Sixty - seventh Annual Report 2004

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Tun Abdul Razak Research Centre

A research and promotion centre of the Malaysian Rubber Board

Company registration number: 336256

TARRC, Brickendonbury, Hertford, SG13 8NL, United Kingdom

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Datuk Abdul Hamid Sawal

Dr Sidek Dulngali

Dr Andrew J. Tinker

The Board

Mr Zulkifli Yahya

Dr Trevor Skinner

Mr Oon Kim Hung

The Board

Chairman

Datuk Abdul Hamid Sawal, *PJN, DPMT, DSDK, KMN, SDK, BEcons (Hons) (Malaya), MBA (USA)*
Director General of Malaysian Rubber Board, ex-officio

Vice-Chairman

Dr Sidek Dulngali, *JSM, BSc (Hons), PhD*
London Representative, Malaysian Rubber Board, ex-officio

Other Members

Mr Zulkifli Yahya, *BEcons (Malaya), MBA (UKM)*
Counsellor (Commodities), Malaysian Trade Commission, London
Appointed by the Minister of Primary Industries, Malaysia (Resigned 31st December 2004)

Dr Trevor Skinner, *PhD, FPRI*
Appointed by the Minister of Primary Industries, Malaysia (Resigned 31st December 2004)

Mr Oon Kim Hung, *BSc (Hons)*
Oon Corporation Resources (M) Sdn Bhd
Appointed by the Minister of Primary Industries, Malaysia

Dr Andrew J. Tinker, *JSM, PhD*
Director of Research, ex-officio

Deputy Company Secretary

Dr Elias Bin Awang, *PhD*

Accounts Supervisor

Zaila Bakar, *CAT*

Registered Office and Laboratories

Tun Abdul Razak Research Centre,
Brickendonbury, Hertford, SG13 8NL
United Kingdom

Solicitors

Stephenson Harwood

Auditors

Wagstaffs Chartered Accountants

Bankers

Bank Bumiputra Malaysia Berhad
Barclays Bank PLC

(as at 31st December 2004)

Senior Staff

(as at 31st December 2004)

Industry Development & Promotion Division

Division Head

Salleh Subari BSc, ANCRT *

* Seconded from the MRB

Market Intelligence & Promotion Unit

Unit Head

K. Lawson MSc, MBA, MCLIP
Principal Scientist

Senior Scientist

R. Newell BSc
G.M. Reader BSc

Scientists

D. Cawthra BA
S.T. Mahyudin BA
N. Tyler BSc

Industrial Support Unit

Unit Head

B.W. Evans PhD
Principal Scientist

Senior Scientists

G.E. Bennett MPRI
M.S.D. Fernando PhD, DIC, MIChemE
I.R. Wallace TPRI

Scientist

G.T. Spiller BSc

Deputy Company Secretary

Elias Awang PhD

Administration

M.P. Harris
Assistant Company Secretary

Zaila Bakar CAT
Accounts Supervisor

D.M. Newton BSc
Computer Network Administrator

Site Services

S. Ballard
Site Manager

Quality Assurance Officer / Health & Safety Officer

F.J. Winfield MSc
Principal Scientist

Rubber Consultants

I.R. Gelling KMN, PhD
Administrator

Director of Research

A.J. Tinker JSM, PhD

Research Contract Co-ordinator

A.D. Roberts PhD, FInstP, FIMMM, MRSC

Engineering Products & Design Division

Division Head

K.N.G. Fuller PhD, MInstP
Senior Principal Scientist

Engineering Design Unit

Unit Head

A.H. Muhr PhD, CPhys, CEng, MIMMM
Principal Scientist

Principal Scientist

H.R. Ahmadi MSc

Higher Scientists

J. Gough PhD
J.G.R. Kingston PhD, GradIMMM

Scientist

J.K. Picken MSci

Product Evaluation & Testing Unit

Unit Head

P.S. Brown MA
Principal Scientist

Senior Scientist

C.D. Forge MSc

Materials Research & Development Division

Division Head

S. Cook PhD
Senior Principal Scientist

Consultant

I.R. Gelling KMN, PhD

Advanced Materials & Product Development Unit

Unit Head

A.V. Chapman PhD
Principal Scientist

Senior Scientists

T.R. Johnson DPhil, FRSC
I.J. Stephens FIMechIE

Higher Scientists

J. Patel BSc, CEng
T.J. Pond MSc

Scientist

D. J. Lowe BSc

Materials Characterization Unit

Unit Head

I.S. Stephens BSc
Principal Scientist

Senior Scientists

R.C. Crafts MSc, CChem, MRSC
R.T. Davis PhD
P.C. Gugan BSc
M.J. Perkins PhD *(Deputy Unit Head)*

Higher Scientists

C.J. Lewan BSc
S. P. Perkins PhD
P.E. Swinyard BSc, CChem, MRSC

Datuk Abdul Hamid Sawal

Chairman, Tun Abdul Razak Research Centre

Chairman's Foreword

The rubber market stayed buoyant in 2004 as prices remained at new highs compared with previous years. Among the factors sustaining the higher trend in NR prices were tight raw material supply coupled with strong consumer demand, in particular from China. The year also saw substantial rises in crude oil prices, generating concerns that surging oil prices and depleting fossil fuel reserves would result in costlier synthetic rubber, though improving further the prospects for natural rubber. Better prices are a welcome respite for millions of smallholders in NR producing countries, as they are now able to enjoy better returns for their effort. This then is in sharp contrast to the situation experienced three years ago, when prices fell to depressed levels, prompting the governments of the three major NR producing countries to devise measures to prop up prices and to improve the plight of the smallholders. It is hoped that with healthy demand and better supply management, prices will continue to remain remunerative and that interest in the NR industry will continue to be sustained.

The automotive component sector in Malaysia has been identified as one of the areas expected to have excellent potential for growth. In 2004 TARRC officers participated in European automotive exhibitions to promote several Malaysian manufacturers, their products and the industry in general. Many of the major players in Europe were approached and these efforts confirm there is genuine interest in investment, outsourcing and Joint Venture opportunities with the Malaysian industry. In this context it is envisaged that collaboration with other Malaysian organisations such as the Malaysian Rubber Export Promotion Council (MREPC), the Malaysian Industry Development Authority (MIDA) and the Malaysian External Trade Development Corporation (MATRADE) will increase with a growing number of joint events and visits.

Although it is not always possible to know the outcome of matchmaking for outsourcing deals, at least eight instances are known where Malaysian companies have secured business as a result of initial contact with TARRC officers. Several European companies have visited Malaysia to meet up with Malaysian manufacturers and at least two companies are pursuing Foreign Direct Investment (FDI) opportunities with Malaysian manufacturers.

Global competition means that production costs are of vital importance and TARRC's project devoted to improving productivity and efficiency in the product manufacturing industry in Malaysia continued to make encouraging progress in 2004. I am pleased to note that feedback given by the companies involved in this programme of working visits by TARRC and Malaysian Rubber Board (MRB) staff is positive and several areas of improvement can be identified. This work is ongoing and, in addition to reducing costs by addressing basic manufacturing issues, it is important that advanced manufacturing techniques are passed on to manufacturers, allowing the industry in Malaysia to further improve their competitiveness.

The Research and Development programme continues to play its part in assisting the rubber industry to be an important source of growth in the Malaysian economy. With staff from TARRC and the Rubber Technology Centre (RTC) of the MRB working together on most projects, interaction can only enhance progress and the joint research programme meetings held during the year in Malaysia proved extremely fruitful. The Unified Research Programme between the two laboratories is directed towards product diversification into high-tech products for transport, aerospace and marine industries and officers at TARRC and RTC remain at the forefront of latest scientific and engineering developments within these fields of research.

TARRC's work on nanocomposites provides an excellent example of development in an emerging technology expected to provide the performance enhancements necessary for continued product advances. Although nanocomposites based on thermoplastics and nanoclay fillers have been commercialised for some years now, work on nanocomposites based on rubbers has only been undertaken in recent time. TARRC has prepared nanocomposites based on natural rubber, epoxidised natural rubber and EPDM. Encouraging results are being obtained: the nanocomposites based on EPDM are showing a substantial increase in fatigue life. The prospect of achieving much enhanced durability is exciting.

TARRC's consultancy unit Rubber Consultants continues its efforts to increase income generation. Attaining ISO 9001:2000 certification in 2004 will assist in this. It is encouraging that 2004 was another record year for turnover by the consultancy unit, with a substantial increase over 2003. At the same time, Rubber Consultants also plays its part in assisting the industry in Malaysia; this was exemplified in 2004 by the vital support played by the consultancy in a Malaysian manufacturer of isolators securing a large contract for the supply of seismic isolators for liquefied natural gas storage tanks in China.

Datuk Abdul Hamid Sawal

Report of the Board

The Board is pleased to submit this its sixty-seventh Annual Report and the Audited Accounts of the Research Centre for the year ended 31st December 2004.

The Board

Datuk Abdul Hamid Sawal (Chairman) was appointed Director General of the Malaysian Rubber Board (MRB) by the Minister of Primary Industries, Malaysia on 1st January 2000 and remains a Member and Chairman of the TARRC Board (ex-officio). Dr Sidek Dulngali as London Representative of the MRB, remains a Member and Vice-Chairman (ex-officio) and Dr Andrew Tinker, as Director of Research, remains a Member (ex-officio). Mr Zulkifli Yahya and Dr Trevor Skinner were both re-appointed to the Board by the Minister of Primary Industries, Malaysia on 1st January 2003 and both resigned as members of the Board on 31st December 2004 after over three years. Mr Kong Ping Yee resigned as a Member of the Board on 31st December 2003 after six years. The Board was pleased to record its gratitude and appreciation for their service rendered to the Research Centre. Mr Oon Kim Hung was appointed to the Board by the Minister of Primary Industries on 1st January 2004.

The Board met three times during 2004 to transact business.

The Members of the Board as at 31st December 2004 are listed on page 3.

General Meeting

The sixty-seventh Annual General Meeting of TARRC was held on 3rd August 2004 at the Bangunan Getah Asli, the headquarters of the Malaysian Rubber Board in Kuala Lumpur.

Legal Status

The Tun Abdul Razak Research Centre (TARRC) is an organization and research centre of the Malaysian Rubber Board (MRB), the body corporate established by statute in Malaysia for purposes of overseeing the development of the rubber industry with research and development as the core activity. Incorporated in England since 1938, TARRC is a Company Limited by Guarantee and not having a share capital, the word 'Limited' being omitted by Licence of the Department of Trade and Industry. TARRC by reason of the definition in Section 1(1) of the Companies Act 1980 and the bringing into force of Part 1 of that Act became a Private Company on 22nd December 1980.

Principal Activities

The principal activities of TARRC are scientific research into rubber, technological developments in the compounding, processing, and the improvement of tyre performance and service lifetime of rubber products as a whole. It also publishes and distributes scientific and technical literature on rubber for, in particular, the promotion of Malaysian rubber products and Malaysian rubber. Foreign Direct Investment (FDI) opportunities and manufacturing activities in the Malaysian rubber industry are also promoted and encouraged by participation in international meetings, seminars and exhibitions. All activities contribute to the aim of expanding markets for Malaysian rubber products.

The Board adopted the Report 'The Continuing Role of the Tun Abdul Razak Research Centre' following its submission to the Honourable Minister of Primary Industries, Malaysia, in 1999. The Report clearly sets out the core activities of TARRC as specialized R&D focussing particularly on its prevailing expertise in rubber in engineering applications and advanced materials, transfer of technology, commercialization of R&D outcomes, promotion of products, training for personnel both from the Malaysian Rubber Board and the industry in Malaysia and consultancy services. Clear targets are set for income generation.

In keeping with this policy, the Board charged the Director and Staff to continue to enhance income through exploitation of TARRC's scientific resources and expertise and commercialization of its R&D findings to increase its degree of self-financing. The Board was pleased that in 2004 TARRC was running three contracts, two financed by the European Union and one funded from Biffaward. TARRC was also a partner in 3 others, all financed by the European Union.

The Board was pleased that YB Datuk Seri Dr Jamaludin Jarjis, the Hon. Minister of Science, Technology and Innovation, was able to visit TARRC during the year. The Board was also pleased to note the interest demonstrated by the Minister on the progress made by TARRC's Materials Research and Development Division on studies of nanocomposite materials, and favourable comments on the conference and meeting facilities offered at Brickendonbury.

The Board was also pleased that The Deputy Minister of International Trade and Industry YB Dato' Ahmad Husni bin Mohamad Hanadzlah, Dr Michael Dorsim Lunjew, Deputy Secretary I, the Ministry of Plantation Industries and Commodities, and a delegation from the Ministry of Agriculture & Agro-based Industry, including Director Generals and other distinguished visitors from the various departments and agencies, were able to visit TARRC during the year.

TARRC plays an ever increasingly important role as Malaysia industrializes. Although technical support for Malaysian rubber continues, the Centre's much more important role now is to assist Malaysian rubber product manufacturers by factory visits, transfer of technology, enhancing their product development capabilities and compounding and processing know-how. TARRC answered 143 recorded technical enquiries in support of the Malaysian rubber industry, 33 of these coming from Malaysian companies seeking advice and assistance on compounding, product manufacture and specifications. TARRC has also continued to work closely with other Malaysian organizations, particularly the Malaysian Rubber Export Promotion Council, the Malaysian External Trade Development Corporation and the Malaysian Industrial Development Authority, to promote the Malaysian-manufactured rubber products and the rubber industry as a whole.

The Board was pleased that the TARRC laboratories achieved ISO 9001:2000 certification in 2004 resulting from culmination of many months of work developing and implementing an organisation-wide quality management system that meets the stringent requirements of this International Standard.

The Board is pleased with the encouraging start made under the project to investigate the properties of rubber nanocomposites containing organoclays and that observations so far indicate that it should be possible to obtain enhanced durability of these new materials through the use of nanoclay fillers.

The Board was pleased with the progress being made in the technical promotion of DPNR to major European manufacturers of engineering products. The Board is also pleased that the promotion of base isolation systems is continuing to show promising developments with a final structure agreed for a base isolated demonstration building in Algeria, incorporating 17 elastomeric isolators that will be manufactured in Malaysia.

The Board was pleased with Rubber Consultants' highest recorded turnover in 2004 for the second year running.

These activities and the work of TARRC as a whole in 2004 are discussed by the Director of Research in his Report on pages 20-29.

Senior Staff as at 31st December 2004

During the year two appointments were made, one senior officer retired and three resigned. The total senior staff strength on 31st December 2004 was 42, including five employed on contract.

Supporting Staff as at 31st December 2004

During the year one member retired and five resigned. The total number of supporting staff on 31st December 2004 was 44, including five employed on contract.

The Board records its thanks to all employees for their work in 2004.

Publications

A list of the staff lectures and the scientific and technological papers published in 2004 follows the Report of the Director of Research on page 30.

Finance

The Income and Expenditure Account and the Balance Sheet as at 31st December 2004, together with Explanatory Notes and the Auditor's Report, are presented on pages 10 to 19. In the opinion of the Board, the current market value of TARRC's freehold properties is in excess of the net book value shown in the Balance Sheet.

Auditors

During the year, Wagstaffs Chartered Accountants were appointed auditors to the company and in accordance with Section 385 of the Companies Act 1985 a resolution proposing their reappointment will be put at the forthcoming Annual General Meeting.

For and on behalf of the Board
Datuk Abdul Hamid Sawal
30th August 2005

Directors' responsibilities

Company law requires the directors to prepare financial statements for each financial year which give a true and fair view of the state of the affairs of the company and of the profit or loss of the company for that year. In preparing these the directors are required to:

- *select suitable accounting policies and apply them consistently;*
- *make judgements and estimates that are reasonable and prudent;*
- *prepare the financial statements on the going concern basis unless it is inappropriate to presume that the company will continue in business.*

The directors are responsible for keeping proper accounting records which disclose with reasonable accuracy at any time the financial position of the company and to enable them to ensure that the financial statements comply with the Companies Act 1985. They are also responsible for safeguarding the assets of the company and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

Independent auditors' report to the members of the Tun Abdul Razak Research Centre

We have audited the financial statements of Tun Abdul Razak Research Centre for the year ended 31st December 2004 which comprise the income and expenditure account, the balance sheet, the cash flow statement and the related notes. These financial statements have been prepared under the historical cost convention and the accounting policies set out therein.

This report is made solely to the company's members, as a body, in accordance with Section 235 of the Companies Act 1985. Our audit work has been undertaken so that we might state to the company's shareholders those matters we are required to state to them in an auditors' report and for no other purpose. To the fullest extent permitted by law, we do not accept or assume responsibility to anyone other than the company and the company's shareholders as a body, for our audit work, for this report, or for the opinions we have formed.

Respective responsibilities of directors and auditors

As described in the statement of directors' responsibilities the company's directors are responsible for the preparation of the financial statements in accordance with applicable law and United Kingdom Accounting Standards.

Our responsibility is to audit the financial statements in accordance with relevant legal and regulatory requirements and United Kingdom Auditing Standards.

We report to you our opinion as to whether the financial statements give a true and fair view and are properly prepared in accordance with the Companies Act 1985. We also report to you if, in our opinion, the directors' report is not consistent with the financial statements, if the company has not kept proper accounting records, if we have not received all the information and explanations we require for our audit, or if information specified by law regarding directors' remuneration and transactions with the company is not disclosed.

We read the directors' report and consider the implications for our report if we become aware of any apparent misstatements within it.

Basis of audit opinion

We conducted our audit in accordance with United Kingdom Auditing Standards issued by the Auditing Practices Board. An audit includes examination, on a test basis, of evidence relevant to the amounts and disclosures in the financial statements. It also includes an assessment of the significant estimates and judgements made by the directors in the preparation of the financial statements, and of whether the accounting policies are appropriate to the company's circumstances, consistently applied and adequately disclosed.

We planned and performed our audit so as to obtain all the information and explanations which we considered necessary in order to provide us with sufficient evidence to give reasonable assurance that the financial statements are free from material misstatement, whether caused by fraud or other irregularity or error. In forming our opinion we also evaluated the overall adequacy of the presentation of information in the financial statements.

Opinion

In our opinion the financial statements give a true and fair view of the state of the company's affairs as at 31st December 2004 and of its deficit for the year then ended and have been properly prepared in accordance with the Companies Act 1985.

Wagstaffs
Chartered Accountants and Registered Auditors
Richmond House, Walkern Road, Stevenage
Hertfordshire, SG1 3QP

Income & Expenditure Account

for the year ended 31st December 2004

	Notes	2004 £	2003 £
Income	2	3,783,300	3,729,491
Cost of sales		(2,416,541)	(2,279,603)
Contribution		1,366,759	1,449,888
Distribution costs		(3,093)	(2,759)
Administrative expenses		(1,477,042)	(1,565,037)
Other operating income		84,255	102,749
Operating deficit	3	(29,121)	(15,159)
Other interest receivable and similar income	4	15,305	23,054
(Deficit)/Surplus on ordinary activities before taxation		(13,816)	7,895
Tax on (deficit)/surplus on ordinary activities		-	-
(Deficit)/retained surplus for the year		(13,816)	7,895

There are no recognized gains or losses other than the surplus or deficit for the above two financial years.

Balance Sheet

as at 31st December 2004

		2004		2003	
Fixed Assets	Notes	£	£	£	£
Tangible assets	7		1,550,512		1,548,451
Current assets					
Stocks	8	1,715		1,712	
Debtors	9				
falling due after more than one year		219,545		219,545	
falling due within one year		360,634		439,400	
Cash at bank and in hand		1,468,899		1,669,602	
		2,050,793		2,330,259	
Creditors: amounts falling due within one year	10	(403,810)		(667,399)	
Net current assets			1,646,983		1,662,860
Net assets			3,197,495		3,211,311
Capital and reserves					
Other reserves	11		597,978		597,289
Income & expenditure account	11		2,599,517		2,614,022
Equity funds	12		3,197,495		3,211,311

These financial statements were approved by the Board on 30th August 2005 and signed on its behalf by:

Datuk Abdul Hamid Sawal
Director

Dr Andrew Tinker
Director

Cash Flow Statement

for the year ended 31st December 2004

	Notes	2004 £	2003 £
Reconciliation of operating deficit to net cash outflow from operating activities			
Operating deficit		(29,121)	(15,159)
Depreciation		108,775	119,758
(Increase) in stocks		(3)	3
Decrease in debtors		78,766	178,825
(Decrease) in creditors		(263,589)	139,386
Net cash inflow from operating activities		(105,172)	422,813
Cash flow statement			
Net cash inflow from operating activities		(105,172)	422,813
Returns on investments and servicing of finance	19	15,305	23,054
Capital expenditure	19	(110,836)	(95,518)
Decrease in cash in the year		(200,703)	350,349
Reconciliation of net cash flow to movement in net funds (Note 20)			
Decrease in cash in the year		(200,703)	350,349
Net funds at 1st January 2004		1,669,602	1,319,253
Net funds at 31st December 2004		1,468,899	1,669,602

Notes to the Financial Statements

for the year ended 31st December 2004

1. Accounting policies

Accounting convention - **The financial statements are prepared under the historical cost convention.**

Turnover - **Turnover represents the total invoice value, excluding value added tax, of sales made during the year.**

Tangible fixed assets and depreciation - **Depreciation is provided at rates calculated to write off the cost less residual value of each asset over its expected useful life, as follows:**

Land	– Not depreciated
Freehold buildings	– 2% Straight line
Leasehold properties	– Straight line over the life of the lease
Plant and machinery	– 20% Straight line
Fixtures, fittings and equipment	– 20% Straight line
Motor vehicles	– 25% Straight line

Stock - **Stock is valued at the lower of cost and net realisable value.**

Pensions - **The pension costs charged in the financial statements represent the contribution payable by the company during the year. The regular cost of providing retirement pensions and related benefits is charged to the profit and loss account over the employees' service lives on the basis of a constant percentage of earnings.**

Notes to the Financial Statements

for the year ended 31st December 2004

***Foreign currencies** - Monetary assets and liabilities denominated in foreign currencies are translated into sterling at the rates of exchange prevailing at the accounting date. Transactions in foreign currencies are recorded at the date of the transactions. All differences are taken to the Income and Expenditure account.*

***Deferred taxation** - Deferred tax is recognised in respect of all timing differences that have originated but not reversed at the balance sheet date where transactions or events have occurred at that date that will result in an obligation to pay more, or a right to pay less or to receive more, tax, with the following exceptions:*

Provision is made for tax on gains arising from the revaluation (and similar fair value adjustments) of fixed assets, and gains on disposal of fixed assets that have been rolled over into replacement assets, only to the extent that, at the balance sheet date, there is a binding agreement to dispose of the assets concerned. However, no provision is made where, on the basis of all available evidence at the balance sheet date, it is more likely than not that the taxable gain will be rolled over into replacement assets and charged to tax only where the replacement assets are sold;

Provision is made for deferred tax that would arise on remittance of the retained earnings of overseas subsidiaries, associates and joint ventures only to the extent that, at the balance sheet date, dividends have been accrued as receivable;

Deferred tax assets are recognised only to the extent that the directors consider that it is more likely than not that there will be suitable taxable profits from which the future reversal of the underlying timing differences can be deducted.

Deferred tax is measured on an undiscounted basis at the tax rates that are expected to apply in the periods in which timing differences reverse, based on tax rates and laws enacted or substantively enacted at the balance sheet date.

2. Income	2004	2003
	£	£
Trading Income	1,049,800	1,113,691
Contributions from MRB	2,733,500	2,615,800
	3,783,300	3,729,491
Trading Income is analysed as follows:		
Class of business		
Rubber Consultants	899,487	788,250
Research and other contracts	150,313	325,441
	1,049,800	1,113,691
Geographical market		
UK	776,605	705,982
Europe	234,474	293,496
Rest of the world	38,721	114,213
	1,049,800	1,113,691

3. Operating (deficit)/surplus	2004	2003
	£	£
Operating deficit is stated after charging:		
Depreciation and other amounts written off tangible assets	108,775	124,758
Loss on foreign currencies	13,276	(80,665)
Auditors' remuneration	10,750	10,750
and after crediting:		
Profit on disposal of tangible fixed assets	-	5,000

4. Interest receivable and similar income	2004	2003
	£	£
Bank interest	15,305	23,054

Notes to the Financial Statements

for the year ended 31st December 2004

5. Employees	2004 Number	2003 Number
Number of employees		
The average monthly numbers of employees (including the directors) during the year were:		
Technical and administration	86	89

Employment costs	2004 £	2003 £
Wages and salaries	2,116,230	1,983,471
Social security costs	170,868	159,944
Other pension costs	297,835	533,821
	2,584,933	2,677,236

5.1 Directors' emoluments	2004 £	2003 £
Remuneration and other emoluments	64,322	59,058
Pension contributions	11,350	9,132
	75,672	68,190

	Number	Number
Number of directors to whom retirement benefits are accruing under a money purchase scheme	-	-
Number of directors to whom retirement benefits are accruing under a defined benefit scheme	1	1

6. Pension costs

The company operates a defined contribution pension scheme in respect of the senior employees. The scheme and its assets are held by independent managers. The pension charge represents contributions due from the company and amounted to £13,932 (2003 -£4,869).

The company operates a funded pension scheme in respect of the directors and employees, projecting benefits based on final salary. The assets of the scheme are held separately from those of the company, being invested in units within professionally managed funds. Contributions to the scheme are charged to the profit and loss account so as to spread the cost of pensions over employees' working lives with the company. The rate of contribution is determined by qualified actuaries on the basis of triennial valuations using the projected unit method and based on assumptions which in their opinion meet the requirements of FRS 17. The pension charge represents contributions due from the company and amounted to £528,952 (31st December 2003 - £409,077).

Analysis of the amount charged to operating profit	2004 £	2003 £
Current service cost	283,903	528,952

Notes to the Financial Statements

for the year ended 31st December 2004

7. Tangible fixed assets

	Land and buildings freehold	Long leasehold property	Plant and machinery	Fixtures, fittings and equipment	Total
Cost	£	£	£	£	£
At 1st January 2004	2,264,592	243,586	3,529,132	266,533	6,303,843
Additions	-	-	110,836	-	110,836
At 31st December 2004	2,264,592	243,586	3,639,968	266,533	6,414,679
Depreciation					
At 1st January 2004	1,014,289	85,510	3,389,060	266,533	4,755,392
Charge for the year	43,272	4,872	60,631	-	108,775
At 31st December 2004	1,057,561	90,382	3,449,691	266,533	4,864,167
Net book values					
At 31st December 2004	1,207,031	153,204	190,277	-	1,550,512
At 31st December 2003	1,250,303	158,076	140,072	-	1,548,451

8. Stocks

	2004 £	2003 £
Finished goods and goods for resale	1,715	1,712

9. Debtors

	2004 £	2003 £
Trade debtors	252,316	222,371
Amount owed by connected companies	294,644	386,599
Other debtors	33,219	49,975
	580,179	658,945

Included within debtors are staff loans to the sum of £21,053 (2003: £24,885) representing amounts due from employees in respect of housing loans. The full balance at the year end is considered to be due after more than one year. Included within amounts due by connected companies is £219,545 which is repayable after more than one year.

10. Creditors: amounts falling due within one year

	2004 £	2003 £
Trade creditors	62,088	3,445
Other taxes and social security costs	56,894	55,180
Other creditors	31,955	345,811
Accruals and deferred income	252,873	262,963
	403,810	667,399

11. Equity reserves

	Income and expenditure account £	Special reserve £	Total £
At 1st January 2004	2,614,022	597,289	3,211,311
Transfer of realised surplus	(689)		(689)
(Deficit)/retained surplus for the year	(13,816)		(13,816)
Other movements	-	689	689
At 31st December 2004	2,599,517	597,978	3,197,495

12. Reconciliation of movements in members' funds	2004 £'000	2003 £'000
(Deficit)/Surplus for the year	(13,816)	7,895
Opening members' funds	3,211,311	3,203,416
Closing members' funds	3,197,495	3,211,311

13. Pension cost note

Pension scheme arrangements: The company provides pension arrangements to the director and the majority of full-time employees through one defined benefit scheme and the related costs are assessed in accordance with the advice of professionally qualified actuaries.

Actuarial valuation: details of the most recent actuarial valuations of the principal schemes, which were conducted as at 1st January 2003, using the projected unit valuation method. The following FRS 17 information has been provided to the company by HSBC Plc Actuaries:

13.1 Principal actuarial assumptions were:

Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 %	2003 %	2002 %
Rate of increase in salaries	3.5	3.5	3.5
Rate of increase in pensions in payment	2.5	2.5	2.5
Rate of increase in deferred pensions	3.0	3.0	3.0
Discount rate	5.5	5.5	5.5
Inflation assumption	2.5	2.5	2.5

13.2 The principal liabilities in the scheme were:

Tun Abdul Razak Research Centre Pension and Assurance Scheme

	Long term rate of return expected at 31/12/04 %	Value at 31/12/04 £'000	Long term rate of return expected at 31/12/03 %	Value at 31/12/03 £'000	Long term rate of return expected at 31/12/02 %	Value at 31/12/02 £'000
Equities	6.5	3,574	6.5	3,481	6.5	2,549
Bonds	4.5	1,230	4.5	566	4.5	510
Property	-	-	-	-	5.5	56
Other	3.8	240	3.8	304	3.8	241
Total market value of assets		5,044		4,351		3,356
Present value of scheme liabilities		(7,259)		(6,727)		(6,185)
Deficit in the scheme		(2,215)		(2,376)		(2,829)
Net pension assets/(liabilities)		(2,215)		(2,376)		(2,829)

13.3 Analysis of the amount charged to operating deficit

Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 £'000	2003 £'000
Current service cost	361	361

13.4 Analysis of the amount charged to other finance income
Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 £'000	2003 £'000
Expected return on pension scheme assets	278	212
Interest on pension scheme liabilities	(374)	(346)
Net outgoing	(96)	(134)

13.5 Analysis of amount recognised in Statement of total recognised gains and losses
Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 £'000	2003 £'000
Actual return less expected return on pension scheme assets	(75)	416
Experience gains/(losses) arising on the scheme liabilities	-	5
Actuarial gain recognized in STRGL	(75)	421

13.6 Movements in deficit during the year
Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 £'000	2003 £'000
Scheme deficit at beginning of the year	(2,376)	(2,829)
Movement in year:		
Current service cost	(316)	(361)
Contributions	(648)	527
Other finance income	(96)	(134)
Actuarial gain/(loss)	(75)	421
Scheme deficit at end of the year	(2,215)	(2,376)

13.7 History of experience gains and loses
Tun Abdul Razak Research Centre Pension and Assurance Scheme

	2004 £'000	2003 £'000
Difference between the expected and actual return on scheme assets:		
amount (£)	(75)	416
percentage of scheme assets	(1)%	10%
Experience gains and losses on scheme liabilities:		
amount (£)	-	5
percentage of the present value of the scheme liabilities	-	0%
Total amount recognised in Statement of total recognised gains and losses:		
amount (£)	(75)	421
percentage of the present value of the scheme liabilities	(1)%	6%

13.8 Reconciliation of net assets under FRS 17:	2004	2003	2002
	£	£	£
Net assets as stated in Balance Sheet	3,197,495	3,211,311	3,203,416
FRS 17 pension asset	5,044,000	4,351,000	3,356,000
FRS 17 defined benefit liabilities	(7,259,000)	(6,727,000)	(6,185,000)
Net assets including pension liabilities	982,495	835,311	374,416

13.9 Reconciliation of reserves under FRS 17:	2004	2003	2002
	£	£	£
Income and Expenditure Reserve as stated in Balance Sheet	2,599,517	2,614,022	2,602,810
FRS 17 pension asset	5,044,000	4,351,000	3,356,000
FRS 17 defined benefit liabilities	(7,259,000)	(6,727,000)	(6,185,000)
Income and Expenditure Reserve including pension liabilities	384,517	238,022	(226,190)

14 Financial commitments

At 31st December 2004 the company had annual commitments under non-cancellable operating leases as follows:

	Other 2004	Other 2003
	£	£
Expiry date:		
Within one year	595	-
Between one and five years	8,343	9,138
	8,938	9,138

15 Capital commitments

Details of capital commitments at the accounting date are as follows:

	2004	2003
	£	£
Contracted for but not provided in the financial statements	23,253	-

16. Related party transactions

During the year the company charged the Office of London Representative of the Malaysian Rubber Board a sum of £24,000 (2003: £28,652) in respect of administration services. At the Balance Sheet date an amount of £2,157 (2003: £78,230) was owed by the Office of London Representative of the Malaysian Rubber Board. Both the company and the Office of London Representative are owned by the Malaysian Rubber Board. The company charged £9,300 (2003: £8,930) to the Office of London Representative of the Malaysian Rubber Board for use of the office and services supplied.

During the year the company charged a sum of £75,273 (2003: £88,825) to Elgem Technology Ltd for scientific and research consultancy, and the provision of services. At the Balance Sheet date Elgem Technology Ltd owed this company a sum of £292,487 (2003: £308,369).

Tun Abdul Razak Research Centre, Elgem Technology and the Malaysian Rubber Board Office of London Representative are all controlled by the Malaysian Rubber Board.

17. Company limited by guarantee

The Tun Abdul Razak Research Centre (TARRC) is an organisation and research centre of the Malaysian Rubber Board, the body corporate established by statute in Malaysia for purposes of overseeing the development of the rubber industry with research and development as the core activity. Incorporated in England since 1938, TARRC is a Company Limited by Guarantee and not having share capital, the word Limited being omitted by Licence of The Department of Trade and Industry. TARRC by reason of the definition in Section 1 (1) of the Companies Act 1980 and the bringing into force of Part 1 of the Act became a Private Company on 22nd December 1980. The liability of each member is limited to £1.

18. Controlling interest

The company is controlled by the Malaysian Rubber Board, which is a statutory Authority of the Government of Malaysia.

19. Gross cash flows

	2004		2003
	£		£
Returns on investments and servicing of finance			
Interest received	15,305		23,054
Capital expenditure			
Payments to acquire tangible assets	(110,836)		(100,518)
Receipts from sales of tangible assets	-		5,000
	(110,836)		(95,518)

20. Analysis of charges in net funds

	Opening balance	Cash flows	Closing balance
	£	£	£
Cash at bank and in hand	1,669,602	(200,703)	1,468,899
Net funds	1,669,602	(200,703)	1,468,899

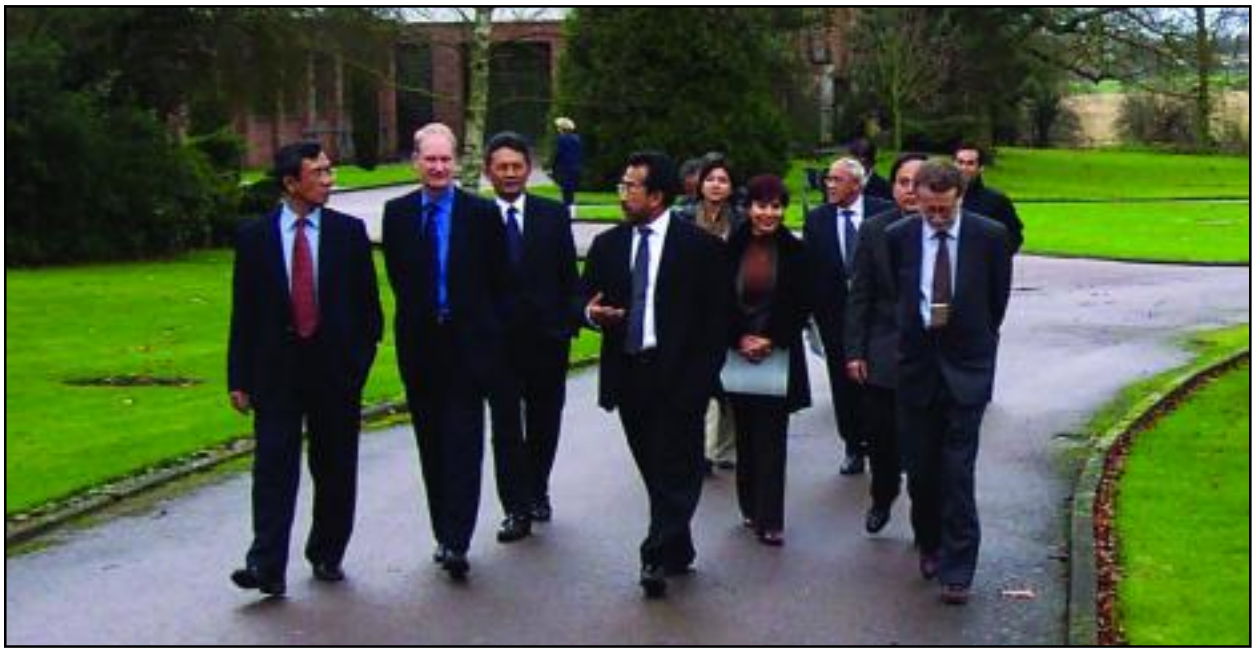
21. Taxation

The Department of Trade and Industry has approved the Company as a research association for the purpose of Income and Corporation Taxes in accordance with the Corporation Taxes Act 1988 and the Capital Allowances Act 1990. The company is therefore exempt from Income and Corporation taxation in this regard.

Director's Report

Visitors to Brickendonbury

As always, we were very pleased to welcome visitors from Malaysia during the year. On the 22nd December we were delighted to welcome YB Dato' Sri Dr Jamaludin Jarjis, the Hon. Minister of Science, Technology and Innovation. The Minister was given a briefing by Dr Tinker, Director of Research, and entered into discussions on some of the areas of TARRC's research programme with much enthusiasm. The progress made by TARRC's Materials Research and Development Division on studies of nanocomposite materials was of particular interest to the Minister. We were also encouraged by the Minister's favourable comments on the conference and meeting facilities offered at Brickendonbury, and following his visit an enquiry from Malaysia was received to host training seminars for Malaysian students in 2005. It is expected that TARRC's conference facilities will be able to be marketed more successfully to other organizations in 2005 when extensive structural work on the mansion is completed.



(Left) TARRC was delighted to welcome YB Datuk Seri Dr Jamaludin Jarjis, the Hon. Minister of Science and Technology. The Minister (second left) is pictured holding a rubber mount during the tour of the laboratories with Dr Marina Fernando. Dr Fernando explained to the Minister the advantages of using simulation codes to predict in advance any flow related problems which may occur during injection moulding of rubber components, and the way in which the results of such an analysis can be used to optimise part and mould designs.

(Above) The Hon. Minister is also pictured in the grounds of Brickendonbury with (from left to right) Dr Sidek Dulngali, Vice Chairman, TARRC, Dr Andrew Tinker, Director of Research, Mr Salleh Subari, Head, Industrial Development and Promotion Division and (far right) Dr Keith Fuller, Head, Engineering Products and Design Division.

We were also pleased to welcome the Deputy Minister of International Trade and Industry YB Dato' Ahmad Husni bin Mohamad Hanadzlah to the laboratories during 2004. He is pictured with Dr Andrew Tinker discussing the concept of base isolation using rubber-to-metal bonded bearings.

The Deputy Minister of International Trade and Industry YB Dato' Ahmad Husni bin Mohamad Hanadzlah visited TARRC on 21st June and was given a briefing on the activities of TARRC and a tour of the laboratories.

Another distinguished visitor to TARRC from the Malaysian government during the year was Dr Michael Dorsim Lunjew, Deputy Secretary I, the Ministry of Plantation Industries and Commodities.

Lastly, we were also pleased to welcome a delegation from the Ministry of Agriculture, Malaysia, led by Director Generals and other distinguished visitors from the various departments and agencies. These included Mr Hj Haron A. Rahim, Director General, Federal Agricultural Marketing Authority (FAMA), Dato' Dr Hawari Hussein, Director General, Veterinary Services Department, Dato' Khamsiah bt Hj Muhammad, Deputy Director General, Department of Agriculture, Mr Ibrahim Salleh, Deputy Director General, Department of Fisheries, Dr Ahmad Tajuddin Zainuddin, Deputy Director General, Malaysian Agricultural Research and Development Institute (MARDI), Mr Wan Ibrahim Wan Abas, Deputy Undersecretary, Ministry of Agriculture and Mr Mohd Zaimi bin A. Razak, Director of FAMA.

Quality, productivity and efficiency

For any company, achieving and maintaining the highest standards of quality and consistency in its work is of paramount importance. ISO certification has become a universally accepted mark of a company's commitment to meet and exceed its clients' expectations. Therefore I am delighted to report that in the early part of 2004 the TARRC laboratories achieved ISO 9001:2000 certification. This designation indicates that the necessary procedures are in place at TARRC to assure the delivery of a quality service. Certification to ISO 9001:2000 is the culmination of many months of work developing and implementing an organisation-wide quality management system that meets the stringent requirements of this International Standard. We regard this achievement as a beginning, and

not an end, of the objective to constantly strive to improve our systems and increase customer satisfaction. ISO certification, together with the existing ISO 17025 accreditation, also provides broader access for TARRC's consultancy unit, Rubber Consultants.

I am also pleased to report that the Head of the Materials Research and Development Division has achieved 'black-belt' status after the completion of the course 'Six Sigma Breakthrough - Process Improvement Specialist Training'. This concept is proven to improve processes and products, reduce waste and increase efficiency. The Division Head and another TARRC officer then observed 'yellow-belt' training held at an outside company, which enabled them to run a two day course at TARRC to explain the fundamentals of Six-Sigma to twelve members of staff. The course proved to be a success, ensuring staff were exposed to best practice ideas in both technology and manufacturing and it is expected to motivate personnel to promote best practice and continuous improvement at TARRC. Training to 'yellow-belt' status will be expanded to the whole site in 2005.

The understanding gained by TARRC scientists, technologists and engineers in achieving these standards will be passed to the Malaysian industry. This fits in closely with the research centre's work concerned with improving productivity and efficiency in the rubber product manufacturing industry in Malaysia. This has become a vital part of TARRC's programme, with a project devoted entirely to this challenge. Two officers from the Industrial Support Unit completed five four-day visits to companies in Malaysia, in which waste was addressed in all its forms thereby improving efficiency and reducing costs. Addressing these problems is vital for companies to be able to compete effectively in competitive world markets. We are pleased that we have received encouraging feedback from several of the companies involved in this programme of visits by TARRC technical officers. Even though the companies visited have been manufacturing a diverse range of products, it appears that several similar areas of improvement can be identified.

A unified, world-class rubber R&D facility

In recent years, TARRC and the Rubber Technology Centre (RTC) of the Malaysian Rubber Board have pursued a unified research programme, with scientists from both research centres working together on most of the projects. It is still vital for TARRC officers to meet face-to-face with colleagues at the RTC to discuss in-depth the planned future work and to be able to suggest modifications that will result in a programme that is more focused. During 2004 several of TARRC's senior management, technical and marketing staff visited Malaysia to take part in the Joint Research Programme meetings and to develop contacts between Malaysian companies and organisations and various European buyers. MS Project is being used as the project management software and adopting this consistent method at both laboratories will give greater monitoring and control over activities. It has already aided project leaders to plan, manage and communicate project information far more effectively.

Progress in interaction between the two laboratories can clearly be seen in the Engineering departments of both research laboratories, where a sophisticated finite element analysis (FEA) modelling tool, ABAQUS, is now being shared using a single licence over the Internet. This was commissioned at TARRC in 2004 with the installation of a dual processor work-station used to run the software. This facility augments the existing MARC FEA platform at TARRC.

During these visits, TARRC staff were also able to participate in further trial runs at the pilot plant at the RTC at Sungei Buloh to evaluate a proposed new process for the commercial production of epoxidised natural rubber, ENR. Such trials require considerable planning, as they can only realistically be performed during an actual ENR production run to ensure that any findings are related directly to the production process itself. Modifications to the process indicated that significant improvements can be made to the downstream work-up procedure. These will streamline the production process, allowing greater automation and improved product quality.

Promotion of the Malaysian rubber industry

Under the Industry Development and Promotion Division, encouraging progress has been made in publicising Foreign Direct Investment (FDI) opportunities and manufacturing activities in Malaysia and expanding markets for Malaysian rubber products. Various literature and promotional tools have been prepared for display and handouts at exhibitions, meetings and seminars. We are also generating promotional material for publication in various outlets as a way to expose industrialists to the opportunities available for trade and investment in the Malaysian rubber industry.

Working closely with other organisations such as Matrade, MIDA and MREPC, the Market Intelligence and Promotion Unit took part in five exhibitions during the year, two concerned with the building industry, one automotive, one medical and the biggest rubber and plastics fair in the world held in Germany every three years, the K Fair. It is encouraging to note that a number of visitors to the stands have pursued their enquiries with a request for TARRC to obtain quotations for specific parts or products from Malaysian manufacturers. A number of individual business meetings have also been held with interested parties, regarding sourcing products and investment opportunities in Malaysia. Due to the large number of enquiries received at both exhibitions, many more companies are becoming aware of Malaysia as a potential source of rubber-related products.

Through participation at and attending international trade exhibitions, contact has been made with several European companies who, with TARRC's assistance and encouragement, are actively pursuing investment opportunities in the Malaysian rubber products sector.

TARRC has now worked closely with Matrade at several exhibitions promoting business opportunities within the Malaysian rubber industry and rubber materials and products. Pictured is the stand at the Irish Building Exhibition in Dublin where over 80 enquiries were received on rubber-related products alone.

An additional benefit of the Division's participation in these events is the increase in contacts in Europe that are now readily available on TARRC's database. We now have access to many more potential buyers of Malaysian rubber products and those interested in opportunities for investment in the Malaysian rubber industry. This kind of information allows us to quickly and efficiently contact companies by means of e-mail news alerts to inform them of events and distribute information. For example, we were able to e-mail an invitation to all suitable companies to the Malaysia-UK Business Forum held in London in October 2004. At this event, the Prime Minister addressed UK businessmen to explain opportunities available to them in Malaysia. Several promising contacts made at recent exhibitions were personally invited and several follow-up meetings were held with TARRC officers during the day.

Technical promotion of DPNR

Deproteinised natural rubber (DPNR) is a purified form of natural rubber, from which most of the ash and protein components have been removed. The rubber is produced under very closely controlled conditions at the RTC in Malaysia. Because of the material's special attributes, it has enhanced value in certain specialised applications. For example, its low stress relaxation and creep make it suitable for seals, joint rings and hydromounts, while its good dynamic properties allow it to be used for anti-vibration mountings.

Good progress is being made in the technical promotion of DPNR, and a successful first stage evaluation was conducted at one of the leading manufacturers of rubber-to-metal bonded engineering products, antivibration mountings and suspension components. The second stage trial was to assess a 50/50 blend of DPNR/synthetic polyisoprene, these results were discussed at a meeting to the company towards the end of the year. Overall results were promising: an increase in bond strength and better creep performance from joints made from DPNR. The company remains interested in DPNR as an alternative to synthetic polyisoprene.

Several other visits were made to major rubber component producing companies towards the end of the year to promote DPNR. A major rail pad supplier was visited and an evaluation programme was set up to assess the suitability of DPNR for rail pads. A successful outcome could lead to a high purchase volume of material per year. After contacting an independent supplier to Network Rail it was decided to compare the performance of DPNR for an anti-vibration mount currently used to isolate vibrations the railways. Testing will take place at TARRC to generate comparative data.

Engineering products & design

Promotion of base isolation systems

We continue to exploit our expertise in the area of elastomeric base isolation, where TARRC engineers have been at the forefront of its development for many years. A prime example of the technical back-up TARRC engineers can provide to Malaysian manufacturers was demonstrated this year with work carried out, through Rubber Consultants, to support the successful bid of a Malaysian company for the supply of high damping rubber isolators for two liquefied natural gas tanks in China. The number of isolators required make it the largest such contract awarded to a Malaysian manufacturer. The multinational engineering contractor in charge of the project emphasised that the backing of the Consultancy was an essential prerequisite to the award of the contract to Malaysia.

TARRC engineers also continued to be committed to promoting the MRB's expertise in the area of base isolation, participating in meetings, seminars and conferences all over the world. TARRC officers addressed a substantial audience at a seminar in Tehran where prospects are good, as despite its high level of seismicity, there are no isolated buildings. TARRC staff also attended meetings with the Oil Corporation, Housing Corporation and

TARRC engineers were able to support, through Rubber Consultants, the successful bid of a Malaysian company for the supply of high damping rubber isolators for two liquefied natural gas tanks in China. The backing of the Consultancy was an essential prerequisite to the award of the contract, the largest such contract awarded to a Malaysian manufacturer.

Housing Ministry in Tehran and several possibilities for future collaboration and demonstration building projects were identified. The project leader at TARRC attended the World Conference on Earthquake Engineering in Vancouver, where a follow-up meeting was held with delegates from the International Institute of Earthquake Engineering and Seismology, Tehran, about the possibility of base-isolating a new building for the Institute.

Following the attendance of the project leader at a promotional seminar organised by the MRB in Algiers in 2003, we are pleased that design work for a base isolated demonstration building in Algeria has been commissioned. It has been agreed that a full structural design for a three-storey building with a basement would be carried out and the final structural design of the base-isolated building was agreed at a meeting in Algiers towards the end of the year. The 17 elastomeric isolators used to support the building will be manufactured in Malaysia.

Product design and manufacturing opportunities

An extensive testing programme has been carried out on three hydromounts in commercial production. The experimental data from this programme have been used to verify a spreadsheet-based model written at TARRC for predicting the main features of the dynamic response of hydromounts. The dynamic response of an in-house hydromount simulation rig can be measured and the data will be compared with those predicted using the same model. As it should be possible to measure more reliably the geometrical and physical properties of the simulation rig, the accuracy of the predictions can be assessed more confidently. The Excel-based model will be extremely useful in the design of new hydromounts.

Also under the Engineering Design Unit, a project is in progress investigating materials being used to provide damping on car doors. The aim of the project is to develop improved panel damping treatments.

Tests on plasticized PVC and on test pieces cut from a door panel treated with it, confirm that it provides the requisite high damping. The results also show that a TARRC methodology for predicting panel behaviour from material properties works well.

A short experimental programme to find elastomers with improved properties for rail damping applications began in 2004. The work has been carried out by an officer on secondment from the RTC as part of her MSc studies at the University of Southampton. Although the specification differs in detail from that for automotive panels, the same technical methodology developed at TARRC is applicable to both applications.

Materials Research & Development

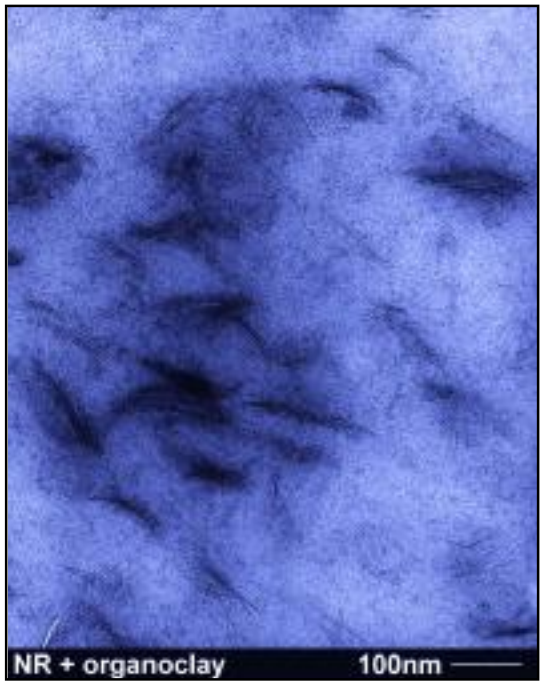
Nanocomposites containing nanoclays

The rapidly expanding field of research into nanocomposite materials is generating many exciting new materials with novel properties. The market for nanocomposite materials is therefore growing rapidly, principally due to use in the automotive market, where they have the potential to displace traditional materials because of their reduced weight and enhanced properties. Most nanocomposites produced are based on plastics and little has been done so far to exploit commercially the properties of elastomer-based nanocomposites.

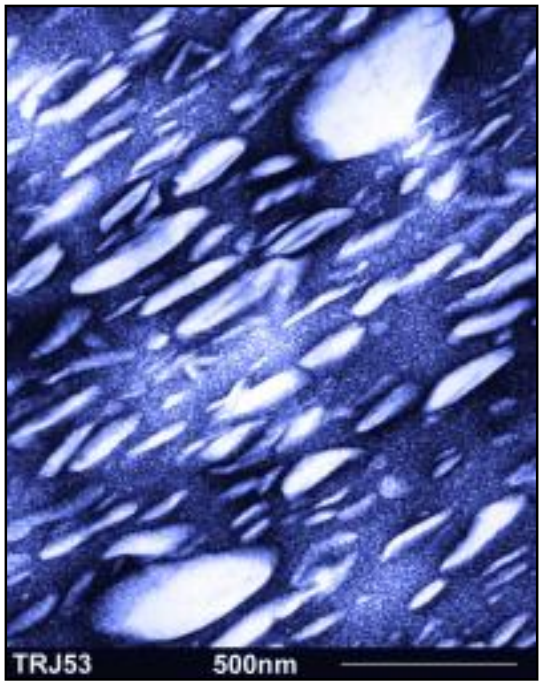
A new project at TARRC began in 2004 to investigate the properties of rubber nanocomposites containing organoclays. Nanocomposites based on NR, ENR and EPDM were prepared with a range of nanoclays and microscopy studies have demonstrated that the nanoclays can be extensively exfoliated, as is required for improved barrier properties. Further studies have shown that despite substantial increases in modulus due to the nanoclays, NR nanocomposites, in which the nanoclay is extensively exfoliated, show little reduction in fatigue life when tested at a fixed strain. The test is more severe for the nanocomposites due to the higher stress experienced by the test pieces. Exfoliation involves the breakdown of the layered nanoclay particles to individual platelets. Nanocomposites based on EPDM, in which the nanoclay is intercalated by the rubber but there is little exfoliation, show only small increases in modulus, but fatigue life at constant strain is increased substantially. These observations suggest that it should be possible to obtain enhanced durability through the use of these nanoclay fillers. We are very encouraged by this very promising start - particularly since the mixing was achieved in conventional rubber mixing equipment.

Development of thermoplastic vulcanisates (TPVs)

In 2003, advances in the formulations and production processes for the new NRTPV developed at TARRC brought the research to the point at which it was ready to be announced. NRTPV is a blend of natural rubber with polypropylene in which the rubber is



This NR based nanocomposite shows evidence of both intercalution and exfoliation of nanoclay filler.



Network visualization is an analytical technique that can be applied to rubber nanocomposites. This micrograph shows poor attachment of exfoliated clay platelets to the surrounding rubber network, except at the edges.

crosslinked during the manufacturing process. The material processes well and the extrudates have a good surface finish, an important criterion which is not easy to meet in a TPV. The physical properties of NRTPV compounds compare well with current commercially available TPVs, and the recovery performance in particular has excelled the performance of any comparable TPV in the market today.

Preparation of larger quantities of NRTPV for sampling out to potential customers began in earnest in 2004 with a neutral coloured NRTPV 60 Shore A grade using the Prism TSE in TARRC's laboratories. Quantities of black coloured grades will also be prepared in 2005: this material will have the resistance to UV radiation necessary for outdoor applications. Coloured NRTPV compounds were prepared for moulding into coasters to have available at the K2004 Exhibition in Düsseldorf in October for promotional purposes. These coasters generated a lot of interest from visitors to the stand; complimentary comments on the pleasant 'feel' of the material were widespread. As soon as the wider range of grades is available, prospective customers will be contacted including manufacturers of rubber products that are either using TPVs or are considering switching from conventional thermoset rubbers to TPVs in products.

Electrochemical degradation

The aim of the project concerning electrochemical degradation (ECD) under the Advanced Material and Product Development Unit is to provide information to Malaysian manufacturers on formulating hose compounds to reduce ECD. ECD, which is the primary cause of failure in automotive coolant hose, may occur when a voltage, induced or applied, is present across a rubber component which is in contact with an electrolyte. The automotive industry is demanding minimum levels of ECD resistance in coolant hose and we are confident that we will be able to assist Malaysian manufacturers in meeting these demands. Studies at TARRC have been undertaken by using a simple apparatus and some advances have been made in

Apparatus has been built at TARRC to test hose samples for electrochemical degradation, the primary cause of automotive coolant hose. The apparatus includes the use of a zero impedance ammeter, which is providing better insights through more consistent measurements of very low current flows. The knowledge gained is enabling ideas of the detailed mechanisms operating in ECD.

respect of the mechanisms of failure, the role of oxygen in reducing the rate of ECD, and the effect of increasing temperature in stimulating ECD. A more sophisticated test apparatus was then built to work on actual hose samples from a Malaysian manufacturer, both to investigate the phenomenon and for screening development compounds for the manufacturer. The apparatus includes the use of a zero impedance ammeter, which is providing better insights through more consistent measurements of very low current flows. The knowledge gained so far is enabling ideas of the detailed mechanisms operating in ECD.

Representation on Standards Committees

TARRC staff continued their involvement with British, European and International standards bodies during the year. Two of TARRC's senior officers are members of ISO committees concerned with 'Rubber and rubber products', 'Elastomeric isolators' and 'Plastics'. These standards contribute to making the development, manufacturing and supply of products and services more efficient and trade between countries easier. It is very beneficial, therefore, that experts from TARRC can use their knowledge to influence the decisions made by these committees. Other areas of work involving standards include medical gloves, latex and the chemical testing of rubber.

Contract research

The EU-funded project 'Reduced Zinc in Rubber products for an Enhanced Environment' is due to finish early in 2005. Based on feedback from the EC, as well as from the collaborating partners, it is considered to have been a very successful project. The wide-ranging studies have established that the zinc oxide content in sulphur-vulcanised compounds of different rubbers (including NR, emulsion SBR, EPDM and NBR) can be reduced typically by about 50%. In a major application, passenger tyre treads, which are blends of the rubbers solution SBR and BR, much larger reductions (about 85%) of zinc oxide level are achievable, with tyre performance unimpaired or even improved. This is a particularly important finding, as wear of tyre treads is considered to be the primary route by which zinc is released from rubber products to the environment. Parallel studies have indicated that the crosslinking chemistry in the high-vinyl solution SBR used in these blends is quite different from that found in NR; this is believed to explain the markedly different dependence on zinc oxide of the solution SBRs and their blends.

The EU-funded CRAFT project 'Thermal Treatment of Scrap Tyres to Produce Re-usable Carbon Black' running since 2001 was completed during the year. The aim was to investigate the commercial value of the products of tyre pyrolysis. A pilot-scale continuous pyrolyser was based in a nearby industrial unit and produced considerable amounts of good quality char for subsequent milling (to reduce particle size) and pelleting (for factory use). Several methods for milling the char were tried on a laboratory scale; the most promising involved jet-milling. The milled black, when compounded in a standard ASTM formulation, almost matched the semi-reinforcing performance of a conventional 500 series of carbon black, indeed bound rubber measurements indicated superior performance.

Rubber Consultants

TARRC continues to carry out important research work for the MRB, but also has a thriving consultancy unit, Rubber Consultants, which provides clients with R & D testing and analytical services. As reported last year, the Materials Characterisation Unit saw its client base from the pharmaceutical industry increase significantly, and this in turn contributed to the highest ever turnover by the Consultancy in 2003, an increase of 20 percent from the previous year. I am delighted to report that income generation in 2004 has included some record months for the Unit, which have again contributed to another extremely successful year for the Consultancy overall, with the highest recorded turnover for the second year running.

The Materials Characterisation Unit continues to update its systems and equipment to keep it at the forefront of analytical testing and R&D and to meet the demands of work carried out for internal and external clients. For instance, during the year the facilities were enhanced by the acquisition of another inert source GC/MS.

The Joint Industry Project on Modelling of Rubber was completed at the end of the year. The broad aim of the JIP was to enhance the tools for designing rubber components using FEA, while keeping within the constraint of existing software and time frames for design. In response to interest from vehicle dynamics engineers, the JIP was broadened to include simple models of rubber components needed for consideration of the connection between FEA and Multibody Dynamics Analysis as well as material models needed for FEA.

This very successful project resulted in two major achievements. Firstly, modelling dynamic stiffness can be achieved by using an overlay of hyperelastic, viscoelastic and elastoplastic meshes. Methods for fitting the parameters have been developed, based on experience with five representative rubber formulations used for the project. Secondly, a simple criterion for estimating fatigue life can largely be met by a modification of the 'cracking energy density' concept developed by one of the participants, based on the fracture mechanics approach developed at TARRC over the last 50 years.

The partnership forming the JIP worked very constructively, and all parties expressed an interest in a sequel project. The emphasis of this project is currently under discussion.

Dr Andrew Tinker
Director of Research

Scientific Papers

H.A.H. Faridah, A.J. Tinker and A.S. Farid
Plasticiser transportation studies in NR and acrylonitrile-butadiene rubber 1. Diffusion coefficient and equilibrium uptake of TBEP in NBR vulcanisates.
Journal of Rubber Research, 2004, Volume 7, Page 219.

Publication 1725

H.A.H. Faridah, A.J. Tinker and A.S. Farid
Determination of crosslink densities of filled rubbers by cyclic pre-straining.
Journal of Rubber. Research, 2004, Volume 7, page 248.

Publication 1726

J. Gough, K.N.G. Fuller and A.G. Thomas
The effect of low temperature crystallization on the mechanical behaviour of rubber
Journal of Polymer Science Part B: Polymer Physics, 2004, Volume 42, pages 2181 - 2190.

Publication 1727

Staff Lectures

All of the lectures listed, with the exception of those marked with an asterisk (*) have been or will be published. Speakers are listed first, unless otherwise indicated.

H.R. Ahmadi, K.N.G. Fuller and I.R. Goodchild
Novel Devices for the isolation of floors against earthquakes and ambient vibrations.
13th World Conference on Earthquake Engineering, Vancouver, B.C., Canada, 1st-6th August.

H.R. Ahmadi
Technical and economic benefits of base isolation.
MRB and International Institute of Earthquake Engineering and Seismology Seminar on Base Isolation for Earthquake Resistant Structures, Tehran, Iran, 21st June.

A.V. Chapman and T.R. Johnson
The role of zinc in the vulcanisation of styrene-butadiene rubbers.
Proceedings of the DIK Rubber Fall Colloquium 2004, Hannover, Germany, 10th-13th November.

Staff Lectures Cont.

S. Cook
Low rolling resistance and good wet grip without silica.
Tire Technology Expo 2004, Stuttgart, Germany, 23rd-25th March.

M.D.S. Fernando, C.D. Forge and J.L. Clark
Can test pieces predict component performance?
Polymer Bonding 2004, Munich, Germany, 27th-28th April.

K.N.G. Fuller
Properties and design of elastomeric bearings.
MRB and International Institute of Earthquake Engineering and Seismology Seminar on Base Isolation for Earthquake Resistant Structures, Tehran, Iran, 21st June.

K.N.G. Fuller, R. Antonucci, F. Bartera and R. Giacchetti (Università Politecnica delle Marche, Italy), F. Balducci (C.R.E.A. Srl, Italy) and M.G. Castellano (FIP Industriale, Italy)
Shaking table testing of an RC frame with dissipative bracings.
13th World Conference on Earthquake Engineering, Vancouver, B.C., Canada, 1st-6th August. Paper No. 1967.

A.H. Muhr
Living on rubber.
The Plastics Historical Society, Institute of Materials, 21st April.*

A.D. Roberts and A.V. Chapman
Is zinc oxide an issue?
ETRA (European Tyre Recyclers Association) Conference, Brussels, 25th March.

H.R. Ahmadi and K.N.G. Fuller, et al
The use of an innovative 3D-isolation system for seismic and ambient vibration to protect the roman ship excavated at Ercolano, Italy.
Proceedings of the Third European Conference on Structural Control, 3ECSC, University of Technology, Vienna, Austria, 12th-15th July.