

## **Root Cause Analysis for Warming Delay of Resilient Solid Tire Heel Compound on Warming Mill During Manufacturing**

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Solid tires used in heavy-duty applications consist of three distinct parts: heel, cushion, and thread. The heel is the innermost layer which provides the resistance to air permeation while ensuring excellent adhesion to the rim and cushion. More fiber reinforced compounds are used in heel production. But a warming delay for about 8-10 minutes which is more than the specified time limits to warm the compounds before production has been observed when warm the compounds using warming mill. Therefore, this research focused to analyse the root causes of the warming delay of compounds during the warming operation. Minimum torque (ML) and Mooney viscosity (MV) of the heel compound, nip size of the warming mill, thickness, and maturity of the incoming compound sheets were selected as key factors for the warming delay. Multiple regressions analysis and simple linear regression were applied to predict the relationships of these factors with the warming time while using cubic regression to find the effect of nip size on the warming time. According to the results, there is a significant effect of these factors on warming time. Improper mixing of the compounds tends to show high values for MV, ML, and thickness of incoming compounds. The maturity of the compounds and the nip size of the warming mill was selected for further study. According to the two-way ANOVA, there is an interaction between maturity and nip size on warming time. The nip size (mm) was varied from 7 to 10 at 1mm interval and the maturity time of the compounds was varied as 6, 12, 24, and 48 hours. Results revealed that warming time can reduce using 9mm nip size and 48 hours maturity time of compounds at warming mill in the manufacturing process.

*Keywords:* Minimum torque, Mooney viscosity, Nip size, Solid tire heel, Warming delay