**From Jamming to Fast Compaction Dynamics in Granular Binary Mixtures.**

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**Highlights**

* The maximal compacity can be optimized with the relative mass fraction of the components.
* The compaction is highly dependent on the size ratio of the beads.
* A jamming transition is observed close to the percolation threshold.

**1. Introduction**

The compaction of granular materials under vibrations is a popular method for powder characterization [1]. The final compacity and the typical time of compaction of a powder can be correlated to its flowability [1,2]. While the compaction dynamics is often studied with identical spheres as model particles, the polydisperse case has been poorly investigated at our knowledge.In our study, we focused on binary mixtures of spherical glass beads. We analyzed the dynamics of those systems by measuring compaction, considering both the mass fraction of small beads and the size ratio , and respectively the diameter of large and small beads.

**2. Methods**

In our study, we use the automated device GranuPack from GranuTools [1,3], illustrated on the left of the Figure 1. This instrument performs free falls of Δz and measures after each tap the height *h* of the granular column. The compacity *η* is obtained by dividing the bulk density by the true density of the material, in our case. The compaction curve is then fitted with the logarithmic law (1), as seen on the right of the Figure 1, to obtain the final compacity and the typical time of compaction .

 

**Figure 1.** (left) Sketch of the experimental setup. (right) Exemples of three typical compaction curves for *f* =0.2*.*

**3. Results and discussion**

(1)

As many studies have shown, we observe that binary granular mixtures increase their maximal compacity with the size ratio of the beads. The evolution of with *f* can be estimated by geometrical arguments [4,5], as seen on the left of Figure 2. Moreover, we observe experimentally a diverging typical time of compaction close to a critical size ratio , as shown on the right of the Figure 2. This divergence appears in the vicinity of the percolation threshold , when small particles can pass through the voids left by the large ones [6].

 

**Figure 2.** (left) Final compacity depending on the fraction of small beads *f* for different size ratios *α*. (right) Typical time of compaction depending on the size ratio for a fixed . The color code is the same for both graphics.

**4. Conclusions**

We studied the dynamics of compaction for various binary mixtures and evidenced a divergence of the typical time of compaction . This divergence seems to occur close to the percolation threshold and suggests that the jamming of the packing is maximum at this point.

**References**

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