DOI : 10.31357/fapsmst.1999.00754

DEVELOPMENT OF A WATERBASED POLYCHLOROPRENE ADHESIVE

BY

LALITH GREGORY WICKRAMASINGHE

MSc (Polymer Science & Technology) - 1999

The work described in this thesis was carried out by me under the supervision of Mr J.T.S Motha and Dr Sudanth Liyanage and a report on this has not been submitted to any other University for another degree.

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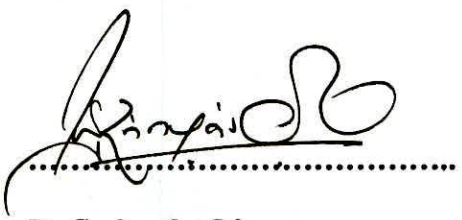
L.G. Wickramasinghe

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.



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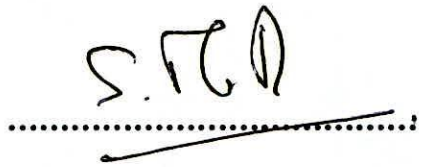

J.T.S Motha

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Thesis submitted to the University of Sri Jayewardenepura for the partial fulfilment of the requirement for the award of the degree of Master of Science in Polymer Science & Technology.

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ABBREVIATIONS

- **ASTM** - American society of testing and material
- **BS** - British Standards
- **CIF** - Cost, insurance and freight
- **GST** - Goods and services tax
- **MEK** - Methyl ethyl ketone
- **phr** - Parts per hundred rubber
- **TEC** - Trichloroethane
- **Tg** - Glass transition temperature
- **Tm** - Crystalline melting temperature
- **VOC** - Volatile organic compound
- **ZDEC** - Zinc diethyl dithiocarbamate

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ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my supervisors Mr. J.T.S. Motha, Manager Rubber and Plastic Division of Industrial Technology Institute and to Dr Sudanth Liyanage of the University of Sri Jayewardenepura for their inspiring guidance and encouragement throughout the research project and in the preparation of this thesis.

I wish to express my gratitude to the Director of the Industrial Technology Institute for the facilities extended to pursue my research work at the institute and to the staff of the Rubber & Plastic Division for their support and assistance provided during my research project.

I also take this opportunity to thank M/s Du-Pont Singapore Pte Ltd of Singapore and M/s Schenectady International of U.S.A and M/s Myung Kwang Chemical Co Ltd of Korea and the other chemical suppliers and their local agents who arranged samples for this research project.

Special expression of thanks to my friends and colleagues who helped me in many ways for the successful completion of my research project and preparation of the thesis and finally, I thank my parents and to my eldest brother for their continued support and encouragement throughout my formal education.

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ABSTRACT

Adhesive is a substance capable of holding material together by surface attachment. The adhesives are either natural or synthetic, organic or inorganic compounds which are commonly polymeric material. Adhesion is interaction that develops between two substrates when they are in contact with an adhesive and is thus a multidisciplinary science dealing with the chemistry and physics of surface and interfaces as well as the mechanics of deformation and fracture of an adhesive bond. Polychloroprene rubber is one of the most widely used and certainly one of the most versatile polymers, ever developed for use as an adhesive base material. Polychloroprene is produced by the emulsion polymerisation process and it is commercially available in solid form as well as in an aqueous dispersion in latex form. The most common and the established polychloroprene adhesive is the solvent based polychloroprene contact adhesive which has been in the market for many years.

The environmental concerns (ozone depletion and smog), health hazard to industrial workers, governments imposing heavy taxes and restrictions on the use of solvents with high VOC, phasing out production of solvents with high VOC and the antisocial impact as a result of sniffing of solvent based adhesives, have created a world wide concern for the use of solvent based adhesives. In considering the above factors the alternatives to solvent based adhesives are hundred percent solid adhesives e.g. hot melt adhesives or water based adhesives.

In this study the theme is to produce an environmental friendly, cost effective water based polychloroprene adhesive to over come the above mentioned factors on solvent based adhesive systems.

Trials were carried out with non carboxylated and carboxylated polychloroprene latex. A water based polychloroprene latex adhesive was formulated by blending the carboxylated polychloroprene latex with dispersions of alkyl phenolic resin, zinc oxide, antioxidant and an aqueous solution of a biocide in the presence of a dispersing agent in the blend. Further improvements were made to the formulation by introducing a vinyl acrylic with the carboxylated polychloroprene latex as the base material in order to enhance the adhesive properties with the synergistic effects of the two material. For applications such as elevated temperature vulcanisates a sulphur/accelerator combination was incorporated for the introduction of sulphur cross links to the system apart from the most common zinc oxide cross links for vulcanisation of polychloroprene rubber.

The formulation with the carboxylated polychloroprene and the vinyl acrylic blend with dispersions of zinc oxide, antioxidant and alkyl phenolic resin with a dispersing agent and a biocide demonstrated very good bond strength for substrates such as wood to wood, veneer to veneer, formica to veneer and leather cloth to veneer. The bond strength for applications such as rubber to rubber and rubber to leather were below expectation.

Further research could be carried out with different types of polychloroprene latex, different blends of polychloroprene latex with other elastomers, different vinyl acrylic blends and different types of resins in the formulation to improve the bond strength for laminates such as rubber to rubber and leather to rubber other applications.