Mathematical Modeling of Rubber Elasticity and Stress – Strain Behavior Under Dynamic Loading

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Rubber, a versatile material used across fields such as materials science, physics, and civil engineering, has been widely studied for its elastic and dynamic properties. Researchers aim to understand how rubber-like materials, such as tires, respond to varying loads. This study focuses on developing a refined mathematical model for rubber elasticity and stress-strain behavior under dynamic conditions, combining mathematical modeling with experimental analysis. Current models like the Generalized Maxwell Model, Fractional Derivative Model, Mooney-Rivlin Model, and Prony Series have limitations in fully capturing the comprehensive behavior of rubber under dynamic stress. Using a Rubber Process Analyzer (RPA), this research involves careful sample preparation, iterative testing, and data analysis. Establishing a reliable mathematical model for rubber elasticity under dynamic conditions is critical for advancing the knowledge and exploring innovative industrial applications.

Keywords: *viscoelasticity, rubber, fractional derivative model, Prony series, Generalized Maxwell Model, rubber viscoelastic behavior*