

EXPERIMENTAL STUDY OF THE INFLUENCE OF PRESHEARING ON THE YIELD STRESS OF CARBON BLACK FILLED RUBBER USING EXTRUSION RHEOMETRY

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Filled rubber compounds exhibit some flow phenomena like the existence of a yield stress, wall slippage and viscoelastic flow properties. In conventional extruders with deep flighted screws, the shear stress is lower than the yield stress in some areas of the screw. These areas remain unmixed and cold for a certain screw length as the rubber inside these areas heats up only through heat conduction instead of dissipation. Dependent on material properties like polymer type, filler type, filler level and process parameters like temperature or preshearing history of the rubber, the existence and amount of yield stress varies. This experimental investigation studies the influence of preshearing using extrusion rheometry. By shearing filled rubber during processing, the filler network, whose origin is assigned to interactions between filler and elastomer, degrades and rheological properties like viscosity and yield stress change. The measurement of yield stress using extrusion rheometry is equivalent to the measurement using capillary rheometry. Using capillary rheometry, a piston is used to build up pressure in the filled barrel so the polymer melt flows out of the barrel. While discharging the barrel, the piston can be locked in position and the pressure in the barrel decreases to a certain level. The differential pressure between two pressure sensors can be interpreted as a wall shear stress and as the yield stress after the differential pressure is converged against a certain value. Using an extrusion rheometer, locking the piston is equivalent to stopping the extruder drive. By varying the screw speed before stopping the drive, the degree of shear deformation can be adjusted. The measured yield stresses at different rotational speed levels show the influence of preshearing on the yield stress.