

THE COMPARISON OF CURE CHARACTERISTIC, MECHANICAL PROPERTIES AND MORPHOLOGY OF PRECIPITATED SILICA/NR WITH IN-SITU SILICA/NR COMPOSITES

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ABSTRACT: Silica has been used as reinforcing filler in natural rubber for a period of time as it results in excellent properties for NR vulcanizates [1]. The polarity of silica surface suffered the processing and the particles dispersion. Silane coupling agent was then introduced to unfold the difficulties. However, the agglomeration of the particles still encountered. The application of silica formed in-situ [2-3] has been one of the methods used to overcome the difficulty. This research is aimed to study the dispersion of silica obtained from rice husk ash (RHA) and formed during the latex agglomeration. The silica solution was prepared via rice husk ash extraction in 1M NaOH for 17 hours. The solution obtained was then mixed, at various content of SiO₂ in solution, with 30 % DRC NR latex and consequently neutralized with H₂SO₄. The dried rubber latex mixture precipitated with CH₃OH was then compounded with curatives additives on a two roll mill. The dried CH₃OH precipitated NR from latex was also compounded with curatives and with various contents of precipitated silica (PSi) in the same manner for comparison. The rubber compounds were characterized at 160 °C using MDR for their cure characteristic properties, i.e. scorch time (t_s) and cure time (t₉₀), minimum and maximum torques. The rubber vulcanizates obtained were mechanically characterized using universal testing machine including hardness tester.

It was revealed that dried in-situ SiO₂ filled NR (uncured) showed high content of bound rubber due to the high porosity of the silica formed in place with agglomeration of NR latex. The porosity of the silica that was formed in-situ also caused higher curatives absorption than the system containing PSi. This led to longer scorch and cure time compared to latter system. The rubber compounds containing in situ formed silica also exhibited higher minimum torques. This was responsible from the rubber molecules that were tied in the high porosity silica. These tied rubber molecules obstructed the flow of the molecules in the melted state shearing in MDR. Whereas, maximum torque of the rubber compounds was affected by the high porosity of the silica. It was found that maximum torques were lower than the other case up to silica

content of 15 phr and started to increase again at 20 phr content. The high porosity of the silica was responsible for the small extent of crosslinking reaction by the absorption of the curatives additives. However, at high content of silica during the formation, porosity of the particle became collapsed. This led to particles agglomeration. The curatives additives absorption became less and the crosslinking reaction could occur in a greater extent. The silica formed in situ could reinforce efficiently at the content of 30 phr, in both modulus at 200 % elongation and ultimate tensile strength. The elongation at break and tear strength of the vulcanizates did not suffer by the increased of the silica compared to the other system. This may be due to the well dispersion and the tied rubber molecule occurred in the new system.

KEYWORDS: in situ formed silica, cure characteristic properties, mechanical properties, natural rubber composites.

References

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