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Compression of a porous materials "a stunt man's hypothesis"

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Abstract

This contribution introduces a newer concept of structural modeling of processes by one-dimensional compression of porous materials, such as non-woven textiles (bonded) and/or foams. The similarity of compression of porous material with jumps of stunt men to the layer of paper-board boxes in movies inspirited author to formulate the presented structural model as a probable hypothesis.

A hero jumps down from the roof or the window of a high building in a typical old thriller movie. A double – stunt man – usually personates such actions so that he is jumping down to a very thick layer of empty paper-board boxes. Such cardboard boxes are reasonably soft, flexible and elastic and – in the places where the impact from stunt man's body is too intensive – they crumple and fold up themselves, and so they promptly reduce their volume. Therefore, the stunt man stays living (usually).

1. Introduction

The relation between pressure p and packing density μ by one-dimensional deformation of fiber assembly (to non-deformable box) is given by the known Wyk's equation [1](285-292).

$$p = k_p \mu^3 \text{, or more generally } p = k_p \mu^q \qquad (1)$$

Alternatively, according to our modification (Neckář 126-130) it is valid

$$p = k_p \mu^3 \Big/ \left[1-(\mu/\mu_m)^{2+a}\right]^3 \qquad (2)$$

where k_p, $q \leq 3$, μ_m are suitable parameters - see the scheme on Figure 1. Such type of concave functions was experimentally observed by lots of authors many times.

Nevertheless, the experimental trend of p - μ relation

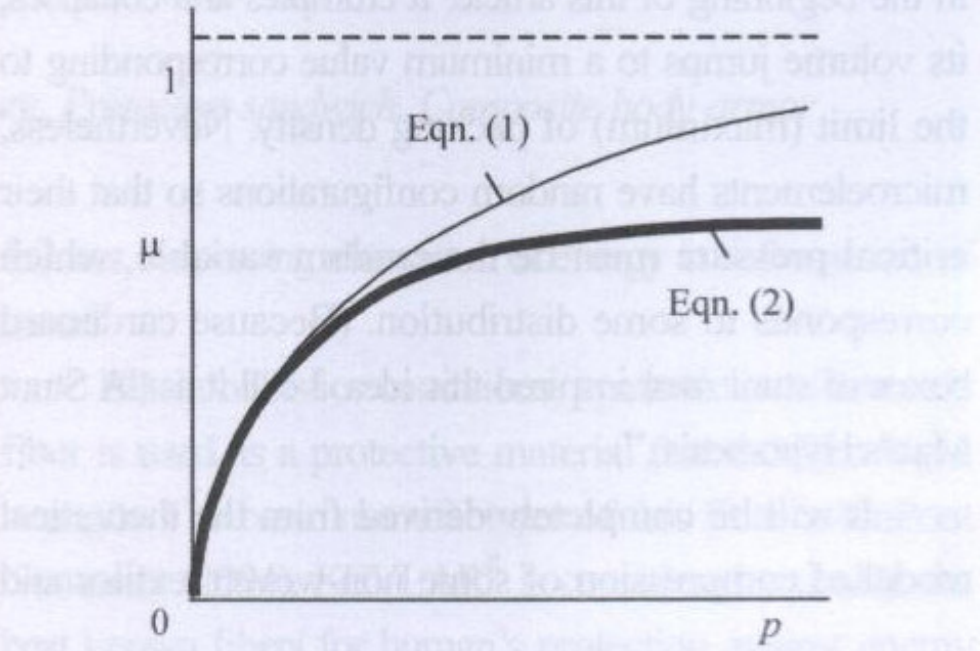

Fig. 1. Scheme of functions (1) and (2)

is another for non-woven textiles and/or polymer foams – see the curve 1 on Figure 2. In opposite to earlier functions – curve 3 – the typical experimental curve contents the flex point and then it has a convex course. Then comes the question of why?

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