EXPERIMENTAL METHOD USED TO DETERMINE MOONEY -- RIVLIN CONSTANTS FOR RUBBER. PART I

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Abstract: *The present paper describes a new experimental method used to determine stress-strain correlation for cylindrical rubber specimens. Three rubber samples with 3.4 mm diameters were used. In order to obtain a single axis stress state, the length-diameter ratio of the samples was taken larger than 10. The loading force was measured by aid of resistive transducers and strain was determined with a laser profilometer.*

Keywords: *rubber, measure, stress, Mooney-Rivlin.*

1. Rubber elasticity

Synthetic rubber is a macromolecular compound with properties similar to those of natural rubber, [1],[2]. Synthetic rubbers can be obtained via polymerization or poly-addition of one or two different monomers, which under certain conditions react with each other thus generating specific products with particular molecular structure and weight, [3].

From a technical point of view, the most important reaction of rubber is with sulfur, called vulcanization. This reaction takes place by heating the rubber-sulfur mixture to a temperature higher than the melting point of sulfur (115.50°C). Rubber's reaction with sulfur is irreversible. Vulcanization of synthetic rubber takes place similar to that of natural rubber, [4].

The most widely used synthetic rubber is made of butane-styrene (SBR). This type of rubber was discovered during World War II and it is frequently used in the manufacturing of sealing elements due to its low permeability to the passage of gases.

Neoprene is another type of synthetic rubber that has high resistance to degrading factors. Unlike natural rubber, neoprene has low flammability and isn't soluble in mineral oils. These properties recommend it in engineering applications, [4].

Another synthetic rubber, mainly used in automotive industry for the manufacturing of tires, is ethylene-propylene, a compound made from ethylene and propylene.

2. Experimental set-up

In order tot determine the stress strain correlation for rubber, in the present work, an experimental set-up was used that applies loads to a rubber specimen while fixed on the X-Y stage of a laser profilometer.

The laser profilometer is fitted with a measuring stage capable execute controlled movements in a plane. The relative position of the stage can be accurately determined at any moment by reading its point of origin coordinates.

The employed force sensor consists of a resistive transducer made from a strain gauge connected to a strain indicator.

The experimental rig consists of a specimen clamping system with a fixed element to which the force sensor is attached. At the other end, the specimen is clamped to the device's nut-screw assembly. This device ensures load application by changing the nut-screw relative positions, thus submitting the specimen to traction. The size of the applied force is determined by aid of the strain indicator. The whole device is placed on the X-Y stage of the laser profilometer. Two markers are then painted on the specimen, using a rapidly drying paint. The positions of the two markers are then found by aid of the optical camera attached to the profilometer. This camera permits to read the coordinates of the markers by report to the stage origin. First, the marker positions are determined in an unloaded state, and then at various loads. The rubber specimen elongation is then determined as difference