

3936612 SCPO/M : MAJOR: POLYMER SCIENCE; M.Sc. (POLYMER SCIENCE)

KEY WORDS : NATURAL RUBBER/ BUTADIENE RUBBER/ ABRASION
RESISTANCE/ FRICTION/ PRECIPITATED SILICA/ SILANE
COUPLING AGENT

PROMSAK SA-NGUANTHAMMARONG: A STUDY OF ABRASION
RESISTANCE OF SILICA-FILLED NATURAL RUBBER AND ITS
IMPROVEMENT. THESIS ADVISORS: KRISDA SUCHIVA, Ph.D., ARUNEE
TABTIANG, Ph.D., CHAKRIT SIRISINHA, Ph.D. 145 p. ISBN 974-662-758-9

Natural rubber (NR) is known for its superior mechanical properties, but its abrasion resistance is poorer than those of many synthetic rubbers, in particular that of butadiene rubber (BR). The abrasion resistance of silica-reinforced NR vulcanisate is of interest for many applications, such as sport shoes and rice-husk remover where technology of blending of rubbers (NR/BR and NR/NBR blends) is used to improve the abrasion resistance. The present thesis was undertaken in order to understand why the abrasion resistance of NR is inferior to that of BR and how the abrasion resistance of NR might be improved. Particular consideration was given to the factors which might affect abrasion resistance of silica-filled NR and comparative study of abrasion properties of silica-filled NR and BR vulcanisates.

The controlled adhesion between rubber and silica by using silane coupling agent was shown to have small effect on improvement of abrasion resistance of NR, both by pre-treatment and by modification during mixing. Hardness also had comparatively small effect on improvement of abrasion resistance of NR. Increase in hardness from 60 to 73 (Shore A) resulted in only about 20% improvement in abrasion resistance of NR.

In the study of abrasion resistance of NR in comparison with BR, there appeared to be no direct correlation between ultimate properties of the two rubbers and their abrasion resistances. The thermal oxidative degradation of rubbers during abrasion test and the reduction of molecular weight of rubbers during processing were found to have minor influence on the abrasion resistant value. The study of aged vulcanisate samples showed that the abrasion resistance of silica-filled NR vulcanisate was not only inferior to that of BR initially, but would also deteriorate faster during use.

The very good correlation between DIN volume loss and coefficient of friction of NR/BR blend and also SEM study of the abraded rubber surface led to the conclusion that surface friction of rubber appears to be the major factor determining abrasion properties of rubber. Attempts to improve the abrasion resistance of silica-filled NR vulcanisate by lowering surface friction through chlorination and use of external lubricant (Struktol WB 16) were made with little success. In the case of surface chlorination, no improvement was obtained, but the use of external lubricant yielded 13% improvement when as high as 10 phr of the lubricant was used.