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

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**Abstract:** *This paper presents some experimental results obtained for rubber stress-strain correlation. Three cylindrical rubber specimens with 1.7 mm radius were used. The specimens were subjected to uniaxial tensile testing. The material was considered incompressible, homogenous and isotropic. The experimental results were used to determine Mooney-Rivlin constants. The employed experimental method was first described in [1]. The experimentally obtained Mooney Rivlin constants were used to describe rubber behavior in Femap software. A contact between a 12.6 mm rubber sphere and a rigid flat plate was modeled. The finite element analysis results were compared to those obtained experimentally.*

**Keywords:** *rubber, model, strain-stress, Mooney-Rivlin constants.*

## 1. Mooney-Rivlin model

Mooney, [2] defines nonlinear elastic materials by aid of an expression similar the one illustrated by Eq. **Error! Reference source not found.**.

$$W = C_1\left(\overline{I}_1 - 3\right) + C_2\left(\overline{I}_2 - 3\right), \qquad (1)$$

where, $C_1$ and $C_2$ are material constants, $\overline{I}_1$ and $\overline{I}_2$ are the first and second invariants of the Cauchy – Green strain tensor.

This is a particular case of the generalized Rivlin model, employed to determine the behavior of incompressible materials, as shown in Ref. [2]. It is mostly useful for the modeling of hyper-elastic materials. The specific energy of deformation is defined by means of the Cauchy – Green strain tensor's invariants. The model was advanced by Melvin Mooney in 1940 and it is expressed using invariants determined Ronald Rivlin, thus resulting the model's name.

The material constants $C_1$ and $C_2$ used in this model can be determined from the stress – strain characteristic of a material, assuming that said material is incompressible, homogenous and isotropic, [1].

Studies found in literature, [3, 4] present rubber as incompressible and having a transverse contraction coefficient close to 0.5. For calculus simplification, rubber is considered isotropic and homogenous.

## 2. Money Rivlin constants

Conventional stress is calculated as ratio between the axial forces applied to the specimen and the cross-section area corresponding to an unloaded state. In the current study, average values obtained experimentally and presented in Ref. [4], were employed. The following correlation between mean conventional stresses and strains was obtained, as illustrated in Fig. 1.
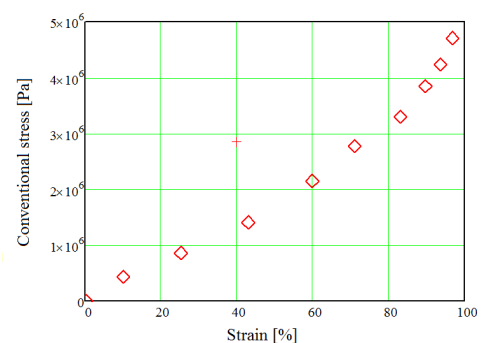


**Figure 1:** *Rubber stress-strain correlation obtained under uniaxial tensile load*