disintegration time were assessed for 180 batches of several hundred tablets. They were correlated with changes in compaction pressure, machine speed and tablet thickness.

Tablets were made from each material in three thicknesses: 3, 4 and 5 mm at a constant diameter of 12 mm using flat-faced punches. At each thickness, compaction pressures of approximately 90, 180, 260 and 330 MN m^{-2} were used, and at each pressure the tabletting machine was run at 700, 1100 and 1500 tablets/min.

Because Emcompress special (calcium dihydrogen phosphate) required a lubricant, 1·5% by wt of magnesium stearate was blended in with it, and with the other bases also in order to give comparability. In all cases the tap density of the powder was slightly increased by the addition of the lubricant. All the materials flowed well, and compressed without any sign of capping or difficulty in ejection, except for an initial test on unlubricated Emcompress special, when ejection difficulty was experienced.

Weight variation was small for all materials (coefficient of variation about 0·4%) but tended to increase with increasing machine speed and with decreasing tablet thickness. At the highest speed for 5 mm tablets, there was a great increase in coefficient of variation to above 2% due to difficulty in getting the powder to flow into the dies sufficiently freely.

Surface hardness and elasticity were independent of compaction force for all five materials, once a sufficient pressure had been applied to make a good tablet (usually 180 MN m^{-2}). The hardness was greater at the centre of the face than at the periphery.

The tensile strength decreased in the order Celutab hydrous, Celutab anhydrous, Emcompress, spray-dried lactose, lactose granulation. Machine speed had little effect. Plots of tensile strength against compaction pressure for lactose, both spray-dried and in granules, were linear, as reported by Fell & Newton (1970). This linearity cannot extend indefinitely, of course, but it does appear to cover the normal range of compaction pressures.

Mean disintegration times depended upon tablet thickness and upon compaction pressure. Celutab dissolved rather than disintegrated, the anhydrous form the more rapidly. Spray-dried lactose tablets dissolved to about 40% of their initial bulk, then fragmented. Emcompress tablets require a disintegrant and only a few were tested to check that they remained unaffected by two hours immersion in water at 37°. Lactose granulation tablets took the same time to pass the mesh as did Celutab anhydrous.

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Contribution of slip and Knudsen flow to tablet permeability measurements

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A cell was constructed to measure the air permeability of tablets after ejection from the die. Measurements were made either by drawing or by blowing dry air through the tablet.

The values of the specific permeability, B_0, were found to be a function of the pressure drop across the tablet. The permeability equation of Carman and Malherbe (1950), which allows for slip flow, includes a pressure dependent term. Using a modified permeability,

$$B = e^3/k\,(1-e)^2S_0^2,$$

Carman's equation can be written as a quadratic equation in $\sqrt{B}$, i.e.,

$$\alpha B + \sqrt{B} = \beta,$$

where α and β are functions of the experimental variables and atmospheric pressure. The terms in B and $\sqrt{B}$ depend upon the contributions of slip and viscous flow respectively. Ignoring the slip flow term, B_0 can be calculated from $B_0 = e(\beta/\alpha)$, suggesting that the correct permeability should be obtained from an expression of the form, $e(B + \sqrt{B}/\alpha)$. This is a

function of pressure, but by inserting zero flow conditions at standard atmospheric pressure a non-pressure dependent permeability can be calculated, i.e.,

$$B^* = e(B + 0{\cdot}2268 \times 10^{-6}.CON.\sqrt{B}),$$

where CON is a constant dependent in part upon the Kozeny constant.

Table 1 compares values of B_0 and B* and the contribution of slip and viscous flow to B* at different flowrates and porosities for lactose tablets. The contribution of slip flow to the total flow is of the same order or greater than the contribution of viscous flow. This will lead to large errors in calculated values of S_0. The error in B_0 is sufficiently great at low porosities to require the computation of B*.

Table 1

e	$B_0.10^{15}(m^2)$	$B^*.10^{15}(m^2)$	Viscous flow	Slip flow
0·1035	0·1141	0·1285	0·0185	0·1100
0·1035	0·1324	0·1265		
0·1686	0·6078	0·6445	0·1924	0·4521
0·1686	0·6889	0·6416		
0·2809	5·667	5·731	3·310	2·421
0·2809	5·843	5·736		

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The compaction properties of potassium bromide with particular reference to infrared spectroscopy

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Potassium bromide in a range of particle sizes has been compacted in a vacuum die at various applied pressures to produce flat discs. The infrared transmittance of the discs has been measured and related to the compaction mechanism.

The material used was potassium bromide (Analar grade: B.D.H. Ltd.). It was milled, and the following size ranges (μm) were prepared by sieving: 53–90 (mean 71), 90–140 (mean 110), 355–420 (mean 388) and 500–600 (mean 550). All of these fractions were then used to make flat discs or tablets, 13 mm diameter, in a vacuum die. Compaction pressure was applied and measured by a small calibrated hydraulic press; the pressure range covered was 100–1000 MN m^{-2}. The infrared transmittance of each disc was determined on a Pye SP100 spectrophotometer, and its tensile strength was measured by diametral compression using the apparatus of Shotton & Ganderton (1960).

Lambert's law was obeyed by all the discs: plots of log (absorbance) against thickness were straight lines, plotting at constant compaction pressure. All the lines had the same slope, with the exception of the thinnest tablets at the largest particle size, where the thickness was only one or two particle diameters.

Over practically the whole pressure range, the 110 μm material gave higher transmittance. The 71, 388 and 550 μm particle sizes all scattered a greater proportion of the incident radiation. At any one particle size, the transmittance increased fairly rapidly with increasing compaction pressure, usually reaching a maximum at or about 400 MN m^{-2}. Thereafter, there was a slight fall, followed by a less-pronounced rise in the region of 1000 MN m^{-2}. This behaviour reflects the fact that in the initial compaction stages the crystals are being forced into contact and welded together: the relative density reaches about 0·99 at 400 MN m^{-2}. Additional compaction force introduces flaws into the crystals which act as scattering centres for radiation and reduce the transmittance. At 1000 MN m^{-2} these tend to heal. This is confirmed by the behaviour of the tensile strength of the discs, which also rises, for 0·5 g