TARRC NEW LITERATURE

Except where otherwise indicated, copies of the papers noted below are obtained from the Tun Abdul Razak Research Centre librarian. A £5.00 handling charge (surface mail) will be made per reprint. Invoices will not be issued for reprints.

Rubber springs
Isolation - whether from shock or from vibration - is achieved by inserting a compliant component in the otherwise relatively rigid transmission path connecting the source to the receiver. This paper seeks to explain what properties are required of the compliant component, or spring, and how these properties may be achieved by correct choice of rubber compound and geometrical design.

The function and design of rubber springs. A.H. Muhr. Workshop on rubber-in-engineering applications in the transport industry (non-tyre sectors). Kuala Lumpur, Malaysia, 17-18 July, 1995.

Publication 1575

Noise control
Different strategies using elastomers to control noise are considered. The physics of each method is described and the effect of important variables including material properties on its effectiveness is outlined. Finally, some of the current techniques for controlling noise in the transport industry are discussed. The use of elastomers in this area is growing rapidly with the increasing public demand for quieter vehicles and a less noisy environment.

Noise reduction using rubber. H.R. Ahmadi, K.N.G. Fuller and A.H. Muhr. Workshop on rubber- in-engineering applications in the transport industry (non-tyre sectors). Kuala Lumpur, Malaysia, 17-18 July, 1995.

Publication 1576

FEA in component design
Developments in commercial software and the reduced cost of powerful computers have now brought a Finite Element Analysis (FEA) capability within the reach of designers of rubber products. FEA can accurately predict the force-deformation behaviour of rubber components. Experience is needed, though, in choice of appropriate models for the material properties as an input to the FE program. Guidance is given on this issue. The failure behaviour of rubber components cannot in general be reduced to a simple criterion, as with yield stress in metals; more success has been found using a fracture mechanics approach, for which the presence of a crack must be included in the analysis. The current status of research in this area is described.

Finite element analysis and the design of rubber components. A.H. Muhr and H.R. Ahmadi. Workshop on rubber-in-engineering applications in the transport industry (non-tyre sectors). Kuala Lumpur, Malaysia, 17-18 July, 1995.

Publication 1577

Leaching and NR latex film
In an attempt to improve the understanding of the mechanism by which aqueous leaching of prevulcanized natural rubber latex films improves their physical properties, experiments have been carried out on such films after storage under controlled humidity conditions. Under such conditions of ambient and high humidity, unleached films were found to absorb much more moisture than leached counterparts, while crosslink density was not affected by leaching. The effect of leaching on the tensile strength and modulus however was generally significant.

Effect of leaching and humidity on prevulcanized NR latex films. M. Morris, M Amir-Hashim (RRIM) an d M. O'Brien and A. Farid (School of Polymer Technology, University of North London. ACS Rubber Division Meeting, Louisville, October 1996.

Publication 1578

TPENR
A dynamically vulcanized blend of epoxidized natural rubber and polypropylene can have properties typical of other TPEs of this type. However, this material offers a combination of very good oil resistance and excellent resistance to heat ageing. The latter extends to good recovery properties at high temperatures. The environmental resistance compares favourably with that of NBR vulcanizate and of NBR-based TPE.

Oil and heat resistant TPE. J. Patel, C. Riddiford and A. Tinker. Rubber Technology International '96, 83-87.

Publication 1579

High damping rubber bearings
The International Atomic Energy Agency has initiated a co-ordinated research programme on implementation of base-isolation for nuclear structures. This paper discusses two areas relevant to modelling elastomeric base-isolators. These are the use of simplified models to predict the response of isolated structures to earthquake inputs and Finite Element Analysis (FEA) for calculating the stress distributions within the isolators.

Predicting the response of high damping rubber bearings using simplified models and finite element analysis. K.N.G. Fuller, J. Gough and H.R. Ahmadi. Based on two lectures given by H.R. Ahmadi at the

International Atomic Energy Agency meeting in St. Petersburg, Russia, 25-31 May, 1996.

Publication 1580

Seismic isolators

A curvilinear hysteretic model of damping natural rubber (HDNR) able to accommodate the stiffening of the rubber at large shear deflections is presented. Predictions of structural accelerations or bearing displacement produced by earthquakes above the design level generally give higher values than those using a linear spring and dashpot model. The damping level required in the bearings for minimum structural acceleration response is assessed using non-classical modal analysis based on linear models and the curvilinear hysteretic model. At present, confirmation that HDNR shows stable behaviour over time has to be provided by accelerated ageing tests; data suggest that increases in the modulus of elasticity should be less than 20% over a service life of several decades.

High damping natural rubber for seismic isolators: modelling behaviour and predicting longevity. K.N.G. Fuller and H.R. Ahmadi. Workshop on testing and modelling innovative systems for seismic response control of buildings and bridges. University of Naples Federico II, May 1996.

Publication 1581

Anti-seismic bearings

The linearized beam-column theory for the mechanics of laminated bearings is summarized and theory is presented for the "lift-off" behaviour seen at large shear deflections when bearings are located in recesses, rather than bolted. Experiments show that an axial load increases the dynamic shear stiffness and damping of a single high damping natural rubber layer, but in accord with the theory the shear stiffness of laminated bearings is reduced by an axial load while the damping is increased. Results of tests to failure for 17 permutations of axial load and bearing specification show that the shear capacity exceeds 70% of the plan dimension in all cases except for a squat design with thin endplates located in a recess. The shear capacity of such bearings is limited by yield of the endplates rather than rupture or instability.

The deflection capacity of rubber anti-seismic bearings. A.H. Muhr. Fourth World Conference on Joints and Bearings. Sacramento, September 1996.

Publication 1582

Rubber-to-metal bonds

An exploratory experimental study has been made of those bond strength test methods that are amenable to a fracture mechanics interpretation: peel, rod pull-out, and simple shear. Equations for calculating fracture energies from these test pieces are given. Application of fracture mechanics to the simple shear test piece is complicated by the need ideally to use the retraction energy in the calculations, and by the observation that failure did not initiate from artificially introduced cuts placed where intuition suggests initiation should occur.

A fracture mechanics study of natural rubber-to-metal bond failure. A.H. Muhr, A.G. Thomas (Queen Mary and Westfield College, University of London) and J.K. Varkey. (Rubber Research Institute of India, Kottayam, Kerala). Journal of Adhesion Science and Technology, 1996, 10, 593-616.

Publication 1583

Environmental stability

When designing or adapting small-scale laboratory tests for the estimation of long-term environmental resistance it is essential to identify the main causes of product failure, to consider the various factors that may influence the activity of protective agents, and to recognize the role of diffusion control on some forms of deterioration. This paper outlines a plan for test development, with reference to standard laboratory tests, and is illustrated by work conducted at TARRC on thermal oxidative ageing, creep/stress relaxation, ozone attack, fluid resistance and low temperature crystallization.

Using laboratory tests to predict environmental stability of rubber products. P.M. Lewis. Presented at XVI Journée Technologique, Viellissement et Comportement à Long Terme des Materiaux Elastomères, CTTM-IRAP, 27-28 November, 1996.

Publication 1584

Natural rubber

This paper – a summary of the Rubber Foundation Lecture: Natural Rubber – Ab Initio Ad Futurum, presented at the IRC '96 - gives an overview of the history of the natural rubber industry. (See also Rubber Developments, Vol.49, No.3/4, 1996, p.40-44).

The natural choice. C.S.L. Baker. Materials World, 1997, January, 14-16.

Publication 1585

Natural rubber

This book chapter gives a comprehensive overview of natural rubber. It includes a brief summary of the history of NR cultivation, rubber production and the grading of dry NR. The properties and chemistry of NR are discussed, together with the applications for rubber. The processing and use of latex rubber is also examined. The economics of NR production is also considered. An extensive bibliography is included.

Rubber, natural. C.S.L. Baker and W.S. Fulton. In Kirk-Othmer Encyclopaedia of Chemical Technology, fourth edition, volume 21. John Wiley, 1997.

Publication 1586

Laboratory tests

Small scale laboratory tests, including ISO and BS standard methods, have been used to predict long-term performance of rubber with some measure of success in the case of creep, fatigue and crack growth, but difficulties remain with the prediction of long-term changes in modulus, stability in which is important in building mounts and other load bearing applications. This paper briefly reviews the successes and failures of standard laboratory tests and proposes that the prediction of long-term performance should be pursued as an integral part not only of the design process but of the overall team effort.

Use of laboratory tests for prediction of long-term performance of rubber. P.M. Lewis. Polymer Testing 97. RAPRA Technology, Shawbury, 7-11 April, 1997. Day 4. Durability of rubber.

Publication 1587

Stress-strain properties

An overview of the dynamic stress-strain properties of filled and unfilled rubbers is given. The dependence of the dynamic properties of filled elastomers on the strain amplitude, strain history, temperature and frequency of excitation is discussed. It is noted that equivalent linear estimates of the dynamic properties can be calculated from sinusoidal test data. The importance of defining the test conditions fully when quoting dynamic properties is stressed. The forced non-resonance method in simple shear is suggested as the preferred method of measuring the dynamic properties of elastomers used in vibration control applications.

Measurement and application of dynamic stress-strain properties of rubber. H.R. Ahmadi and A.H. Muhr. Polymer Testing 97. RAPRA Technology, Shawbury, 9-11 April, 1997. Day 5. Design Data in the Rubber Industry.

Publication 1588

Crosslink distribution

A swollen-state NMR method of rubber blend analysis has been used to study crosslinking in gum vulcanizates for cure times ranging from t30 to overcure. Natural rubber (NR), cis-poly(butadiene) (BR) and NR/BR blend vulcanizates cured with conventional and semi-Ev sulphur systems based on three common sulphenamide accelerators were studied.

Distribution of crosslinks between the phases of vulcanised natural rubber/cis-poly(butadiene) blends. S.A. Groves and A.J. Tinker. Journal of Natural Rubber Research, 11, 125-148.

Publication 1589

Colwyn Medal awarded to a former TARRC employee

DR K. A. GROSCH has been awarded the Colwyn Medal for 1997. The award is made by the Institute of Materials for outstanding services to the rubber industry of a scientific, technical or engineering character. Consultant Dr Grosch is a world famous authority on the physics of rubber. During 14 very fruitful years at the then Natural Rubber Producers' Research Association, he made outstanding contributions to the understanding of rubber friction and abrasion. In his subsequent career in the tyre industry, Dr Grosch was in the forefront of development efforts which succeeded in converting pioneering work at the NRPRA on oil-extended natural rubber into a major breakthrough in winter tyre technology. His 20 years service in tyre development and testing were also marked by important work in tyre physics, in particular with advances in understanding the relationship of rubber viscoelastic properties with tyre performance criteria. After leaving the tyre industry, Dr Grosch established a successful private company for the development of testing equipment for rubber. Throughout his career, he has published numerous papers in the scientific literature and continues to do so to this day. Dr Grosch's multi-various achievements, however, have to be viewed in the context of his personal situation as a prisoner-of war in England at the end of World War II. Although born in Germany, he decided to settle in England on release, and resume his education in this (for him) foreign environment. He was rewarded with a University of London degree in physics and a subsequent PhD.

Rubber powers aircraft to new heights!

ITS THE IDEAL PRESENT for a child with an interest in aeroplanes and a reasonable mechanical aptitude; a kit model aircraft with the body made of balsa and powered by a rubber band. Follow the assembly instructions, wind up the propeller, launch carefully and the energy stored in the rubber will carry the aeroplane aloft giving the young enthusiast almost as much satisfaction as the Wright brothers had on the day of their first flight at Kittyhawk!

And most of us thought that it stopped there; but not so freelance aero engineer George Heaven of Van Nuys in California who is scaling up the technology to produce the world's first and largest rubber band powered, man carrying aircraft 'Rubber Bandit'. If all goes well, 1997 will see him smash seven world records as he reaches a maximum speed of 55mph, climbs to an altitude of 100 feet and travels a distance of three quarters of a mile in a total flight time of 1m and 30 secs.

The vital statistics of 'Rubber Bandit' are impressive: a wingspan of 68 feet, a length of 33 feet, a propeller 18 feet in diameter and an all up weight of 470 pounds. Finally the all important rubber band weighs 90lbs.

If the flight succeeds it will the climax of three years work by George and his dedicated group of volunteers. The project has certainly caught the imagination of the media with pre flight coverage already featured on several North American and European TV Channels. Bon Voyage!

Award for TARRC Chairman

IN HIS RECENT Birthday Honours List His Majesty the Yang DiPertuan Agong conferred the Panglima Jasa Negara on Haron bin Siraj the Chairman of the Tun Abdul Razak Research Centre. The award carries with it the title Datuk. Datuk Haron is Secretary General of the Ministry of Primary Industries, Controller of Rubber Research and Chairman of the Malaysian Rubber Research and Development Board.

A native of Johor in the South of Malaysia, Datuk Haron took a first degree at the University of Manchester followed by an MSc at Williams College USA. He joined the Malaysian Administrative and Diplomatic service in 1969 with an initial posting to the Ministry of Trade and Industry. 1972 saw his first appointment in the Ministry of Primary Industries and three years later he became Acting Assistant Secretary General (Rubber Research and Development)

The ensuing years contained a string of appointments of gradually increasing responsibility and mainly involving trade and industrial development. Prior to his return to the Ministry of Primary Industries in September 1996 he was the Malaysian Permanent Representative in Geneva, within the Ministry of External Affairs.

Datuk Haron bin Siraj

The Institute of Materials launches its first Materials Congress

THE FIRST Materials Congress to be organised by The Institute of Materials is to be held from 6-8 April 1998 at the Royal Agricultural College, Cirencester.

Under the overall title 'Frontiers in Materials Science and Technology', this ambitious multi-event Congress covering the development and profitable application of metals, polymers, composites, rubbers, electronic and biomedical materials, is designed to bring together a large number of industrial and academic members from all parts of the Institute and from the wider materials community.

The technical symposia under the major theme of 'Frontiers for Rubber' will take place on the second day and will include the prestigious foundation lecture given by Prof. J.B. Donnet, Professeur Emeritus at the Universite De Haute Alsace.

The Materials Industrial Exhibition will be a major feature of the Congress focusing on new developments in materials, new technologies and products using novel materials combinations, together with materials testing and evaluation techniques. There will also be software demonstrations and an exhibition of the latest technical books and journals.

The Institute has an extensive regional network and the choice of venue for Materials Congress 98, reflects its policy of holding major events outside London whenever possible. The Royal Agricultural College, set in spacious grounds on the edge of Cirencester, an historic Roman city, readily accessible from all parts of the country, has proved to be a successful venue popular with delegates to previous Institute events, including the Annual Ceramics Convention, and has the full support of the Institute's West of England Metals and Materials Association and the Western Polymer Group.

The First Announcement and Call for Papers with details of Materials Congress '98 including the Materials Industries Exhibition and other associated events, can be obtained from the Conference Department (C806), The Institute of Materials, 1 Carlton House Terrace, London SW1Y 5DB. Tel: +44(0)171 839 4071. Fax: +44(0)171 839 6591.