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United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.118/7
22 February 1972

ORIGINAL: ENGLISH

Expert Group Meeting on Future Trends in, and Competition between, Natural and Synthetic Rubber

Vienna, 27 - 30 March 1972

NEW TECHNOLOGICAL DEVELOPMENTS IN NR AND THEIR EFFECT ON COMPETITION FROM SR [1/]

by

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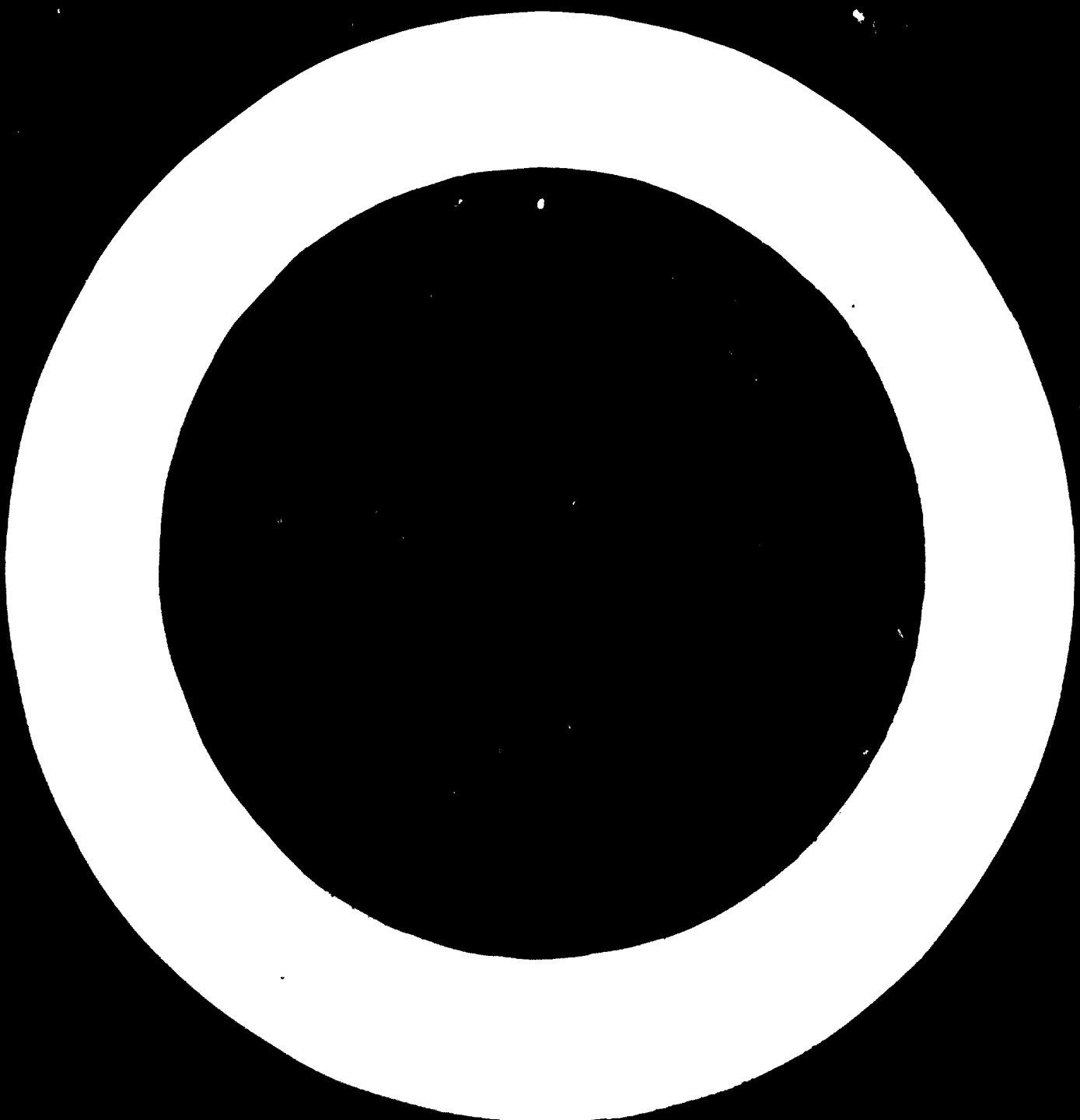


Progressively more stringent demands are being placed by the rubber manufacturing industry on its raw materials. As industrial processes are increasingly automated and as final products are more critically judged in terms of their technical performance, improved consistency, easier processing and higher technical quality are looked for from the feeder rubbers. Thus to maintain and strengthen NR's competitive position it is vital that there should be a steady flow and exploitation of new developments.

The last few years have seen major changes in the marketing of NR. These changes were pioneered by the introduction of the Standard Malaysian Rubber (SMR) Scheme in 1965 involving a move from visual grading to technical grading guaranteeing conformity to specifications and a move from traditional large bales to polythene wrapped small bales. With the adoption of the new grading methods and new methods of processing raw rubber, it is now possible to change and importantly to control rate of cure, viscosity and oxidative breakdown of raw NR. In this way technically uniform and consistent NR tailored to meet consumer requirements and marketed in convenient small compact bales will be well placed to meet foreseeable consumer requirements in handling, mixing, compounding and fabricating processes.

NR latex concentrates have, of course, been produced to rigorous technical specifications for many more years. A new freeze-thaw-resistant NR latex concentrate has recently been introduced. This shows substantially greater stability at sub-zero temperatures than conventional NR concentrates and many of the competitive SR latices. This means that NR latex can be supplied during winter months to countries with severe winters with much less risk of deterioration (destabilization) of the latex during transport and storage. (Freeze-thaw stability is achieved very simply by the addition of a small amount of sodium salicylate to the latex concentrate). Another special type of latex concentrate available from Malaysian producers is methyl-methacrylate-NR graft polymer latex which is used particularly in the adhesive industry.

This contribution is primarily directed to developments leading to the improved performance in service of articles made from NR.

DRY RUBBER

Improved Resistance to Ageing:- Antioxidants are important ingredients in all rubber compounds and provide highly durable rubber components, which in most applications give excellent performance and long life. However, there are some applications in which the antioxidant is physically removed from the rubber during service and as a result the protection it supplies is lost. The recent discovery of a novel method of binding powerful antioxidants to NR provides rubbers which overcome this problem. This is achieved by reacting p-nitrosoanilines or p-nitrosophenols with NR or NR latex to give p-phenylenediamine groups, which are some of the most effective type of antidegradants, chemically bound to the rubber molecule and completely resistant to extraction by water or solvents. The reaction takes place concurrently with vulcanization and involves no modification of technological processing of fabrication techniques. Although faster at high temperatures it also takes place at room temperatures and can readily be accomplished during normal coagulation, thus this protection can be introduced during the preparation of raw natural rubber. Commercial use of this development is seen in those situations where normal antioxidants may disappear due to adverse conditions in service, e.g. tyre treads (wet roads can extract normal antioxidants and impair durability), radiator hose and products which have to be dry cleaned or laundered such as latex thread, latex foam, carpet backings and bonded fibres.

Improved Resistance to Reversion during Vulcanization:- Conventional sulphur vulcanization of NR gives rubbers with excellent strength and fatigue properties, however, during prolonged cure or exposure to high temperatures they have a tendency to lose some of the cross-links introduced during vulcanization - a phenomenon called reversion. A new vulcanization system has been developed which gives NR vulcanizates with physical properties as good or better than those obtained using sulphur vulcanisation, but free from the reversion and with better ageing

qualities than the latter. It involves the reaction of p-nitrosophenol with NR which results in a pendent hydroxyl group which can be utilized for crosslink formation by reaction with a diisocyanate to give a urethane crosslink. The process is technologically attractive and is carried out in one stage by using a product formed from a nitrosophenol and a diisocyanate (an isocyanato-urethane) which can be mixed with the rubber in the normal way and which dissociates on heating at vulcanization temperatures to crosslink the rubber. Although this vulcanizing system is also applicable to certain SR's it is of special applicability to NR and it should be particularly appropriate for the manufacture of large or heavy duty tyres and engineering components.

Improved Consistency of Properties:- NR is the preferred rubber in engineering uses, i.e. springs, bearings and mountings, in carcass compounds in large tyres and in sidewall compounds in radial tyres. The use of new soluble vulcanization systems promises to reinforce this position. Rubber components with greater uniformity of stiffness and strength can be achieved by ensuring that all of the ingredients added to rubber to cause vulcanization remain soluble during storage of the compound and that the products formed during vulcanization also remain soluble subsequently. As an additional dividend improved fatigue life, lower creep and stress relaxation, and even higher resilience are achieved.

Even higher quality rubbers for engineering uses and certain critical tyre applications can be achieved by the use of deproteinised NR in conjunction with soluble vulcanisation systems. Deproteinised NR is made from latex by treating it with an enzyme, the rubber so obtained is less hydrophilic than normal NR. Creep is reduced, particularly under humid conditions and heat build-up and compound stability are improved.

Improved Performance of Winter Tyres: Oil-extended SBR (OESBR) particularly in blends with BR has for many years been the manufacturer's choice for treads of passenger car tyres. It has been found to have an overall good wear resistance combined with good resistance to skidding on wet surfaces. Oil-extended NR (OENR) tyre tread compounds have now been developed which show superior wear and skid behaviour under winter conditions to the currently used OESBR/BR compounds. In a series of nearly 2,000 tests carried out over three winters in Scandinavia, it was found that on snow and ice OENR showed on average 15% better grip and skid resistance to OESBR/BR, while at ambient temperatures below about 5°C its wear resistance was markedly superior and its skid resistance on wet surfaces was just as good. During this winter the first OENR winter tyres have been marketed commercially in Canada and further replacement of OESBR by OENR in this application appears likely.

LATEX CONCENTRATE

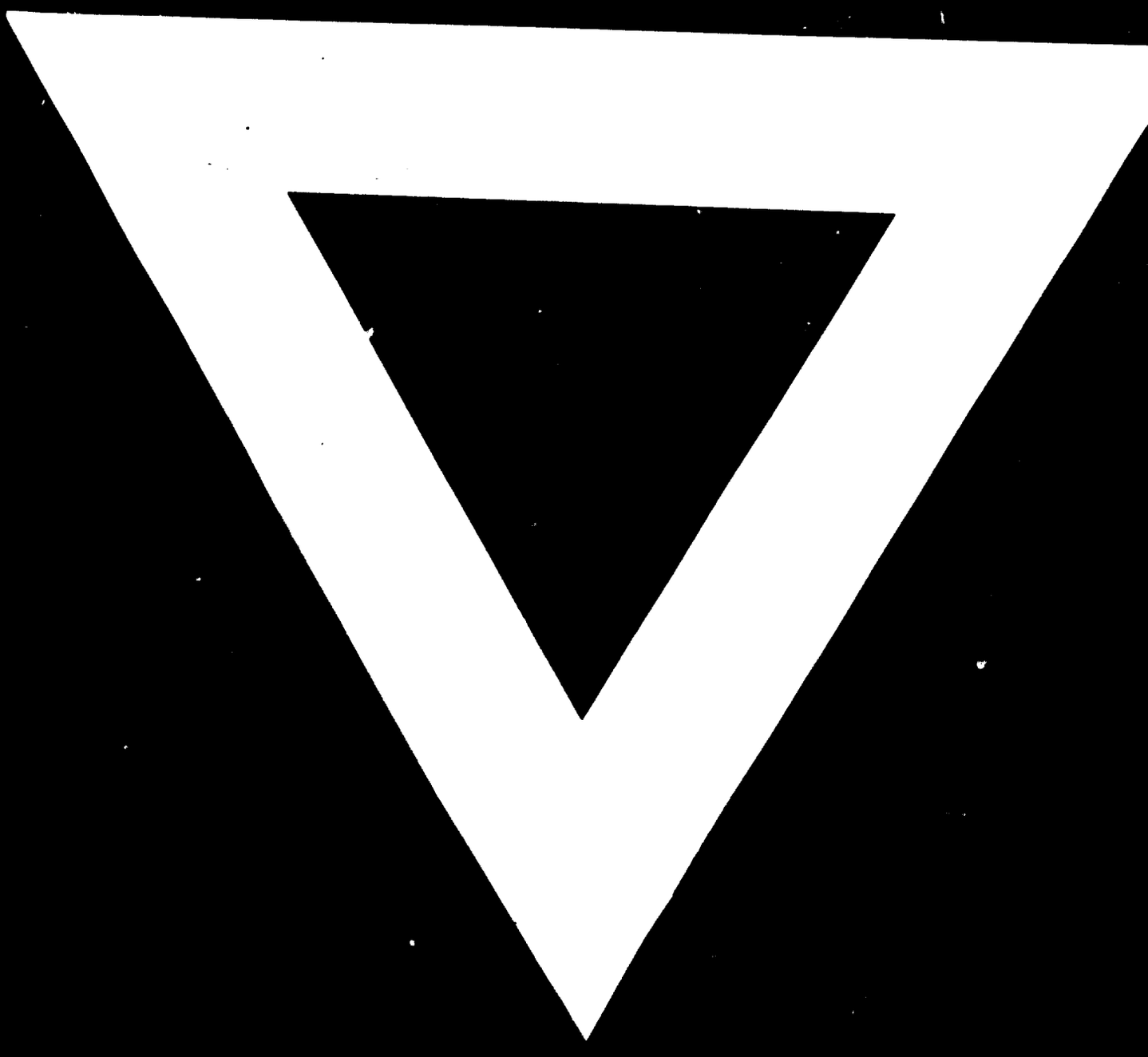
Improved Compounding, Processing and Product Quality:- Notable advances in the compounding and processing of NR latex, and in the quality and performance of the finished products have been achieved during the last few years. In the compounding of NR latex, advantage has been taken of the wide range of new stabilisers which have been made available by the chemical industry, and which enable latex compounds of reproducible and high stability to be obtained. In processing, more rapid sulphur-curing systems have been developed through the use of cheap water-soluble amines (such as diethanolamine) as activators of vulcanization. In the case of vulcanization by thiuram polysulphides and other sulphur donors, thiourea and its derivatives have been shown to be excellent activators. In respect of product quality, notable improvements have been made in the ageing resistance of latex products - especially those containing rubber in the unvulcanized state. In such cases the use of metal-sequestering agents (thiourea, ethylene diamine tetra-acetic acid, etc), in combination with a suitable antioxidant of the p-phenylene diamine type, greatly enhances the resistance of the products to oxidative degradation. Formulations for NR latex compounds have been developed which comfortably meet the flame-

resistance specifications already proposed or likely to be proposed in the foreseeable future. These developments are important to most industrial users of NR latex.

The use of rubber latex (both natural and synthetic) in carpet backings is increasing rapidly, due mainly to the advent of tufted carpets in which the pile needs to be bonded to the carpet backing by an "anchor coating" of latex compound. NR latex anchor coat compounds have been developed which enable rapid processing to be achieved - mainly because compounding is simple and the coatings do not require vulcanisation. Apart from anchor coatings, integral foam backings to carpets have been increasing in popularity and this type of backing now represents the major outlet for latex in carpets. Formulations based on NR latex have been developed for all the main types of foam carpet backings (flat foam, embossed foam, self-gel foam, etc). Self-gel foam backings promise to be of major importance in the rapidly changing carpet scene, apart from the elimination of a processing stage - there is no need for gelation - self-gel mixes are able to accommodate high proportions of cheap fillers. They enable the superior physical properties of NR to be exploited either by giving products of better quality or, because of their higher filler tolerance, permitting the production of lower cost backings. In addition, methods have been established, and are available whenever required, for imparting a high degree of flame-resistance to the backings. This also applies equally to cushioning materials, i.e. moulded latex foam and rubberized hair or coir, in which the main competition is from SBR latex and polyurethane foam.

An example of a completely new outlet for natural latex is the development of compositions consisting basically of NR latex and gypsum plaster (Plaster of Paris). The presence of NR in the plaster not only gives it flexibility and impact resistance, but improves the water-resistance, adhesion and other properties of the plaster. The chief outlets envisaged, in the first place, are as building sealant materials and mine sealants. As building sealants they will be competitive with other elastomeric materials such as polysulphide rubbers, but should be marketable at a much lower price.

The exploitation of these and other developments which are being actively pursued will provide NR articles of improved quality and greater durability and coupled with current developments in production of raw natural rubber will enable NR to remain competitive with SR in terms of both quality and cost.



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