INCORPORATION OF DEVULCANIZED RUBBER INTO A VIRGIN TIRE TREAD RUBBER COMPOUND

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Background

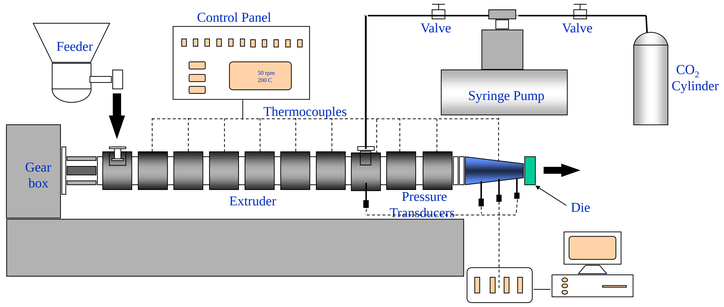
- Devulcanization of waste rubber with $scCO_2$ in an extruder is an environmentally friendly continuous process;
- A reasonably high throughput of devulcanized rubber has been obtained in the devulcanization process in a twin screw extruder, which was stable
- Devulcanized rubber obtained from the devulcanization process can be re-vulcanized again by adding proper amount of curing chemicals

Objectives

- To incorporate the devulcanized rubber into a virgin tire compound for material cost- reduction ;
- To study the impact of devulcanized rubber utilization on tire compound performance ;

Devulcanization

Twin screw extrusion, CO_2 injection, and data acquisition



Sc Co2 injection system

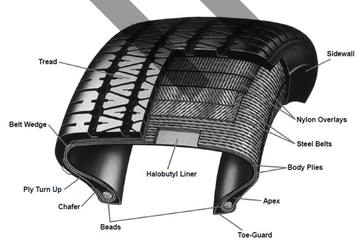
50 mm twin screw extruder (Leistritz Inc. Nj)

Tire tread

- Tread is the wear resistance component of the tire in contact with the road
- It must provide traction, wet skid, and also minimum noise generation and low heat buildup
- A blend of natural rubber, polybutadiene (BR),and styrene–butadiene rubber (SBR), compounded with carbon black, silica, oils, and vulcanizing chemicals

Recipe for sample preparation

Ingredients	*Control*	*10%*	*20%*	*30%*
Tread MB	194 phr	174 phr	155 phr	135 phr
Devulcanized rubber	-	20 phr	39 phr	59 phr
Curing Chemicals	3.5 phr	3.5 phr	3.5 phr	3.5 phr



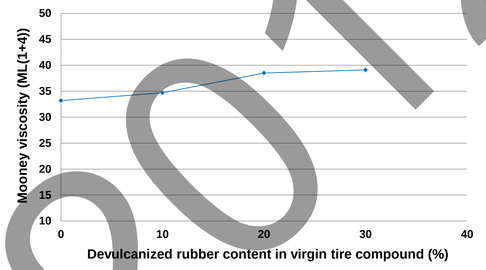
Cross-section of a high-performance passenger tire

- Tire tread MB is a compound of NR and BR plus carbon black, oil, anti ozonant, and etc.
- Tire tread MB was replaced by Devulcanized rubber in order to lower the cost of compound

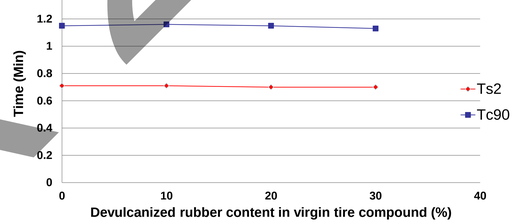
Characterization

- *Mooney viscosity*
- *Curing characterizations*
- *Tensile properties (Tensile strength, Elongation at break)*
- *Hardness*
- *Hysteresis (heat build up)*
- *Cut and chip (% of mass loss)*

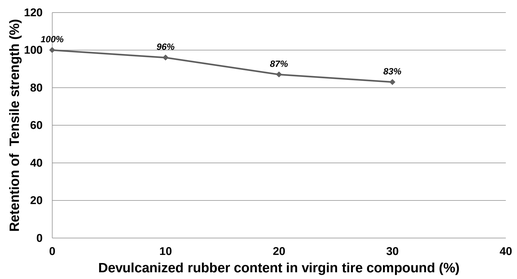
Mooney Viscosity



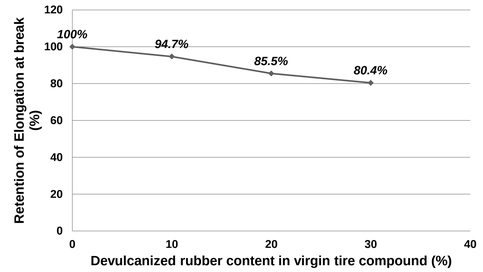
Curing characterizations



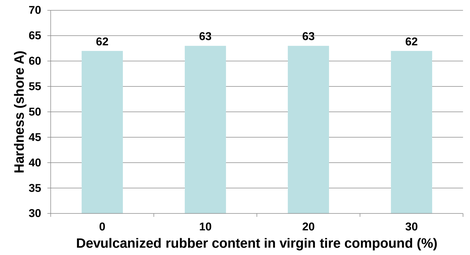
Tensile strength



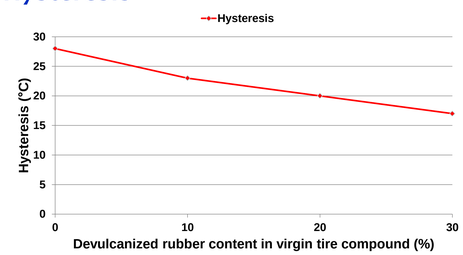
Elongation at break



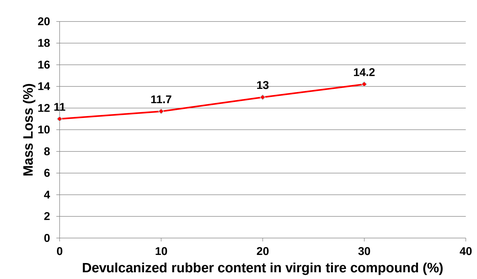
Hardness



Hysteresis



Mass loss in cut and chip test



Concluding Remarks

❖*Devulcanized rubber obtained from our devulcanization process was incorporated in a virgin tire compound and the results show that by addition up to 30 % of devulcanized rubber the Mooney viscosity, Hardness, tear strength and curing properties does not change* significantly. *Tensile strength and elongation at break decrease up to 15 % and 20%, and heat build up improves*

❖*These results show that devulcanized rubber can be incorporated in a tire compound in order to lower the price without significant deterioration of compound properties. However, additional experiments are required to further optimize the tire compound properties.*

ACKNOWLEDGEMENTS

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