# WORK-OF-FAILURE MEASUREMENTS ON FORMULATED TABLETS

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Our previous studies (Rees & Rue, 1977) with several direct compression (DC) diluents have shown that tablets which deform considerably before fracture when tested for strength in diametral compression are more resistant to mechanical failure than other tablets of equal tensile strength. The integral of applied load, F with respect to diametral deformation, x which we termed work of failure, $W_f$ is related to the "toughness" (Dieter, 1961) of the tablet.

$$W_f = \int F \, dx$$

Since this property appears to provide a basis for comparing tablets of different materials, we have studied several DC diluents compressed at different pressures as well as fifteen types of placebo tablets of various sizes formulated with different combinations of typical diluents, binders and lubricants.

Sufficient DC diluent to produce a compact, 2.49 mm thick at zero theoretical porosity, was accurately weighed, conditioned at 50% R.H., and compressed in a lubricated die between 12.7 mm diameter, plane-faced punches using an instrumented reciprocating machine. The formulated placebo tablets were supplied by pharmaceutical companies. Their qualitative composition was disclosed but no further details were requested since the objective was to test the general applicability of work of failure measurements to compressed tablets, irrespective of their composition and method of manufacture.

All tablets were measured, then tested in diametral compression at a platten rate of 0.26 mm $min^{-1}$, using a load transducer and displacement transducer to measure applied force and platten movement. Tablets were also subjected to multiple diametral impact loading (Rees and Rue, 1977) to simulate conditions to which tablets might be subjected in practice. The number of impacts, N required to cause failure was determined.

A linear correlation coefficient of 0.875 was obtained between work of failure and log N considering collectively the tablets of single DC diluents and the formulated tablets of different sizes. However there was no significant correlation between tensile strength and log N ($r = 0.378$). Since tensile failure occurred in most cases during the diametral compression test, a correction factor was applied to convert the applied load, F to a tensile stress. The corrected value of work done by the plattens to cause tensile failure is:

$$W_f^* = \frac{2}{\pi Dt} \int F \, dx$$

where D and t are the diameter and thickness of the tablet. For bi-convex tablets the cross-sectional area term, Dt was modified to allow for the curved faces. Using the corrected work of failure, $W_f^*$ a linear correlation coefficient of 0.869 was obtained for all the tablets taken collectively.

Friability measurements on the formulated tablets indicated an exponential decrease in the value of $W_f^*$ with increasing friability expressed as a percentage.

We conclude that work of failure measurements provide a suitable means for comparing formulated tablets of different composition and that a correction factor for tablets of different sizes is unnecessary.

G. E. Dieter (1961) "Mechanical Metallurgy", McGraw Hill Hogakusha International Student Edition, Tokyo.

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