

# THE INFLUENCE OF DIMENSIONS ON THE STRENGTH AND STRENGTH VARIABILITY OF TABLETS

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The basic two-parameter Weibull relationship between a particular value of the fracture stress ( $\bar{\sigma}_f$ ) and the associated failure probability ( $P_f$ ) has been shown to be valid for compacts of lactose (Stanley & Newton, 1975). An important attribute of the Weibull hypothesis is that the mean fracture stress of a batch of nominally identical compacts is a characteristic of the specimen and not of the material itself; it is a size-dependent quantity. The larger the specimen the more likely it is that it will contain a flaw of given severity and consequently the smaller will be the mean fracture stress. With certain conditions and assumptions (Stanley & Newton, 1975), the relationship between the mean fracture stresses ( $\bar{\sigma}_{fA}$  &  $\bar{\sigma}_{fB}$ ) of batches of two similar specimens of different volumes ( $V_A$  &  $V_B$ ) can be derived in the form:-

$$\frac{\bar{\sigma}_{fA}}{\bar{\sigma}_{fB}} = \left( \frac{V_B}{V_A} \right)^{1/m} \quad (1)$$

where m is the Weibull modulus.

In previous work, 6 batches of tablets were prepared from a -90 + 63  $\mu$ m size fraction of  $\alpha$ -lactose monohydrate. Within a batch, tablets were nominally identical, but the tablet volume was varied systematically from batch to batch. The mean fracture stress of the different batches could not, in all cases, be related by equation (1).

As a continuation of these fracture studies, further tests have been carried out with sodium chloride of the same particle size as the lactose. Two batches of different volume but the same diameter to thickness ratio were prepared and tested under the conditions previously described (Stanley & Newton, 1975) (it is known that sodium chloride and lactose compact by different mechanisms (Cole, Rees & Hersey, 1975)). For each batch the strength variability was adequately represented by the Weibull relationship. The summarised results in the table show that, contrary to the implications of equation (1), the smaller tablets have a lower mean fracture stress. This demonstrates that a doubling of the volume results in significant changes in some features of the compaction process, resulting in 2 sets of tablets which cannot be considered as identical, in a structural sense.

Table. Characteristics of sodium chloride tablets prepared by compaction at a rate of 1 mm min<sup>-1</sup>, with an applied pressure of 35.5 MNm<sup>-2</sup>.

No. in batch	Tablet diameter cm	Tablet thickness cm	Tablet volume cm <sup>3</sup>	Mean failure stress ( $\bar{\sigma}_f$ ) MNm <sup>-2</sup>	Weibull modulus (m)	Predicted mean failure stress from equation (1)		
						m=9	m=10	m=11
25	1.261	0.421	0.5258	1.02	11.75	-	-	-
24	1.009	0.328	0.2623	0.85	9.14	1.102	1.093	1.087

Cole, E.T., Rees, J.E. & Hersey, J.A. (1975). Pharm. Acta Helv., 50, 28-32.

Stanley, P. & Newton, J.M. (1975). Second International Conference of Compaction and Consolidation of Particulate Matter. Brighton. p. 129-141.