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Influence of the weighing bar position in vessel on measurement of cement's particle size distribution by using the buoyancy weighing-bar method

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Abstract. The buoyancy weighing-bar method is a new simple and cost-effective method to determine the particle size distribution both settling and floating particle. In this method, the density change in a suspension due to particle migration is measured by weighing buoyancy against a weighing–bar hung in the suspension, and then the particle size distribution is calculated using the length of the bar and the time–course change in the mass of the bar. The apparatus of this method consists of a weighing–bar and an analytical balance with a hook for under-floor weighing. The weighing bar is used to detect the density change in suspension. In this study we investigate the influences of position of weighing bar in vessel on settling particle size distribution measurements of cement by using the buoyancy weighing-bar method. The vessel used in this experiment is graduated cylinder with the diameter of 65 mm and the position of weighing bar is in center and off center of vessel. The diameter of weighing bar in this experiment is 10 mm, and the kerosene is used as a dispersion liquids. The results obtained show that the positions of weighing bar in vessel have no significant effect on determination the cement's particle size distribution by using buoyancy weighing-bar method, and the results obtained are comparable to those measured by using settling balance method.

1. Introduction
The buoyancy weighing-bar method (BWM) is a new method in determination the particle size distribution both settling particle and floating particle [1–2]. The BWM has been proven capable to measure size distribution of some particles and the results are proportional to those measured by sedimentation balance method, centifugal sedimentation method, laser diffraction method, Coulter counter method and microscopy method [3–7]. In addition, to estimate the size distribution measurement of fine particles, the BWM could be combinated with the Rosin-Rammler equation [8]. Besides, the particle size distribution also can be measured in Allen region by using BWM [9]. In this research, the BWM is used to determine particle size distribution of cement by investigating the influences of weighing bar position in vessel. The principal of this method that the density change in a suspension due to particle migration is measured by weighing buoyancy against a weighing–bar hung in the suspension, and the particle size distribution is calculated using the length of the bar and the time–course change in the mass of the bar [1–2, 10–11]. In this study, the initial buoyant mass of the weighing-bar depends on the particles between the top and bottom of the weighing-bar in kerosene as suspension.

2. Material and Methods

Figure 1 schematically illustrates the experiment. The weighing–tools is weighing–bar (diameter: 10 mm, length: 210.0 mm, submerged length: 200.0 mm) which is composed of aluminum (density: 2700 kg/m^3). The analytical balance (minimum readout mass 0.1 mg) have a below–balance–weighing hook for hanging measurement. The sample material is cement (density: 2500 kg/m^3). The particle suspension is placed in a vessel. Vessel used in this experiment is graduated cylinders with diameter of 65 mm and volume of 1000 ml. The position of weighing bar are in center and off center of vessel. In this experiment, kerosene is used as the dispersion liquids. The suspensions have a solid concentration of 10 kg/m^3 (ca. 1 wt.%) [12]. To prepare a suspension, a 1000 ml liquid and the particles to be tested are mixed in a glass cylinder. Using a hanging wire, which does not extend due to the weight of the weighing-bar, the weighing-bar is hung from the analytical balance. The room temperature is approximately 298 K. After thoroughly stirring the suspension using an agitator, the weighing-bar is set with the balance. The measuring data, which consist of time and the corresponding mass of the bar $_B$, are recorded. The measuring time is less than two hours and the data are collected every 60–second intervals. After the measurement, the particle size distribution is calculated based on the theory [1-2, 10-11]. As comparison method, the particle size distributions are also measured by using the settling balance method.

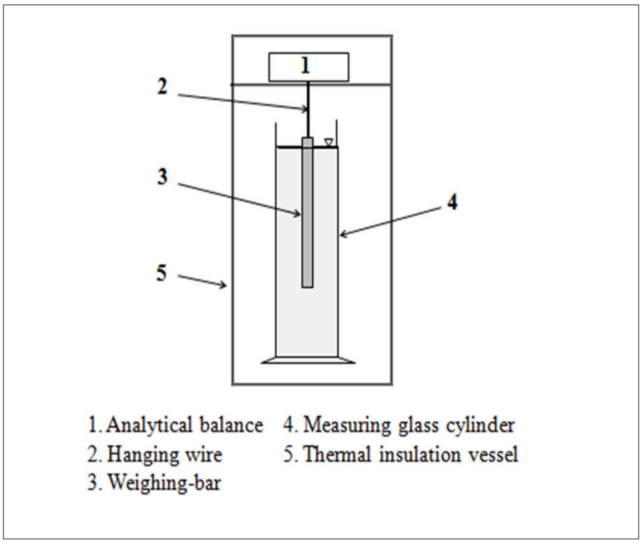

Figure 1. Illustration of the experimental apparatus

3. Results and Discussion

Figure 2 shows the change with time in the apparent mass of weighing-bar the when the position of weighing bar in the center of vessel.

The figure 2 shows that the apparent mass of the weighing-bar increase until all the cement particles settle below the lower end of the weighing-bar, and then the apparent mass of the weighing-bar become constant. The change in the apparent mass is due to the change in the buoyant mass against the weighing-bar as well as particle settling.

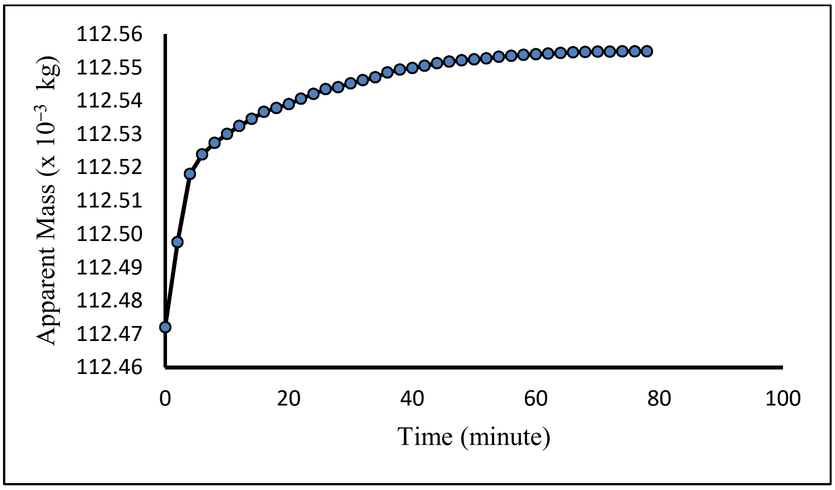

Figure 2. Apparent mass of the weighing-bar as a function of time when the position of weighing bar in the center of vessel

Figure 3 shows the change with time in the apparent mass of weighing-bar the when the position of weighing bar in the off center of vessel. Similar to figure 2, the figure 3 shows that the apparent mass of the weighing-bar increase until all the cement particles settle below the lower end of the weighing-bar, and then the apparent mass of the weighing-bar become constant. The change in the apparent mass is due to the change in the buoyant mass against the weighing-bar as well as particle settling.

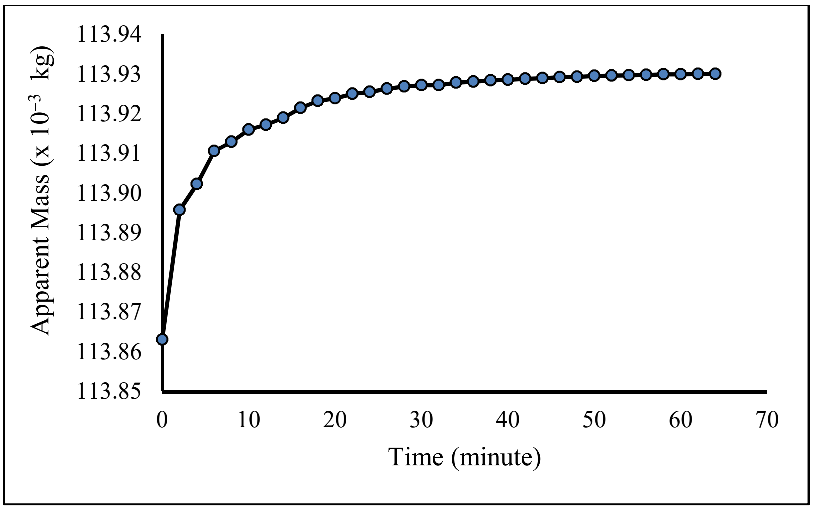

Figure 3. Apparent mass of the weighing-bar as a function of time when the position of weighing bar in the off center of vessel

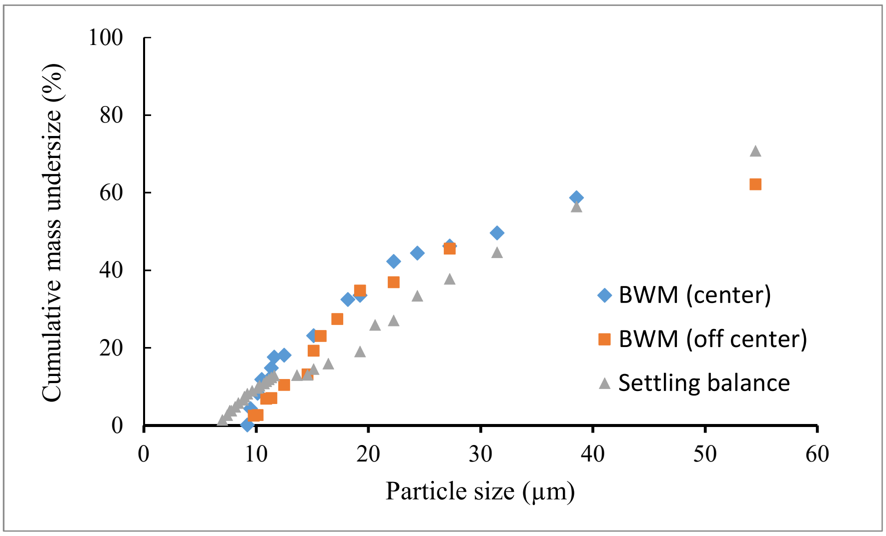

Figure 4. Particle size distributions measurement of cement using kerosene as liquid

Figure 4 shows the influence of the weighing bar position on settling particle size distribution measurements of cement by using BWM. In this experiment, the liquid used is kerosene and the samples are sieved by using sieve tray 80 mesh, but does not pass through sieve tray 140 mesh. The results show that the particle size distribution measured using the weighing bar in the center of vessel is simililar to that the particle size distribution measured using the weighing bar in the off center of vessel, and the results are comparable to those measured by settling balance method. Hence, the location of the weighing bar does not influence the particle size distributions of cement by using kerosene as liquid.

4. Conclusions

The study investigates the influences of position of weighing bar in vessel on settling particle size distribution measurements of cement by using the BWM. The conclusions of this study are:

1. The particle size distribution of cement could be measured by BWM using kerosene as liquid, and the particle size distribution obtained are proportional to those measured by settling balance method.
2. The particle size distribution measured by BWM using the weighing bar in the center of vessel is close to that the particle size distribution measured using the weighing bar in the off center of vessel.

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