Methodology and Experimental Procedure

1. Particles Preparation and Deposition

Prior to the experiment, the testing device was initially assembled and leveled. Afterwards, the front panel of the lower box was closed, and the upper box was mounted. Then, a funnel was placed at the top of the box, where 3,535 particles were poured and allowed to fall freely, thereby filling the container under gravity. After all particles have been deposited, the top box and the funnel are removed.

Afterward, the table was cleaned thoroughly before installing the two cameras at the top and the front of the bottom box. The initial state of the sample (particles) was recorded from the rear transparent side of the bottom box, while the initial sample height was measured. Finally, the baseboard surface above which the particles flow was wiped with a dry cloth to remove dust or debris.

2. Image Capturing and Video Recording

The digital camera oriented at the rear transparent side of the bottom box was used to capture the initial configuration of the particle bed. Meanwhile, a video camera positioned to capture the front of the setup continuously recorded the experiment from initiation through completion.

3. Methodology and flow of experiment

The experiment commences by turning on the motor, which moves the front panel upward at constant speed. Figure 1 shows the distribution of the speed velocity. The mean of four institutions is 0.0645m/s. Consequently, allows the particles to flow out of the bottom box and spread over the baseboard. Once all particles reached a stagnant state, the final configuration and distribution of particles were captured using the camera positioned at the top of the aluminum frame. Meanwhile, the rear-facing camera was used to record the final state of the sample.

4. Image Acquisition and Data Processing

After the experiment, the extent of particle spread above the baseboard was measured visually. The spread of particles over the X-Y plane was determined and analysed based on the lead edge, in the positive X direction far from the bottom box, and in the positive and negative Y directions along the center of the box.

Two types of front positions were defined and measured in each direction: the front and the bulk tips. The front tip defines the position of the furthest particle in the given direction, regardless of being connected or separated from the other particles. On the other hand, the bulk front describes the tip of the continuous main cluster of particles, excluding the isolated ones. Subsequently, all the particles were collected, and their total mass was measured to verify the mass conservation. The acquired data was organized for further analysis.

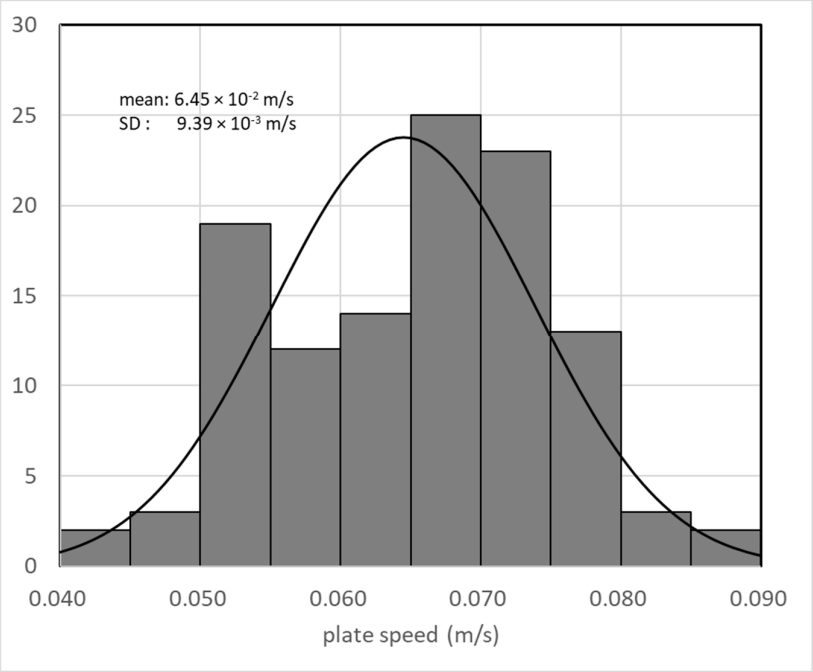

Figure 1 Distribution for plate speed including four institutions