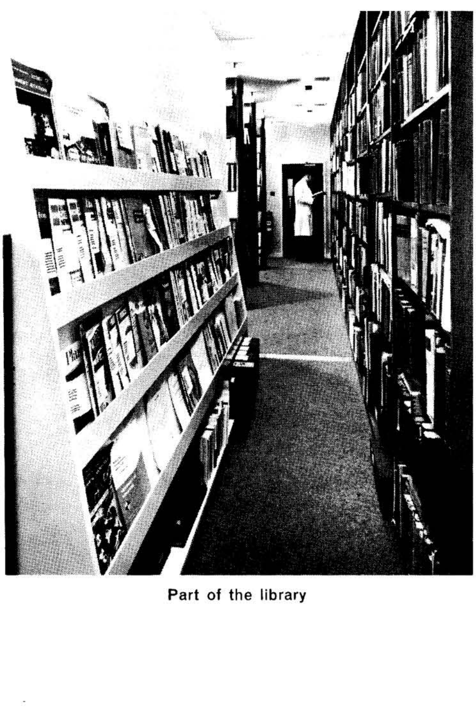


A visual display terminal of the computer linked to the laboratory analysis instruments system

The amino-acid "Autoanalyser"

resources as raw materials for chemical and biological utilization. Research is continuing on the basic trans-esterification reaction in the process, now at the commercial stage, for manufacturing sucrose ester surfactants in order to optimise the product specifications to meet EEC regulations and to study the product metabolism in animals to prepare the way for use in food. Development of the chemical and engineering aspects of production is continuing.

Also reaching commercial manufacture is the microbial polysaccharide xanthan which is to be produced near Liverpool by a joint venture involving Hercules Inc. and Talres Ltd. who will make and sell the gum for applications which take advantage of its unique physical properties. These include pseudoplasticity which is useful in the formulation of oil drilling muds and of sauces, ketchups, etc., and a stability under acid conditions which make it suitable for use in French salad dressing or phosphoric acid suspensions used to dissolve rust. A number of halogenodeoxy derivatives of sugars are being studied; some are the subject of collaborative work with the University's Physiology and Biochemistry Department on anti-fertility activity in males, while others have proved to be intensely sweet. One derivative, 4,1′,6′-trichloro-4,1′,6′-trideoxygalactosucrose (TCS) is about 650 times as sweet as sugar and has a pure sweet flavour without delay in perception or side-flavour or after-taste; surprisingly, the sweetener derivatives show no other physiological activity.



Part of the library

Pilot plant evaluation has been completed on the patented "Transformed Sugar Process" whereby cane juice can be concentrated into a dry free-flowing microcrystalline brown sugar with no resulting mother liquor. The Sugar Technology group, under Dr. G. W. Vane, is also studying problems faced by production staff in the Group and carrying out fundamental research on, inter alia, sucrose crystallization rate, the nature of impurities responsible for specific difficulties in sugar factories and refineries, the use of ion exchange resins and other adsorbents in sugar liquor purification, etc. Of particular interest has been the use of a specific assay for dextran which occurs as a result of microbial degradation in stale cane.

The low technology fermentation unit is concerned with the growth of *Candida utilis* yeast on effluents of high BOD which contains simple carbohydrates; this not only produces a valuable animal feed but avoids the need for land and capital expenditure on a conventional biological trickling filter. Another project involves the conversion of citrus peel and other fruit wastes into animal feed protein using the mould *Aspergillus niger*.

"Immobilized enzymes" is a phrase which will be familiar to refinery technologists because of their use in recent years for the conversion of glucose syrups to high fructose corn syrup. Tate & Lyle's Research Laboratory has been studying glucose isomerase and also using other such enzymes for hydrolysis of starch solutions to glucose. The work has shown them to be cheaper and longer-lasting than the soluble enzyme, and maybe adaptable to the production of power alcohol from crops such as Jerusalem artichokes, cassava, yams, etc.

A comprehensive range of analytical services is provided for the Research teams as well as companies in the Tate & Lyle Group, including gas-liquid chromatography, mass spectrometry, automatic analysis, radioisotope measurements, ultraviolet, visible and infrared spectroscopy, nuclear proton magnetic resonance, fluorometric and atomic absorption spectroscopy. X-ray diffraction and electron microscope investigations are carried out in collaboration with the University of Reading.

Under Dr. R. Tilbury, the Microbiological Technical Services team carries out work on the biodeterioration of Company products and its prevention, as well as the maintenance of the Goup's culture collection and preservation of industrially important strains in a genetically stable form, screening organisms for novel desirable properties and production of mutants with improved characteristics. Assistance has been given to Group members on a wide range of topics including a grade of stainless steel for use in bulk liquid sugar tankers, evaluation of cane mill sanitation agents, molasses fermentability, etc.

The library and information services are available to the Group from a library of over 5000 volumes and a supply of some 400 periodicals, as well as a comprehensive survey of patent information. Some of this is made available outside the Group in the form of *Sugar Industry Abstracts*, produced in collaboration with *La Sucrerie Belge* and published as part of that Journal.

Talres Development Ltd.

Talres Development Ltd., based in Reading, is Tate & Lyle's speciality chemical company. Its expertise is based on work carried out at Tate & Lyle's Research and Development Laboratories over the past ten years.

Much of the development work carried out by Talres has focused on the release of solar energy from plants to enable the production of chemicals from natural feedstocks such as sugar, fats and oils. The depletion of the world's fossil fuel reserves has necessitated a search for alternative energy sources. Talres technology is not only less expensive than that currently employed in the mineral-based chemical industries, it permits the viable production of non-toxic industrial chemicals from regenerable raw materials and, as such, is of particular interest to developing countries. By developing this technology under patent protection and selling the technical know-how to others, Talres is securing a place in an important market where the prospects of growth and development over the next decade are only limited by the relative cost and sources of energy.

In the UK, Talres Development Ltd. is building a manufacturing facility at a cost in excess of £10 million on a 20-acre site on the Knowsley Industrial Park, Merseyside. The company also holds an option on a further 15 acres of adjoining land to allow for future expansion. In the first phase of production, sucrose surfactants and microbial polysaccharides will be produced. Both these speciality chemicals will be based on natural feedstocks. Surfactants are the main active ingredient for detergents and also have applications in many other industries for stabilizing mixes of oils and water. Microbial polysaccharides are, in simple language, industrial gums, used in the food, textile and petroleum industries. These two plants are due to be commissioned in February 1979, and will offer employment for 100 skilled and unskilled staff.

These two groups of chemicals have been under production on pilot plant scale for several years. The commercial production and marketing of microbial polysaccharides will be in a joint venture with Hercules Powder Co. Ltd., the UK subsidiary of the major US chemical company, Hercules Inc., who will bring to the joint venture their world-wide marketing experience in the field of industrial gums.

Developed by Tate & Lyle, the sucrose surfactant process is totally independent of petrochemicals. The initial capacity at Knowsley for this group of products will be 5500 tonnes per annum, but the plant has been designed for possible expansion to an ultimate capacity of 22,000 tonnes per annum. The surfactants are based on natural materials, i.e. sugar and oils or fats. As a consequence of this raw material base, the products are non-toxic, non-allergic and biodegradable, giving them wide appeal to the food, cosmetic and similar industries and environmental acceptability both to public opinion and in satisfying stringent legal obligations on pollution control.

The surfactants will be marketed to detergent formulators and manufacturers in the food, cosmetic and plastics industries, where the non-toxicity of products is required.

The joint venture with Hercules Powder Co. Ltd., to produce microbial polysaccharides commercially, is based on Tate & Lyle fermentation technology and Hercules' wide market experience in water-soluble polymers. Microbial polysaccharides are relatively new products in an area which has been traditionally dominated by natural gums from plants or seaweeds.

The plant at Knowsley will initially produce Xanthan, a gum with wide applications throughout the food and petroleum industries. This is the first of a planned series of products based on fermentation. A number of polysaccharides with unique and novel features are also under development to give a broad product base for the joint venture.

This plant has been designed to enable the capacity to be trebled as the market for Xanthan gum builds up and other products under research reach the point of commercialization.

These two plants fit into the planned strategy of Tate & Lyle to enter the chemicals business from its strength in commodities. In addition to the planned expansion of these projects referred to above, a number of additional projects in research will provide the continuity of products to establish this chemical base.

Talres Development Ltd.

The Ladies' Programme

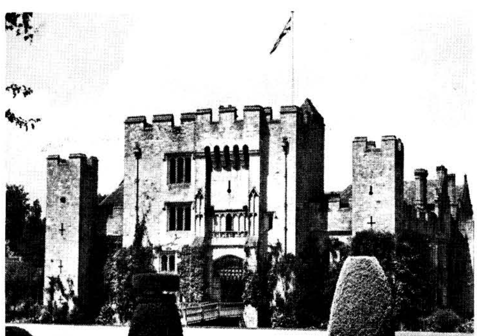
Mary James

Parliament Square and the Houses of Parliament

THE London Hilton Hotel is close to the many fine stores of London's "West End" and the Ladies Committee, headed by Mary James, wife of Tate & Lyle's Alan James, ably assisted by Mollie Bennett, has left sufficient free time for the ladies accompanying SIT members to the London Meeting to browse. For those interested, London has many art galleries, museums, etc., and one in particular which might be appropriate to visit is the Tate Gallery, originally endowed by Sir Henry Tate of the sugar refining company which still bears his name. London has many theatres and a wide variety of restaurants to suit all tastes and these too can be discovered by members and wives during the meeting.

The Dickens Inn

Specific arrangements have also been made, however, and the first, for Monday, May 22, will be a general sightseeing tour of London so that ladies will be able to become familiar at first-hand with the city's landmarks which are so well known throughout the world: the Tower of London, the Houses of Parliament, Westminster Cathedral, St. Paul's, and so on. Luncheon on the Monday will be served at the Dickens Inn in St. Katherine's Dock, near the Tower of London. This is a reconstructed brewery building which existed by the side of the Thames before Dickens was born. Restored



Hever Castle

The Tower of London

as a balconied three-storeyed inn of the Dickens period, the building incorporates the original timbers, bricks and ironwork. At ground level is the Tavern Room, a "pub" serving "real ale" (no bottled or canned beer) and an interesting range of traditional pub food. The Pickwick and Dickens rooms on the next and top floors are an à la carte and theatre restaurant, respectively, with musical entertainment provided in the latter.

On Wednesday, the ladies will be taken to Hever Castle in Kent, "the Garden of England". The oldest part dates from the end of the 13th Century and comprised a fortified farmhouse and yard, surrounded by a moat with a drawbridge. Two centuries later a Tudor dwelling house was built inside the protective wall and this was the home of the Bullen or Boleyn family. Ann Boleyn became Henry VIII's second wife in succession to Catherine of Aragon and it was this marriage which brought about the breach between the king and the Church of Rome which led to the English Reformation. Ann was the mother of Queen Elizabeth I whose long reign was marked by some of the most turbulent and glorious pages of English history.

Windsor Castle

In 1903 Hever was bought by William Waldorf Astor who had recently emigrated from the USA, became a British subject, and was later created a Viscount. He restored the fabric of the Castle and redecorated the interior, adding some magnificent panelling and carved screens. He later enlarged the house by building a village of cottages in the Tudor style to provide guest rooms, servants' quarters and offices, all interconnected by corridors and adjoinihg the Castle by a covered bridge across the moat. Meadows and marshland were reclaimed and a 35-acre lake excavated through which flows the river Eden on its way to the Medway. Rose gardens, Italian gardens and topiary hedges were planted with paved courts, fountains and grottoes providing a setting for the numerous statues and sculptures of the Astor collection.

Windsor Castle, to be visited on Friday morning, needs scarcely any introduction, being one of the best-known homes of the British Royal Family. It was built by William the Conqueror (1027-1087 A.D.) to complete a ring of fortresses around

London. The massive Round Tower was erected by Henry III in 1180; the Norman well, which provided drinking water, still exists. To the north of the Round Tower is the so-called Norman Gate, actually constructed in the 14th Century by Edward III; its portcullis is still in position. The interior contains paintings and sculptures by many masters including Rubens, Van Dyke, Dürer, Canaletto, Gainsborough, etc., as well as historical mementos, armour, and the like. Ladies will be able to

visit the State Apartments and, if time permits, to see Queen Mary's Dolls' House and exhibition of dolls as well as an exhibition of drawings by Holbein, Leonardo da Vinci and other artists. After their stay in Windsor they will travel to Reading University to rejoin their husbands for lunch before returning to London.

Raffinerie Tirlemontoise S.A.

Those SIT members who have been able to accept the kind invitation of M. Albert Bergé and his Company to visit their facilities at Tienen (Tirlemont in French) on May 29, after the London Meeting, will find it a most unusual plant. This is because it comprises three distinct parts, the first a large sugar beet processing plant having a daily slicing capacity of 7000 tonnes and including a pulp drying plant and a Steffen house for extraction of sugar from beet molasses.

The second part is a sugar refinery with a daily output up to 800 tonnes of refined sugar in the form of cube sugar (produced by the R.T. or Chambon processes) as well as sugar loaves, granulated sugar in bulk and packeted, and various grades of refined sugar in different packagings as specified by customers.

Invert sugar is produced in the third part of the Tienen plant, up to a maximum of 160 tonnes per day, expressed as dry sugar. The invert sugars are obtained from the sugar refinery's products and are sold as liquid invert in bulk or in small quantities.

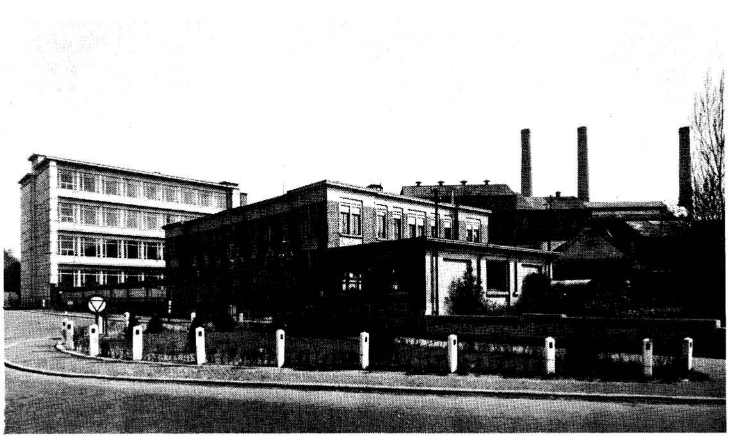
In spite of its name, Raffinerie Tirlemontoise S.A. is concerned with the manufacture of beet sugar; it operates several other beet sugar factories in Belgium as well as at Tienen where it leases part of its buildings and production facilities to "Sucre de Tirlemont", the company which is concerned with sugar refining and invert sugar production.

The Tienen sugar factory is supplied with beets generally by road although it is also able to receive beet in rail cars. The roots are sliced and sugar extracted in two drum diffusers of the company's own design; the raw juice is purified by the classical lime-carbonatation method employing Brieghel-Müller predefecation, and continuous 1st and 2nd carbonatation with recycling of carbonatation mud to the Brieghel-Müller prelimer. In the sugar end processing is conventional except perhaps that the evaporator station comprises one double-effect and one triple-effect Kestner-type units. The pulp is dried in two dryers and pelleted using six Promill presses, to be sold in bulk or in bags.

During the campaign, part of the molasses is subjected to a continuous R.T. version of the Steffen process; finely ground lime is added continuously to the diluted molasses and the precipitated saccharate is separated on continuous belt filters for return to the raw juice purification station. Sugar is thus returned to the main process stream of the factory while the lime in the saccharate cake assists the elimination of juice impurities; it is calculated that 80% of the sugar in the treated molasses is recovered as white sugar.

The beet sugar factory operates only during the winter campaign whereas the refinery continues operation throughout the year, apart from week-ends and an annual closure of 3 weeks for holidays. During the off-season the refinery processes some intermediate products from the sugar factories of the Group—second green syrup, thick juice and raw sugar in various ratios. Because of this, storage capacity for these is fairly large; 69,000 tonnes sugar equivalent in tanks for 2nd green syrup, thick juice and molasses, and 95,000 tonnes of raw sugar. Tienen is probably the only sugar refinery in the world to process such a high proportion of sugar in liquid form and to produce so much molasses.

From an average daily intake of 500 tonnes of thick juice, 900 tonnes of 2nd green syrup and 200 tonnes of raw sugar, the refinery produces some 700 tonnes of refined sugar, 420 tonnes of ordinary molasses and 140 tonnes of Quentin molasses. (This is a process by which the potassium content of the molasses is replaced with magnesium using three 8·5 m^3 columns of ion exchange resin, and sugar thus made available for crystallization, after which the Mg-rich mother liquor is used to



The Tienen refinery

used to regenerate the resin.)

Sugar is recovered by crystallization in three strikes, using rheometer control and batch centrifugals for the first two and conductivity control and a continuous centrifugal for the last. The 1st strike sugar is remelted directly and the other two plus raw sugar remelted after affination. The melt is filtered and decolorized using bone char before being boiled to white sugar.

The refinery produces three major grades of sugar: Adant sugar, and 1st and 2nd granulated sugars. In the Adant process, a high-purity massecuite is fed into moulds where it is centrifuged. Cooling and crystallization occur which binds the crystals to each other and gives the Adant cube its characteristic mechanical properties. After centrifuging the moulds are emptied and the slabs dried, sawn into bars and these broken into cubes. Some of this Adant sugar is sent as raw material to the crushing and sieving station to give a product marketed under the name "perlé".

Granulated sugar I is sent to two R.T.-Chambon cube sugar lines which produce cubes of the same size as the Adant cubes and also to a third line which produces "restaurant rations" or "coffee portions" (respectively one or two cubes wrapped in paper). The first two cube sugar lines each have a capacity of 80 tonnes per day and were developed by Raffinerie Tirlemontoise in collaboration with the Chambon company. By moulding and drying the moist sugar under strictly defined conditions of temperature and humidity, these lines provide a cube sugar with properties as similar as possible to those of the Adant cube.

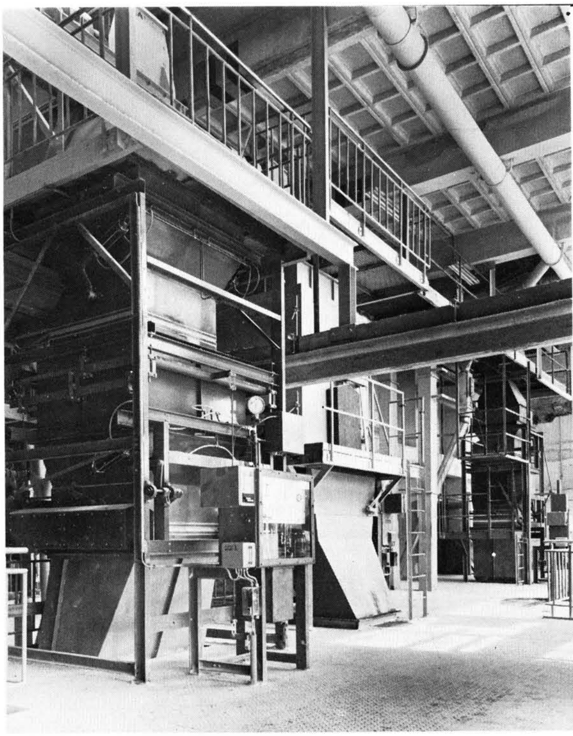
Granulated sugar II is sent to the Chambon moulding line, or to the packeting station where it is filled into 1 kg bags, into sacks or despatched in bulk. Alternatively it may be sent to the sugar loaf moulding line or to the invert sugar production plant. Distribution of the daily production of about 700 tonnes of refined sugar is roughly as follows, on average:

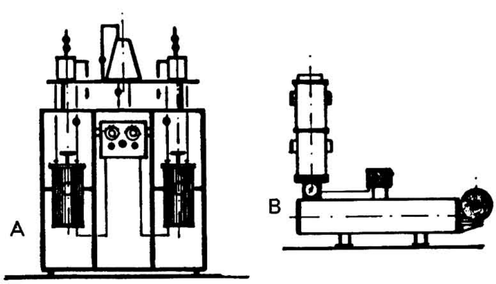
Adant cubes	75 tonnes
Hard cube sugar (R.T. process)...	160 tonnes
"Coffee portions"	16 tonnes
Chambon cubes	120 tonnes
1-kg bags	100 tonnes
Sacks	60 tonnes
Bulk sugar	20 tonnes
Sugar loaves	55 tonnes
Sent to invert sugar production ...	100 tonnes

In addition to the above 20 tonnes per day of brown sugar is produced by mixing 2nd green syrup with run-off from the Adant sugar centrifugation; the mixture is purified by liming and phosphatation, filtered, evaporated and finally crystallized in a mixer under vacuum. The brown sugar is packaged in 1-kg and ½-kg bags using a Hesser packaging machine, at a rate of 40 bags per minute.

The refinery has an ABR bulk silo holding 25,000 tonnes of white sugar as well as a horizontal silo of 12,000 tonnes capacity. It also has warehouses for packaged and manufactured products of 24,000 and 10,000 tonnes capacity, respectively.

The invert sugar plant processes annually some 20,000 tonnes of white sugar to give various kinds of sugar products. Sucrose syrup, "Sweetmix" (liquid mixtures of sucrose, glucose and invert sugar), fondant sugar and "Trimoline" (semi-crystallized invert sugar) are the specialities sold in the largest quantities.





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Printed by John Roberts & Sons Printers (Salford) Ltd, 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.