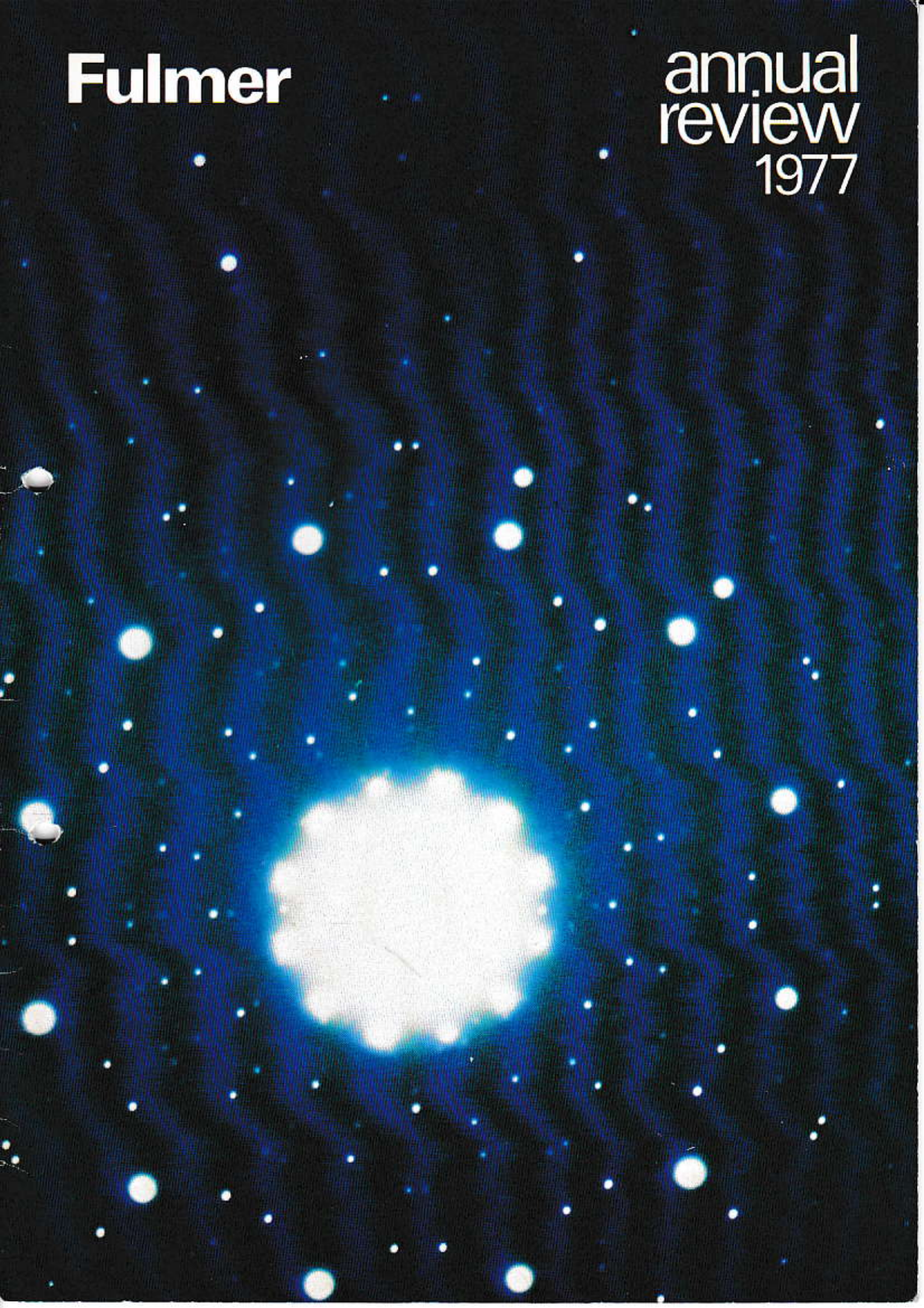


Fulmer

annual
review
1977



Fulmer Research Institute Limited

Fulmer is a contract research and engineering company concerned with the science and technology of materials. We provide research, development, design, testing, consulting and production engineering services to industry, commerce and Government. Our aim is to assist clients to manufacture products and operate processes more profitably.

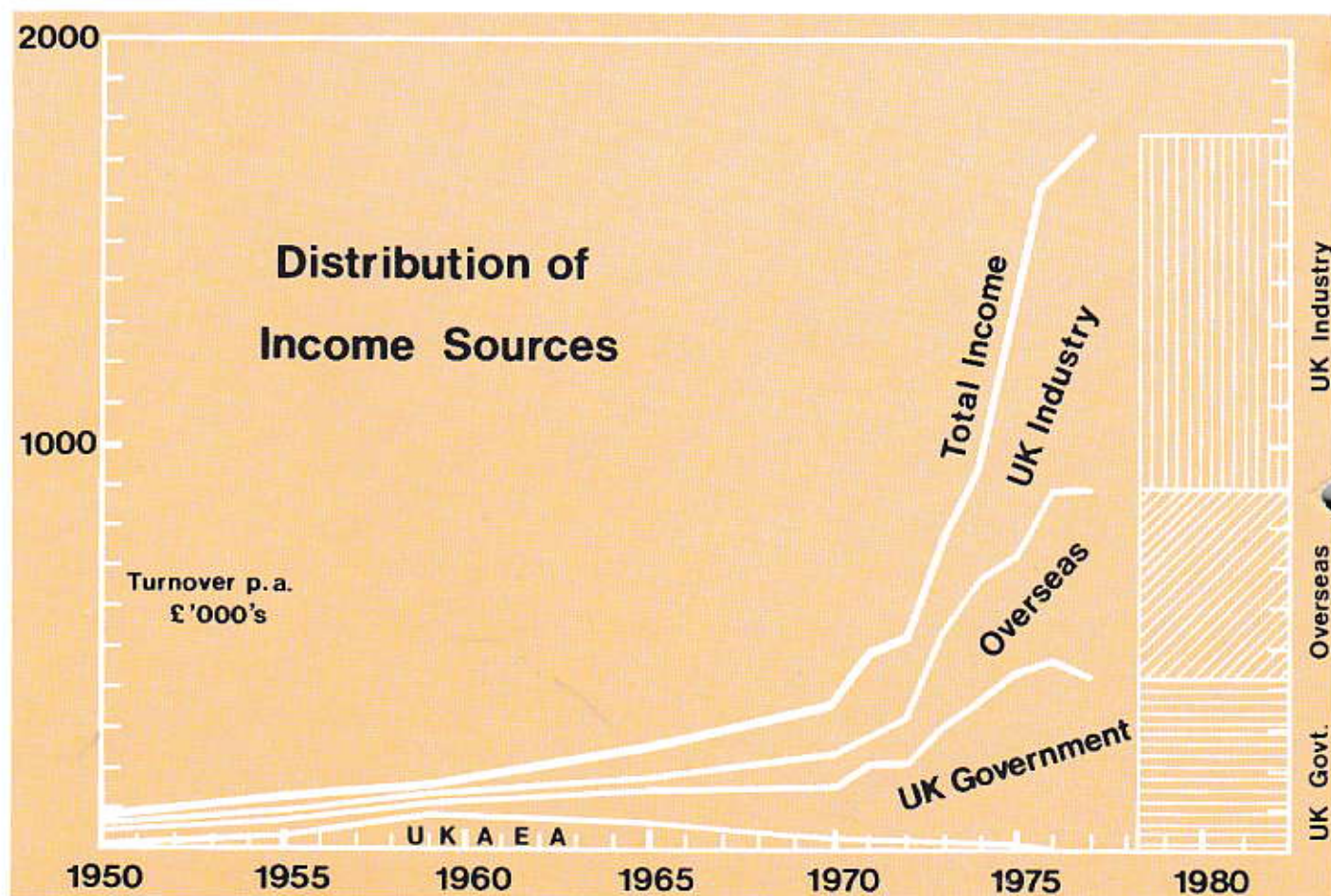
Our activities involve all engineering materials including metals, plastics, polymers, ceramics, fibres, composites, refractories, glasses and adhesives. Typical projects range from the development of new materials and new ways of processing materials to the evaluation of properties of materials under real or simulated service conditions using existing or specially developed testing techniques.

Technical and economic studies and market surveys are undertaken to assist company diversification programmes, or product and process development in engineering materials. These often lead to turnkey projects for the establishment of manufacturing operations.

Consultancy assignments include routine testing and analytical services, materials selection, failure diagnosis and technical advice relating to patents.

Fulmer is thus able to assist with a project from its initial conception through research and development to full scale manufacture. The work is carried out under strict conditions of commercial security.

The income since our foundation in 1946, and the sources from which this income has been earned are shown in the graph below.



The major income earning activities of the Institute and its subsidiaries are product development and testing, process development and control, turnkey projects, technology transfer and training.

Group Trading Report

1977 was a difficult year. Total income increased by £130,000 to £1.8 M but only a small profit of £1,000 was achieved.

The main reason for this disappointing performance was considerable delay in finalising new contracts and renewals in the first half of the year due to cash restraints in industry and government. A rapid influx of new contracts towards the end of the year raised the company order book to record levels, so that there are good prospects for a return to substantial profitability in 1978.

Despite the difficult year additional space and facilities were acquired at Redhill and substantial new capital equipment provided at Stoke Poges and Ashtead. The company is thus in a strong position to benefit from the upturn in business activity expected over the next year.

	Turnover			Profit/(Loss)	
	1976 £	1977 £	Increase %	1976 £	1977 £
Fulmer Research Institute Ltd.	1,134,000	1,158,000	1.76	49,500	(15,700)
Yarsley Research Laboratories Ltd.	306,000	356,000	9.48	36,500	6,350
Fulmer Components Ltd.	109,500	128,000	14.16	16,000	5,300
Reform Manufacturing Co. Ltd.	15,500	20,000	29.03	3,500	—
IPEC (Polymers) Ltd.	107,000	138,000	26.17	6,000	5,050
Total Group	1,672,000	1,800,000	5.08	111,000	1,000

Yarsley Research Laboratories Ltd. included the operating division Yarsley Testing Laboratories (YTL) whose activities produced most of its income. YTL and IPEC (Polymers) Ltd. have now been combined to form the new company Yarsley Technical Centre Ltd., YTEC, which commenced operations on January 1st 1978 at new premises in Redhill. Yarsley Research Laboratories Ltd. now trades from the Ashtead laboratories and includes the polymer and organic chemistry activities formerly mainly undertaken at Stoke Poges.

The total number of staff employed at the end of 1977 was 222.

Skateboarding made the headlines as the craze of 1977.

The dramatic resurgence of a previously unpopular pastime was due entirely to material developments which made possible a greatly improved design of skateboard. This provides yet another striking example of the way in which progress in engineering is always dependent on advances in materials technology and on improvement in the understanding, by designers, of how to use materials correctly. The relationship between skateboard design and materials technology is explained in a report prepared for ROSPA by Fulmer which led to much lighthearted newspaper, TV and radio comment in the pre-Christmas period.

The skateboard illustrated was designed with Fulmer help.

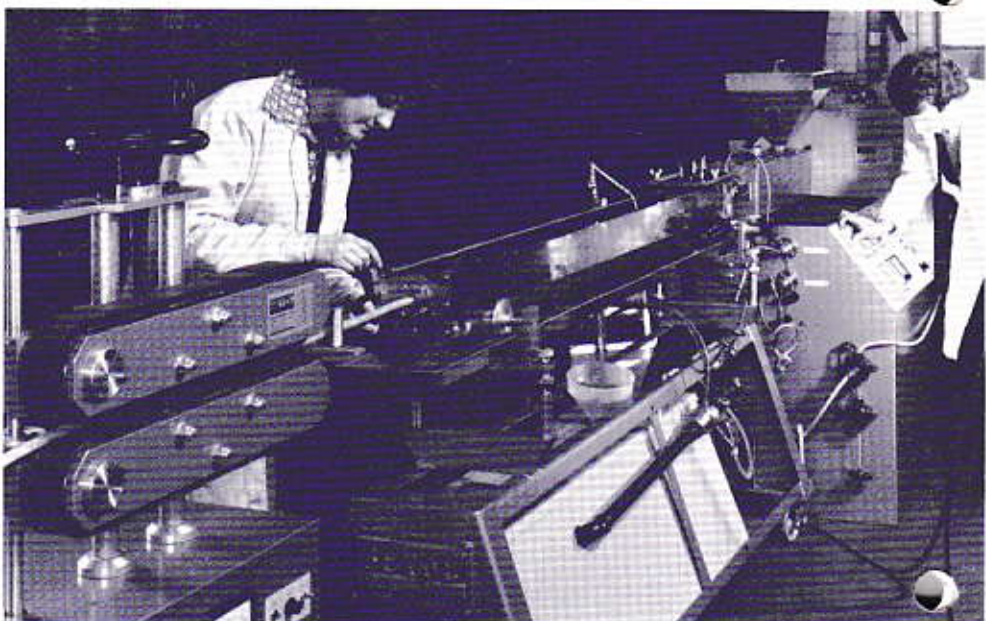


Product Development and Testing



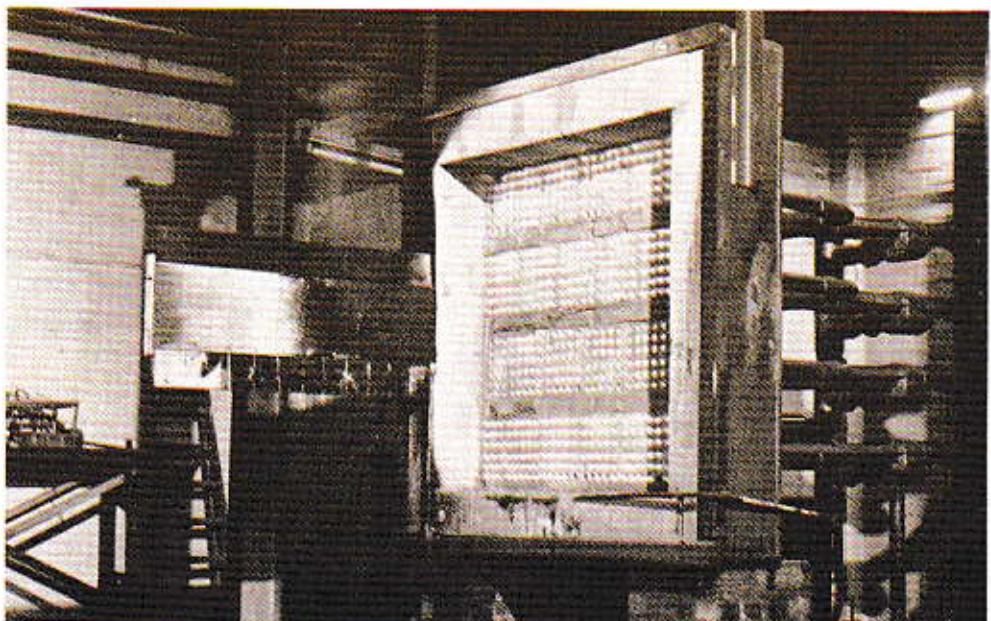
Yarsley Technical Centre

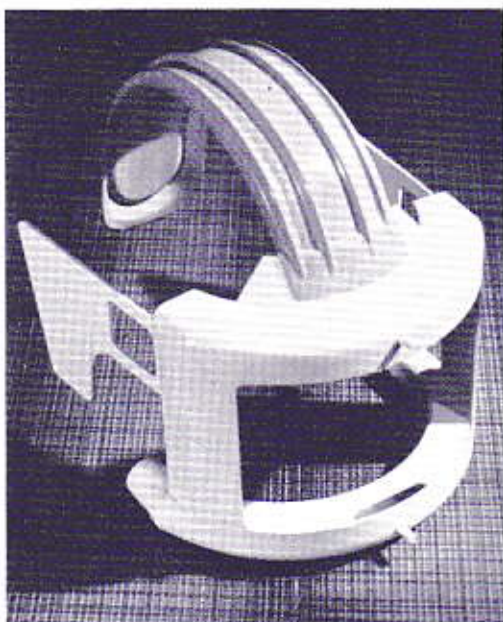
A major event in 1977 was the consolidation of most of our non-metal product development and testing activities into one unit at newly acquired premises in Redhill, Surrey. A new company has been formed Yarsley Technical Centre Ltd. which occupies 25,000 sq.ft. of laboratory, pilot plant and office space on a three acre site. The photographs show a general view of the buildings and some of the facilities.



Centre: Betol one inch screw extruder with vacuum water bath and haul-off facilities.

Bottom: Furnace for testing to BS 476 Part 7; 1971; Section 2. Surface spread of flame. YTEC's fire test certificates are internationally recognised.





The expertise available at YTEC covers all aspects of the development and testing of non-metallic materials, and the products and components manufactured from them. This includes:

Development

of new and improved materials, products and processes.

Materials Testing and Consultancy

to evaluate materials and to resolve problems associated with their use.

Product Design, Evaluation and Testing

including prototype construction, material and process selection, mould design, procurement and proving, product testing and quality control.

Design and Manufacture

of specialised systems for materials processing including hot runner injection moulding.

'Turnkey' Factory Establishment

including selection, procurement and testing of equipment, training of staff.

YTEC facilities include equipment for:

Polymer processing including injection, transfer and compression moulding, extrusion, mixing, blending and compounding, filament production.

Routine and investigational chemical analysis.

Fire testing and fire investigation, including furnaces for surface spread of flame, fire resistance and roof tests.

Measurement of mechanical properties including tensile, impact, flexural shear properties, compression, and fracture resistance.

Physical property measurements, including thermal and electrical conductivity; rheometry; optical properties; permeability to vapours and gases; energy absorption.

Special test rigs for reproducing in-service conditions, which are designed and constructed in our own workshops.

Pollution investigation and the control of environmental hazards.

Other Services available from YTEC include:

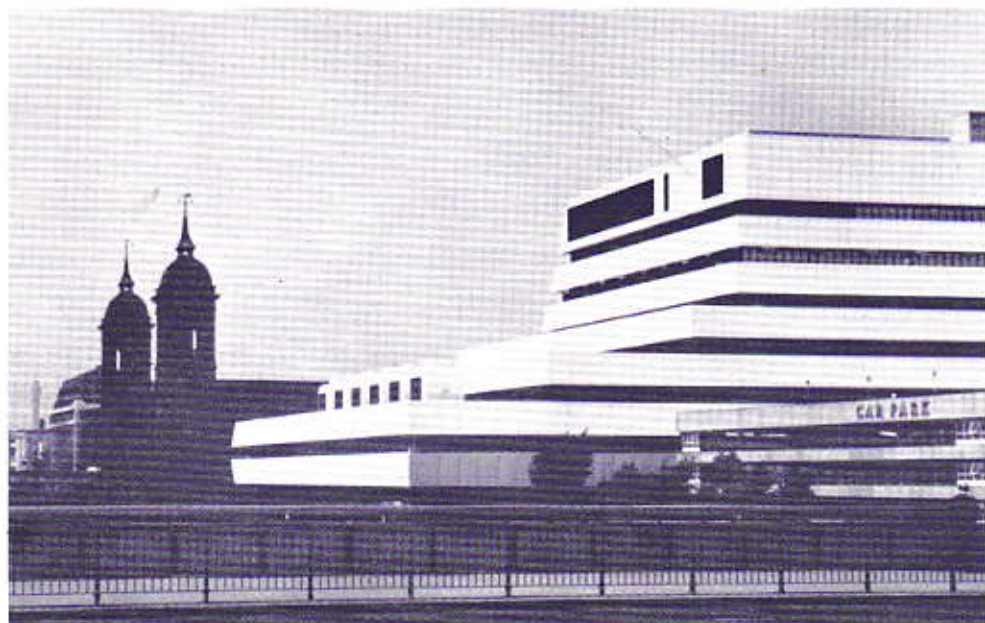
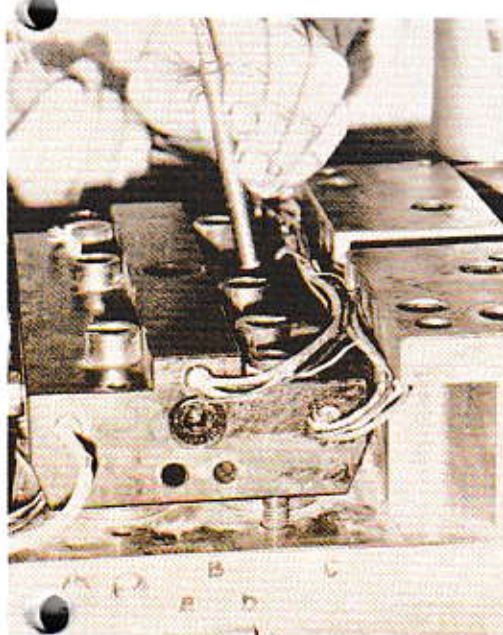
Trades Description Act investigations
Expert assistance in technical disputes

Patent and trade litigation

Toxic substances—test and control

Technical surveys and market research

In 1977 these services were used to improve the following products
petroleum refinery valves
kitchen appliances
electronic components
medical products
surgical aids
automobile components
food and cosmetic packaging
toys, games and D-I-Y equipment

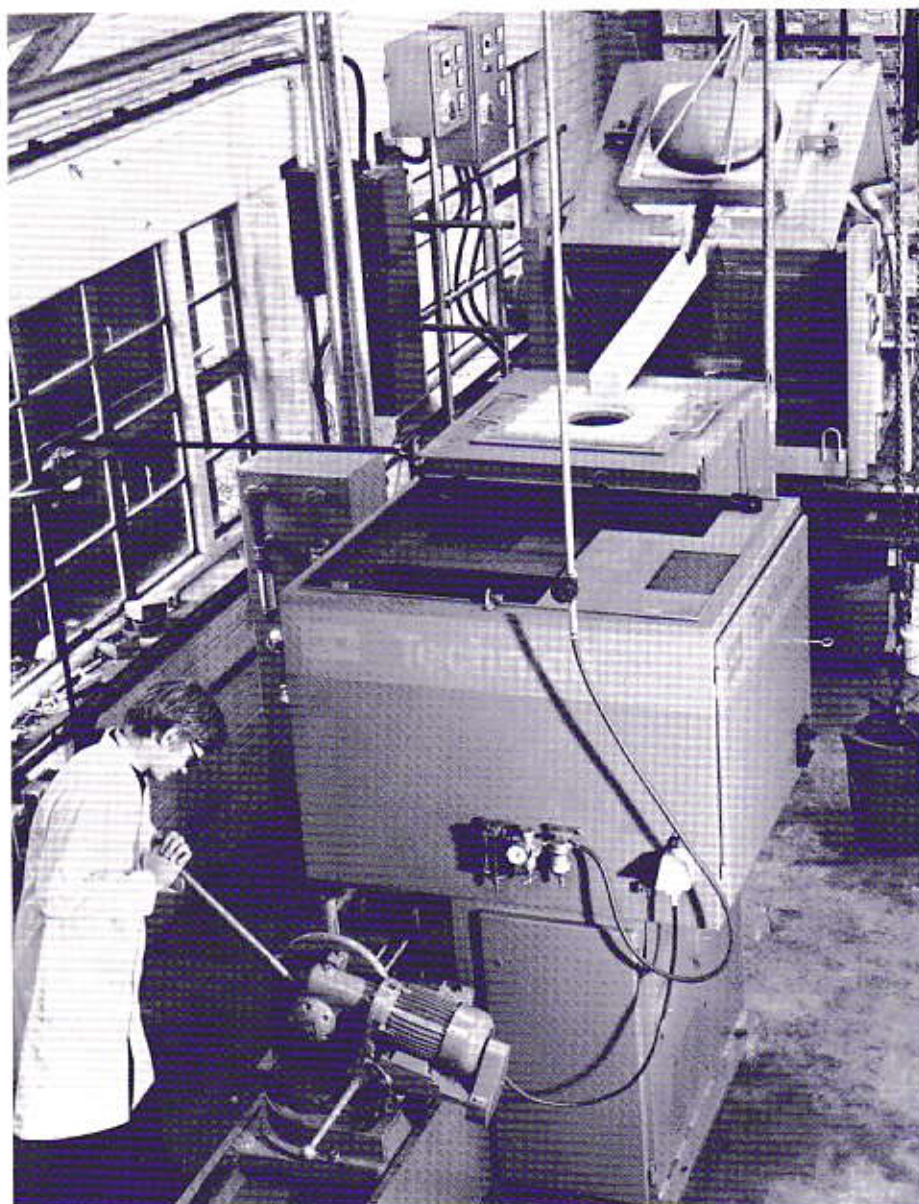


Top: New type of surgeon's helmet developed by YTEC in conjunction with a leading surgeon.

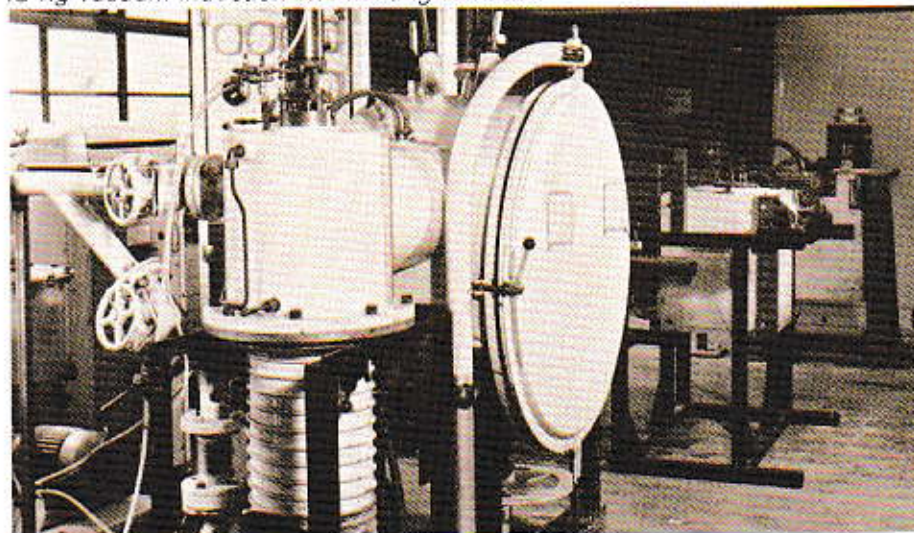
Centre: Assembling a hot runner injection mould.

Bottom: Mondial House—The International Telephone Exchange. YTEC tested the cladding panels.

Process Development and Control



15 Kg vacuum induction and melting furnace.



The Fulmer facilities for metallurgical process control and development were substantially increased in 1977 by the installation of a 500 ton diecasting machine, continuous casting equipment, a 100 kg aluminium melting unit, a 100 kg steel melting unit, a 30 kg holding furnace together with a 15 kg vacuum induction melting and casting furnace. Some of this equipment is illustrated on the left.

Casting Technology

Major contracts now undertaken include the development of a new continuous casting process for producing billets for novel die casting techniques. In conjunction with YTEC a new cast-to-size mould making technique, which could revolutionise the plastics moulding industry, is being investigated. A major sponsor for these process developments is the Mechanical Engineering and Machine Tools Requirements Board in cooperation with industrial partners.

Injection Moulding

The Board also supported the development of a new design of hot runner injection moulding system, based upon well-established principles, to transfer the polymer from the injection machine nozzle to the mould cavity. The system is simple and thermally balanced, and incorporates new design features to assist both the mould maker and the moulders. Temperature controllers which are based on the existing successful YTEC design have also been developed for this polymer transfer system. The controllers are modular and solid-state in construction, and are designed to give temperature control to $\pm 0.5^\circ\text{C}$.

Molten Metal Control

Other achievements in 1977 included the production of a probe to monitor continuously the gas content of aluminium melts. This work was carried out for George Kent and Sons Ltd., in association with NRDC.

A striking improvement in the properties and structure of electroslag refined ingots has been obtained by adding particles of the parent metal through the flux during the refining operation.

The accompanying photographs show, left, a normal electroslag ingot and, right, one subject to the grain refining treatment.

This technique is now being extended to improve the properties of electroslag welds.

Organic Synthesis

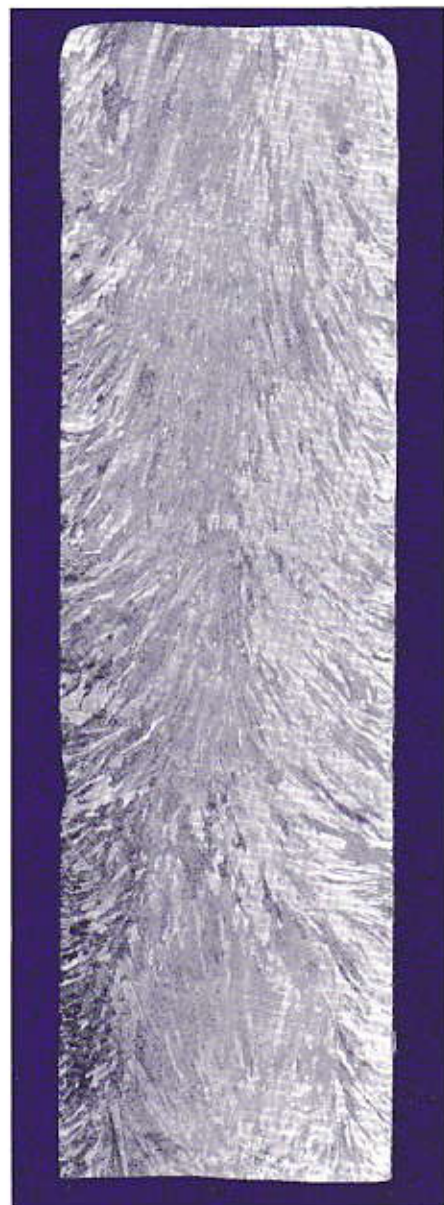
During the current year our position with regard to the production of organofluorine compounds has been consolidated. The main strength remains in the area of perfluorinated aromatics and we now have procedures for the production of the less fluorinated variety of compound. Among the many additional fluorocompounds produced are 4-fluorophenol and 2-, 3- and 4-trifluoromethylphenyl derivatives (e.g. bromo, benzoic acids, benzyl halides).

Compounds regularly produced on a custom synthesis basis are 1,2-dimethyl-1,4,5,6-tetrahydropyrimidine, 4-hexylresorcinol, 5-pentylresorcinol and 3,5-difluoro-4-methoxy-propiofenone.

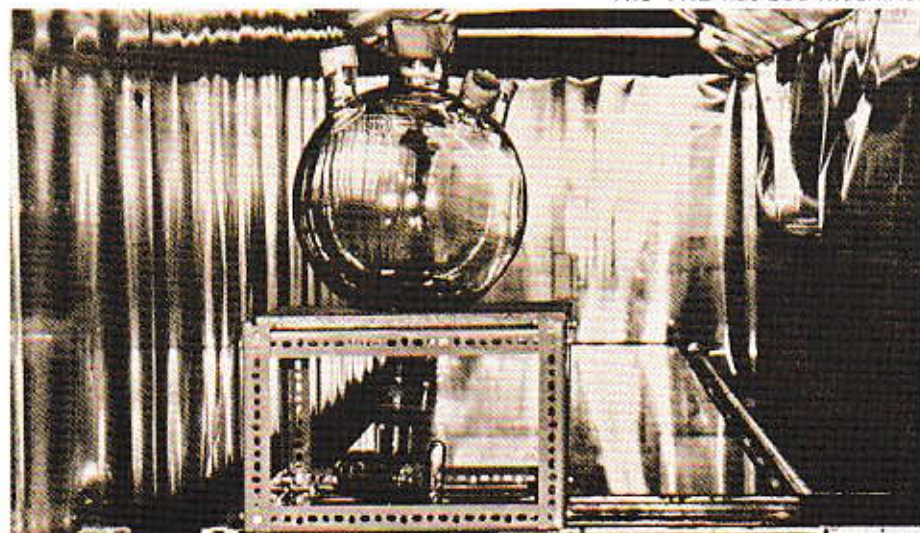
A new multipurpose pilot plant is in course of construction.

Polymer Film Process

At the Ashted location of Yarsley Research Laboratories a flat bed machine for the production of solvent cast polymer film in the thickness range $10\mu\text{m}$ to $10^3\mu\text{m}$ has been commissioned. This plant has been used for the production of photo-tropic film for military purposes.



The YRL flat bed machine.



Turnkey Projects

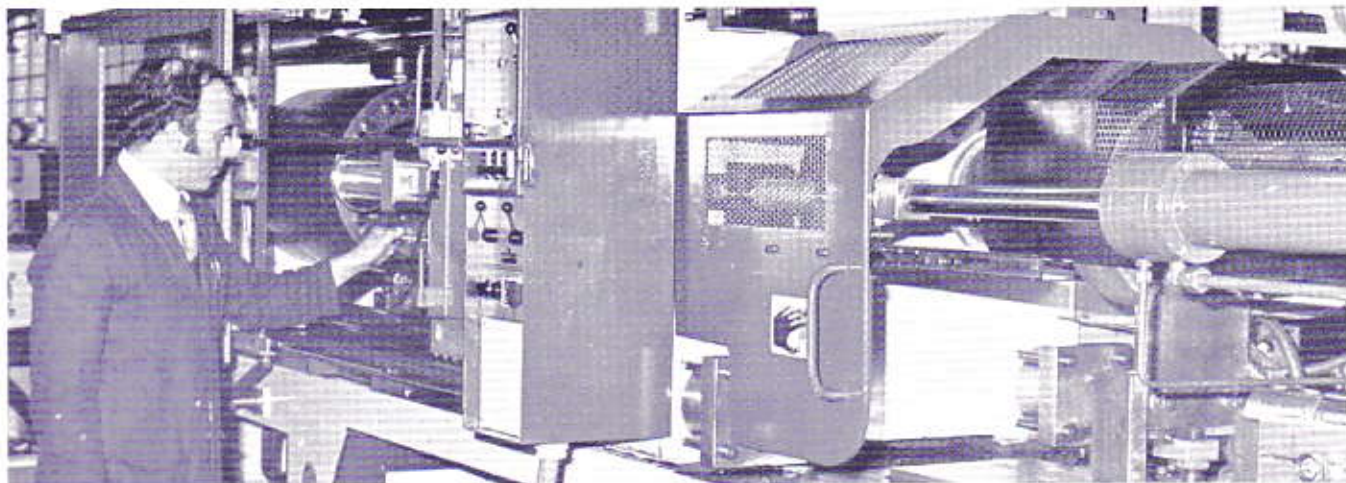
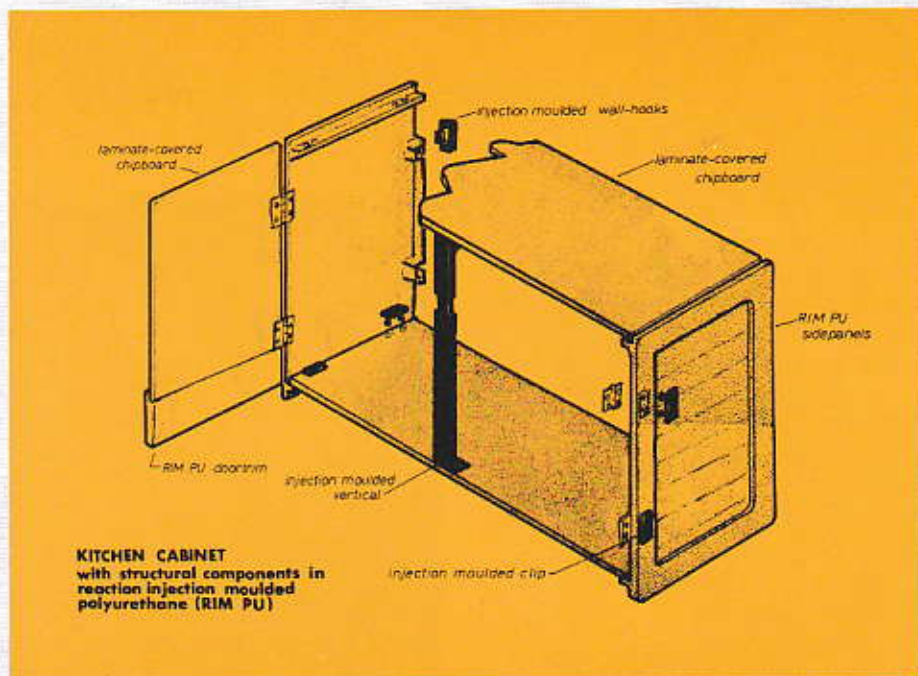
Fulmer is now engaged in commissioning a plastics product factory in Saudi Arabia. Consulting engineers for the project are the Yarsley Polymer Engineering Centre who carried out a study to select the machinery and plant from European and North American Suppliers. After a detailed technical and economic analysis, orders totalling £200,000 were placed in 1977, 95% on British Manufacturers.

The 1,000 sq. metre factory will be in production by mid 1978, less than five months after the foundations were laid. YPEC have recruited British engineers to run the factory for the first few years following commissioning by YPEC staff.

Other turnkey projects begun in the year included a rolling mill project for metal foil and providing assistance to Forging Developments Ltd., in commissioning a plant in Iran to produce forgings for the Iran Tractor Co., a subsidiary of IDRO.

A range of modular kitchen furniture has been designed for manufacture and marketing in the Persian Gulf.

The drawing above shows a top cupboard unit from this range.



Windsor injection moulding machine selected for Saudi Arabia.

Technology Transfer

A two year contract with UNIDO for the setting up of a Metals Advisory Service in Pakistan was completed at the end of 1977.

Seven experts were sent out for periods required by the work to cover their specialities. These included such diverse subjects as metallography, quality control, foundry technology, steel making, management training, project planning, metallurgical analysis, centrifugal spun pipe making and ore beneficiation.

Flexibility, diversity and back-up service was obtained by the UN through sub-contracting to Fulmer instead of using the conventional system of directly employing individual experts. The service has now completed some two-hundred trouble shooting jobs. Follow up enquiries show that the service was much appreciated and often resulted in increased production and financial gain, as well as technical problem solving.

In addition to trouble shooting the project has initiated work on the development of indigenous materials like foundry sands, bentonites, iron ores, chromites and graphite. Longer

term work includes the introduction of technology new to Pakistan such as SG iron founding, special steel making and cokeless cupola melting.

Throughout the work Fulmer has concentrated on instruction and training, every serving expert having Pakistani counterparts. Each specialty has been promoted by seminars internally for the project staff and externally by lectures at firms, learned societies and universities.

All the equipment provided for the

project by the UN has been commissioned and the operators trained by Fulmer personnel.

The picture below shows two MAS staff, Mansoor and Azar, operating the Jarrell Ash computer controlled atomic absorption apparatus in one of the MAS laboratories.

The success of this contract has demonstrated Fulmer's ability to undertake large overseas projects and provide a service not so easily obtained by employing a set of individual experts.



Training

The Developing Countries have a great need for highly trained technologists and Fulmer has co-operated with UNIDO, TETOC and the British Council in providing training facilities for a number of technologists from Bahrain, Chile, Pakistan and Yugoslavia.

Some of these technologists who have recently completed or are mid-way through a training course at Fulmer are shown with two course supervisors. From left to right:

Mr. Munir Ahmad, Senior Engineer and Mr. Mohammed Tufail Mughal, Senior Documentation Engineer both of the Metals Advisory Service, who came to Fulmer for training in foundry practice and in library and information practice. Dr. John Campbell, Senior Research Manager, Materials Processing Section. Mr. Vinko Ivusic, Assistant Lecturer in Materials Science Department of the Faculty of Mechanical Engineering and Naval Architecture at the University of Zagreb who has a British Council Fellowship to gain experience at

Fulmer in Materials Selection and Research. Mr. Robert F. Flint Librarian and Chief Information Officer, Fulmer. Mr. Abdul Quayyum Akhund of the Karachi Shipyards who is following a programme sponsored by TETOC to obtain the skills in the practices required to enable him to take responsibility for the quality control of foundry and related materials and Mr. Abdul Karim Habib Mohammed from Aluminium Bahrain who has received instruction on melting, casting and working of a wide variety of metals.

Consumer Services

Fulmer provides consumer services to industry, Government Departments, Local Authorities and individuals. The Services include:

1. Health and Safety at Work

Advice on improvements to existing processes to comply with legislation and recommendations on alternative processes and materials such as the replacement of solvent based adhesives.

2. Product Assessment

Analysis and testing of products with special reference to safety and product liability. Comparative product testing and advice on improved materials and methods of manufacture.

3. Pollution Monitoring

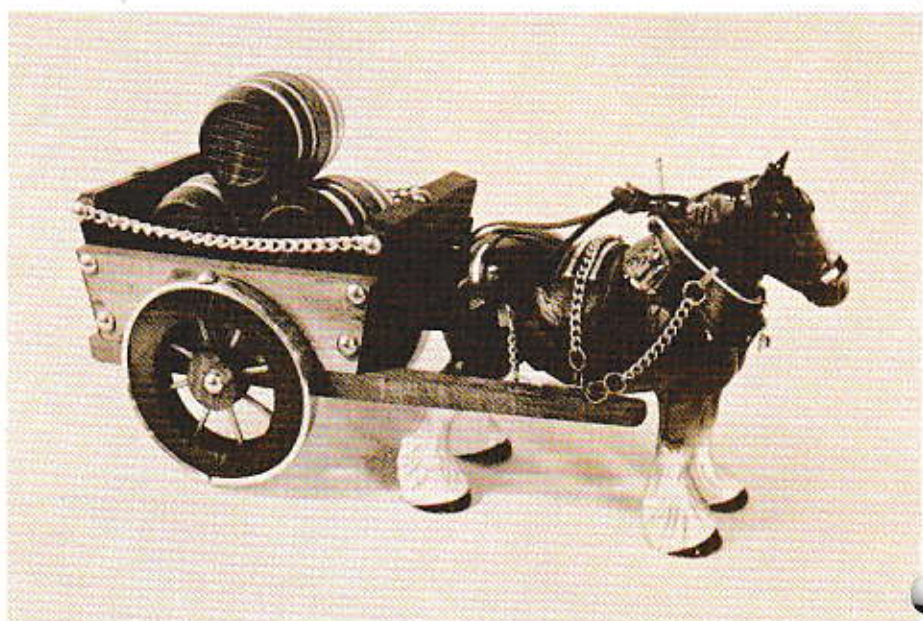
Detection and analysis of industrial pollutants including toxic substances such as asbestos and process effluents.

4. Technical Litigation

Court appearances as expert witnesses on engineering materials and manufacturing processes. Many disputes are settled out of court with Fulmer acting as an independent arbiter.

5. Fitness for Purpose Evaluation

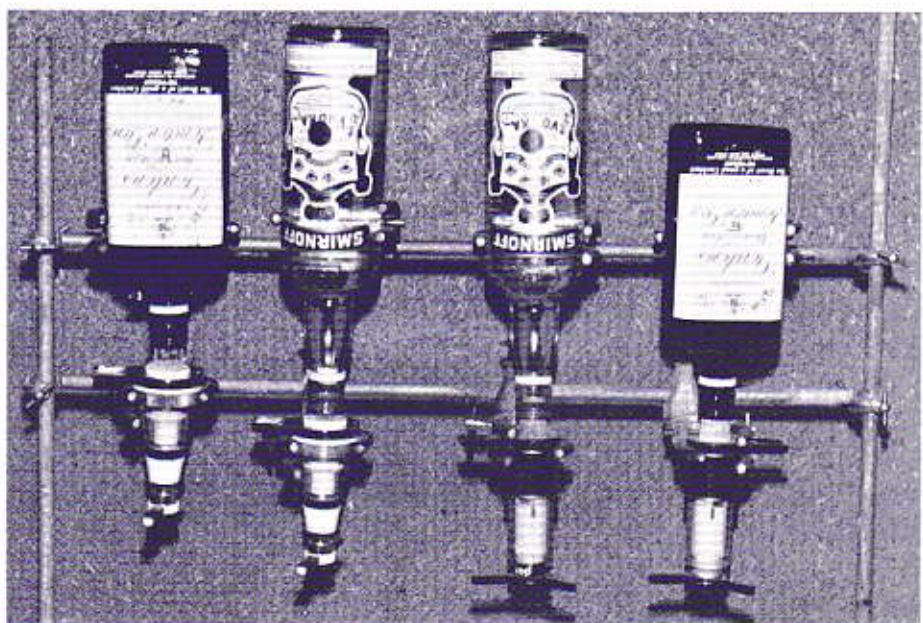
Advice on equivalent specifications. Trades Description Act contravention, Product failure diagnosis and prevention.



Top: MIRAN portable infra-red gas analyser used for detecting potentially hazardous solvent vapours in a working environment.

Centre: The materials used in the manufacture of this model horse and cart were analysed by Fulmer in connection with the Trades Description Act.

Bottom: Different types of spirit measures were alleged to cause varying contamination of the liquid diffusing through them. Our tests showed that these allegations were unfounded.



Publications List

Asbestos

Asbestos-Characteristics, Applications & Alternatives, Fulmer Special Report No. 5.
Published: 1976.

Fulmer Materials Optimizer

Fulmer Materials Optimizer.
An Information system for the selection and specification of engineering materials and manufacturing methods.
Published: 1974.
Updated continuously.

Superplasticity

A review of current materials, processes, applications, patent information, and commercial data.
Published: 1976.
Updated annually.

Research Planning & Design

The R.P.D. system. Notation and language.
A reference book for users of the R.P.D. system for the planning and design of projects, their appraisal and control.
Published: 1972.

Special Publications on Plastics

A Survey of Hot-Runner & Runnerless Moulding Systems

A review of the advantages, limitations and future trends of 20 systems from 6 countries.
Published: 1977.

Structural Foams

A special report on the markets, suppliers and growth potential of structural foams, plus a comparison of currently available materials and processes.
Published: 1977.

Thermoplastics Elastomers

A special report which gives information on commercial elastomers including their chemistry, properties, methods of processing and end uses, and also market information.
Published: 1977.

Plastics in Sport

A special report on the technical role played by Plastics in Sport, plus future projections.
Published: 1977.

Plastics in Gears

A special report on the advantages and limitations of plastics gears, including design data, operating factors and manufacturing methods.
Published: 1977.

Resin Properties Handbook

Comparative property data on new epoxide resins between -40°C to $+200^{\circ}\text{C}$. Loose leaf format for updating and expansion to other resins.
Published: 1976.

Mould Maintenance Manual

Guide to the design and maintenance for moulds for plastic components.
Published: 1976.

Statistics on Plastics 1971-1975

Production and consumption figures on individual materials. Data on related processes.
Growth Prospects and end uses:
Published: 1976.

Market Forecasts for Plastics 1976

Production and consumption figures on individual materials. Data on related processes.
Growth prospects and end uses:
Published: 1977.

Degradable Plastics

Special report on current methods of rendering plastics photo-degradable and bio-degradable. The importance of these materials in relation to the subject of plastics waste disposal is discussed.
Published: 1976.

Disposal of Plastics

Special report on the methods of plastics waste disposal including incineration, land infill, recycling, reclamation and degradable materials.
Published: 1975.

Prices of publications on application.



The Fulmer Materials Optimizer.

Fulmer in Perspective

This review can only touch on some of our new major programme changes in 1977 in view of the confidential nature of much of our work. Continuing work in our 5 operating divisions is outlined below.

Yarsley Research Laboratories

Mr. W. Flavell,
The Street, Ashted, Surrey.
Tel: Ashted 76391

Chemistry of polymers, including new formulations, adhesive technology including hot melt compositions, film technology, organic coatings, process development, custom synthesis, market research and surveys.

Fulmer Technical Services

Dr. G. Sanderson,
Stoke Poges, Bucks SL2 4QD.
Tel: Fulmer 2181

Complete range of analytical and mechanical testing facilities together with sophisticated equipment including XPS, SEM, EDAX, TEM and Quantimet for failure diagnosis and examination of surfaces. Fulmer Technical Services specializes in trouble shooting, simulation testing and consultancy.

Fulmer Research Institute

Dr. W.E. Duckworth,
Stoke Poges, Bucks SL2 4QD.
Tel: Fulmer 2181 Telex: 848314 Fulmer

Surface coatings including chemical vapour deposition, electrodeposition, metal spraying; energy research; novel propulsion systems; alloy development including bearing materials, damping alloys, high energy impact absorbing materials, memory metals; metals processing including die casting, powder metallurgy, metal working. Fibre reinforced composites.

Yarsley Technical Centre

Mr. J.A. Mead,
Trowers Way, Redhill, Surrey RH1 2JN.
Tel: Redhill 65070
Telex: 8951511

Research and development of plastics processing; design and manufacture of specialised systems for polymer processing; product design and evaluation; mould design, procurement and proving 'turnkey' factory establishment for cost effective production of polymer products; technical surveys.

Examination and evaluation of plastics, rubbers, paints, adhesives, timber products, thermal insulating materials, floor coverings, building materials, consumer goods. Special test facilities include fire testing, pollution test equipment, mechanical and chemical testing, thermal conductivity testing.

Fulmer Components

(including Reform Manufacturing)

Mr. T.G. Lewis
231 Berwick Avenue, Slough Trading Estate, Berks.
Tel: Slough 35996

Special product manufacture including pyrolytic boron nitride in the form of crucibles, tubes and coatings for crystal growth of ultra high-purity semiconductors, and plates for heat transfer in travelling wave tubes; delay units for computers. High precision engineering items such as specimen stages for electron microscopy and filament repair service. Small batch production of engineering items such as automatic paint spray unit and 'clip-on' meter for measuring tension in ropes and stays.

Owned by the Institute of Physics

Directors: Sir James Taylor, M.B.E., D.Sc., F.Inst.P., F.R.I.C. (Chairman), W.E. Duckworth, M.A., Ph.D., F.I.M., F.I.S., F.Inst.P., C.Eng. (Managing), P.F. Chester, B.Sc., Ph.D., F.Inst.P., L. Cohen, Ph.D., F.Inst.P., M.A.P. Dewey, F.I.M., E.A.G. Liddiard, M.A., F.I.M., F.Inst.P., B.J. Mason, C.B., F.R.S., D.Sc., W.R. Merton, M.A., F.Inst.P.

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