# A TECHNIQUE FOR THE STUDY OF DENSITY DISTRIBUTION WITHIN COMPACTS

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Hiestand et al (1977) have suggested that the problems of capping and lamination which can occur in tableting are due to residual stresses within the tablet during ejection. To reduce these problems, it will be necessary to reduce these residual stresses, which in turn will require an understanding of their distribution within the compact.

The technique of placing internal sensors within the powder compact as developed by Train (1957) is not applicable to pharmaceutical tablets due to problems of size. Thus a method must be found for making external measurements which can be related to the internal distributions. Train (1957) showed that there is a correlation between the stress distribution and density distribution within a compact. Thus measurement of density distributions offers an alternative approach to the problem, and a technique has been developed for measuring these distributions, based on the work of Woodhead et al (1979). This method uses the reduction in intensity of a collimated beam of gamma rays, produced by a Cobalt-57 source, which can be related to the mass of material in the beam by a calibration. Thus a mass profile can be obtained by measuring the attenuation of the beam at regular intervals across a diameter of the compact. For a given tablet, these mass profiles may be converted to density profiles by removing layers of known thickness from the sample, and repeating the measurements. The derived stress distributions, which will then correspond to the regions of maximum residual stress during ejection, can then be used to locate the positions of maximum stress during compaction.

The compacts used in this investigation were prepared from graded ammonium sulphate, chosen for its direct compressibility and its regular crystalline habit, and were formed by single sided compaction at a constant rate of increasing load on a hydraulic press (Dartec Ltd), and ejected at a constant rate of displacement. Samples were then used for the evaluation of the density profiles for the material.

Figure 1 illustrates a typical density contour plot which can be obtained by this method. This shows a 2.5 cm diameter sample, formed from 8 g of -355+250 micron material compacted to 50 kN at a rate of 0.5 kN $sec^{-1}$, and ejected at 1 mm $sec^{-1}$. The figures represent percentages of solid present.

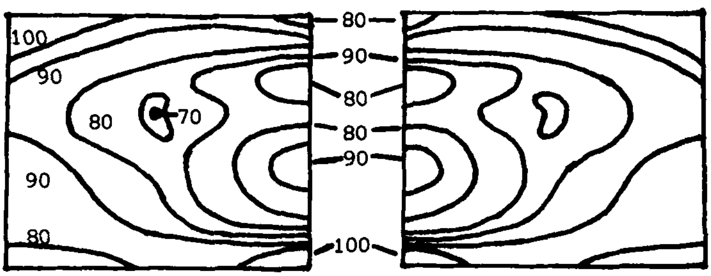


Fig. 1. Densities within an 8 g, 2.5 cm diameter, 50 kN compact of -355+250 micron ammonium sulphate

Hiestand, E.N. et al (1977) J.Pharm.Sci. 66:510-519
Train, D. (1957) Trans. Inst. Chem. Engrs. 35:258-266
Woodhead, P.J. et al (1979) J.Pharm.Pharmac. 31:72P

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