

Rubber and Cord Material Laws for the Prediction of Tire Temperature and Rolling Resistance

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Cooler running tires with reduced rolling resistance is one of the primary considerations of both tire makers and automotive OEMs. To investigate the mechanics of energy loss and temperature rise, a mathematical formulism suitable for numerical analysis is developed and demonstrated.

In the constitutive law, the rubber compounds and the polymeric cords are considered as viscoelastic/plastic materials with temperature, strain and strain history dependent stiffness [1]. A novel cure kinetics model based on the evolution of the rubber network chemistry was also used to capture the permanent change in reference state and change in stiffness. Several applications to different tire performances are provided to demonstrate the impact of this new material constitutive law in improving the quality of the numerical predictions. One application is a rolling tire model that was used to delineate the tire temperature distribution and the resultant rolling resistance for different tread patterns.

REFERENCES

- [1] Adolf, D. B., and R. S. Chambers. "A thermodynamically consistent, nonlinear viscoelastic approach for modeling thermosets during cure," *J. Rheol.* 51, 23-50(200).
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