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A Study on Packing of Powder Beds by Bottom Pressure Measurements

Mamoru SENNA*

A new parameter c, indicating the internal friction in the powder bed was obtained from measurements of bottom pressure. The physical meaning of this parameter was discussed together with several auxiliary experimental results including effects of wall roughness and the size of the cylinder on bottom pressure, the distribution of the bottom pressure, tapping test and direct shearing.

Applied pressure onto the surface of the powder bed packed in a cylindrical container was increased and decreased alternatively for several times to obtain a stationary state, when a linear relation between external and bottom pressures was obtained on increasing external pressure. It must be noted that this linearity was observed even with cohesive materials, although it is expected from Shaxby's equation, derived theoretically from the mechanical balance of powder beds for non cohesive particles. This finding implies a little bit different physical meaning of c from that defined originally by J. H. Shaxby.

In order to elucidate the effect of wall roughness and the influence of diameter of the cylinder on the value of c, six cylinders, having three different diameters with and without an emery cloth on the inner walls of them, were used in the bottom pressure measurements. The results showed that the larger the diameter of the cylinder, the less the relative influence of the wall on c. Thus it might be concluded that when a wide cylinder was used, the value c is acceptable as one of the quantities closely related to the internal friction between powder layers irrespective of the surface roughness. It must be mentioned, however, that the value of c with narrow cylinder is a quantity including the wall friction.

It was shown from the tapping experiments with two cylinders having different wall roughness that the rate of compaction in the tapping tests is also a function of the internal friction between powder layers.

Direct shearing was made to obtain a further theoretical account for c. An approximately linear relation between c, obtained with the wide cylinder, and cohesion was obtained so that the large values compared with the maximum value calculated theoretically according to Shaxby's assumption and Rankine's theory might be explained reasonably by the large shearing cohesion.

The distribution of the bottom pressure and the effect of apparent density on c were also examined.

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