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Development of hydrophobic natural rubber latex film using diatomaceous earth

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Conversion of hydrophilic natural rubber latex (NRL) into superhydrophobic/hydrophobic natural rubber latex film will broaden the fields of its application greatly. Low surface energy and appropriate nano-scale surface roughness are the two main factors which govern the superhydrophobic property. The equilibrium between these two factors results the best superhydrophobic surfaces. Diatomaceous earth (DE) is fossilized diatom cells which can be obtained naturally. DE is a silica-based highly porous structure with nano scale roughness. Usage of DE to manufacture superhydrophobic/hydrophobic material is more economical when compared to conventional methods. DE was treated with silane (Hexadecyl-trimethoxysilane) and incorporated into natural rubber latex to manufacture hydrophobic NRL film. Silane modified DE showed superhydrophobic properties with 157° water contact angle (WCA). Unmodified DE is hydrophilic and it absorbs water. Silane modification increased the hydrophobic nature of the DE surface as well as reduced the surface roughness, this was confirmed by the SEM images. FTIR data confirmed that $Si - O - Si$ bond formation between DE surface and the silane. Modified DE was dispersed in aqueous phase to incorporate to NRL. Water contact angle of modified DE was reduced about 25% when dispersing due to the formation of new untreated surfaces with the particle size reduction process. pH value of dispersed DE was maintained around pH 10. WCA of modified DE incorporated NRL film was increased up to 115° from 8° giving hydrophobic properties to NR. SEM images confirmed that the smooth rubber film surface was modified into a rough surface after the incorporation of the modified DE. The tensile strength of the NRL film had been reduced about 90% after the incorporation of modified DE. However, the hardness was increased about 20%. Considering these properties of modified DE incorporated latex films, this method can be recommended to modify hydrophilic natural rubber latex films into hydrophobic. This modified material can be used in high hardness and hydrophobicity required applications. Also, it may be used as a surface coating on existing products.

Keywords: Diatomaceous earth, Superhydrophobic, Natural rubber latex, Water contact angle, Silane