283f Pulverization of Rubber with or without Carbon-Black under High Normal and Shear Forces

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The objective of this study is to obtain the fundamental understanding of the pulverization of rubber under high normal and shear forces at different processing conditions. To achieve this goal we modified Bridgman Anvil apparatus and it is used to pulverize crosslinked rubber with or without Carbon black at different normal and shear forces, temperature and residence time. This study will enable us to better understand the mechanism of pulverization in Solid State Shear Extrusion (SSSE).

Materials at high shear and compression store an increasing amount of energy until it reaches a value that is no longer sustainable and energy is released through the formation of large surface area (pulverization).SSSE is a non-cryogenic pulverization process that of polymeric and elastomeric materials which works on the principle of above mentioned variables. This process utilizes a specially designed single screw extruder to pulverize polymeric material into fine particles at high shear and normal compression. Successful attempts have been made to pulverize various forms of rubber and polymeric materials using SSSE by controlling above mentioned conditions, however an effect of each parameter on the particle size distribution is still not well understood.

To simulate SSSE and to identify with the effect of variables quantitatively, modified Bridgman Anvil apparatus was developed. Our Bridgman Anvil consists of two hardened steel surfaces in which one is held stationary and while the other is loaded and rotated to provide desired normal and shear forces respectively. Proper heating is provided to both the surfaces to maintain required temperature during pulverization. Surfaces of different roughness were used to study the effect of friction on the particle size distribution.

Deformation and start of pulverization of natural, cross-linked rubber with or without Carbon-black was measured using displacement change and pressure drop across two surfaces of the Bridgman Anvil. The effect of different conditions on the size of pulverized particles will be measured and an attempt will be made to develop mathematical correlations for deformation of tested material. The determination of stress strain distribution in the rubber undergoing such large strain distribution in non-isothermal atmosphere is the key to the understanding of pulverization phenomena. This finite elasticity problem is inherently nonlinear. This all information will be used as a guide to obtain optimum conditions and design parameters for optimum design of SSSE.