COMPRESSIONAL BEHAVIOR OF FIBER ASSEMBLY MASS

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1. INTRODUCTION OF PRESSURE-DEFORMATION

The study on compressional behavior of fiber assembly mass is important, because it is closely related with the technology of fiber fill material for several cushions and quilt.

In this paper, a theoretical equation containning a few structural parameters for pressure-deformation relation is derived by considering the effect of fiber orientation, of an increase in the restraint of fiber bending and of a decrease in the degree of overlapping of summed project area to unit area. Fitting of this equation to experimental results are carried out.

2. THEORY OF PRESSURE-DEFORMATION

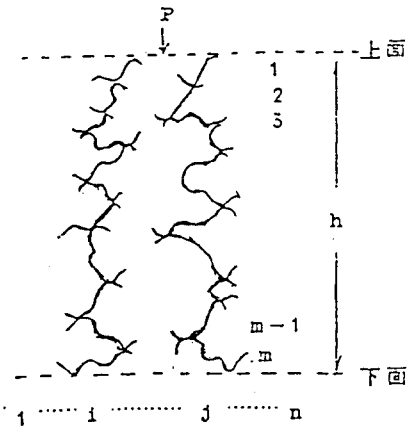Model of fiber mass : n/cm^2 loading path having m serial beam elements.

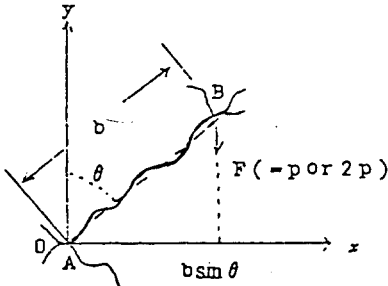Fig.1 (a) A model for fiber assembly mass under compression

Fig.1 (b) Bending of a fiber beam within the assembly

$$P - P_o = \frac{C}{V_o^2 g} \left\{ \left(\frac{V_o}{V}\right)^g - 1 \right\}$$

Where

$$C = \frac{EI}{S^2 \rho^2} \frac{\delta_o(1 + f_\beta)}{\alpha_o^3 \beta_o^3 \gamma_o^3}, \quad -g = 1 + f_\alpha + 2f_\rho + 2f_\gamma - f_\delta$$

3. EXPERIMENT

4 kinds of carded webs and 9 Kinds of cushion contain 30 wt% adhesive fiber are used.

4. RESULTS

All the experimental curves can be well fitted with equation by setting proper values of two parametere g and C except in the region of high deformation ratio, as representatively shown in Fig..
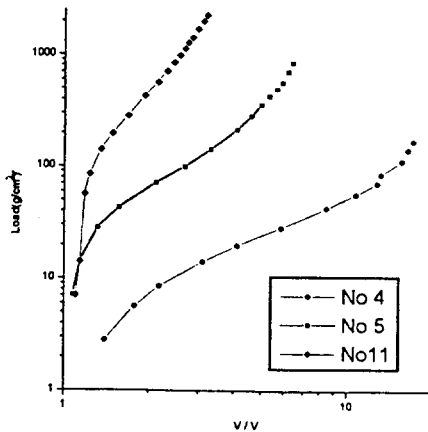

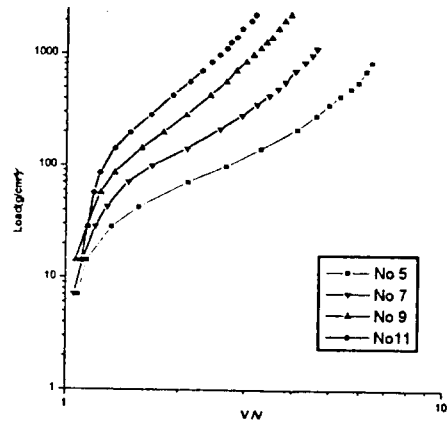Fig. Pressure-Deformation Pressure.

Fig. Pressure-Deformation curve.

5. CONCLUSION

A theoretical equation for pressure-deformation curve was derived and a kind of theory for specific volume of fiber mass was also presented. Experiment of compression test for several kind of carded webs and those heat-treated was carried out. Basing on these results, the change from simple contact to fused contact and controlled initial specific volume, are clarified.