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PARTICULATE LAB PROJECT

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SEDIMENTATION ANALYSIS OF MARBLE & CHALK PARTICLES

ABSTRACT:

Sedimentation is a process used to separate particles based on their density and size. This experiment aimed to analyze the sedimentation behavior of marble and chalk particles. The effect of particle size and density on sedimentation was investigated. The critical height of the clear liquid above the settled particles was measured after 24 hours.

INTRODUCTION:

Sedimentation is a widely used process in various industrial and environmental applications, such as water treatment, mining, and pharmaceuticals. Understanding the sedimentation behavior of particles is crucial for optimizing these processes. This experiment aimed to study the sedimentation behavior of marble and chalk particles.

MATERIALS & EQUIPMENTS:

- **Powder marble**
- **Powder chalk**
- **Sedimentation tank**
- **Sieve analyzer**

METHODS:

The experiment was conducted in two stages:

INITIAL EXPERIMENT:

1. 50g of powder marble was sieved using a sieve analyzer with a mesh size of 45mm.

2. A 50g sample was taken, and a slurry was created with 1 liter of water.

3. The slurry was placed in a sedimentation tank, and the initial height was noted.

4. However, due to the high density of marble particles, they settled immediately, making it impossible to note the readings.

MODIFIED EXPERIMENT:

1. Powder marble was mixed with powder chalk, and the mixture was sieved using a sieve analyzer with a mesh size of 45mm.

2. A 50g sample was taken, and a slurry was created with 1 liter of water.

3. The slurry was placed in a sedimentation tank, and the initial height was noted.

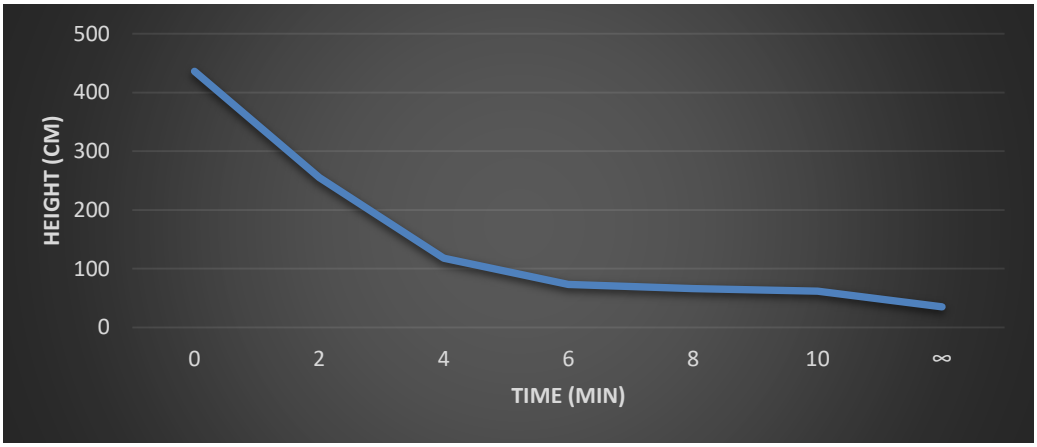
4. Readings were taken at regular intervals of 2,2 minutes.

5. The tank was left undisturbed for 24 hours to allow the particles to settle completely.

RESULTS:

TIME(min)	0 min	2min	4min	6min	8min	10min	∞
HEIGHT(cm)	436cm	255cm	118cm	73cm	66cm	62cm	35cm

CRITICAL HEIGHT = 400cm



THICKENER DESIGN:

Feed = 1L

Mass of sample = 50g

Feed solid concentration = 5%

Clear liquid zone (LC_L) = 400cm

= 0.4m

Compression zone (C_D) =36.5cm

= 0.365m

SETTLING VELOCITY (V_C):

$$V = \int_{10}^{2} \left[\frac{1}{CL}\right] dt$$

$$V = \frac{Height\ at\ 2min - Height\ at\ 10min}{2 - 10}$$

$$V = \frac{255 - 62}{8}$$

$$V = 24.375\ cm/min$$

$$V = 0.2437\ m/min$$

THICKENER AREA (A_r):

$$\frac{LCL}{Ar} = \frac{X}{\frac{1}{CL} - \frac{1}{CD}}$$

Let assume,

X = 1

C_L = 4m

C_D = 0.365m

$$\frac{4}{Ar} = \frac{1}{\frac{1}{4} - \frac{1}{0.365}}$$

$$A_r = 9.95m^2$$

DIAMETER OF THICKENER (Dia):

$$D = \sqrt{(4 \times \frac{A_r}{\pi})}$$

$$D = \sqrt{4} \times \frac{9.95}{\pi}$$

$$D = 3.56m$$

HEIGHT OF THICKENER (H):

$$Height = LC_L + Compression\ zone\ height + Clear\ liquid\ height + Bubble\ zone\ height + Allowances$$

Assume allowance = 1.5m

$$H = 4 + 0.365 + 0.64 + 1.5$$

$$H = 6m$$

DISCUSSION:

The results show that the mixture of marble and chalk particles settled gradually over time. The critical height was noted after 24 hours, indicating the complete settling of particles. The sedimentation process can be divided into three zones:

CRITICAL HEIGHT:

The critical height refers to the height of the clear liquid (supernatant) above the settled particles after a prolonged period, usually 24 hours. It's the point where the settling process is complete, and the particles have reached their final position.

COMPRESSION ZONE:

The compression zone, also known as the compression layer, is the layer of particles that have settled at the bottom of the tank. The height of the compression zone is not the critical height.

BUBBLES ON CLEAR LIQUID:

The bubbles appearing on the surface of the clear liquid are likely due to the decomposition of chalk (calcium carbonate) in water, releasing carbon dioxide gas. This reaction can cause bubbles to form:

$CaCO_3$ (chalk) + H_2O (water) $\rightarrow$ $Ca(OH)_2$ + CO_2 (carbon dioxide)

CONCLUSION:

In conclusion, this experiment successfully demonstrated the sedimentation behavior of marble and chalk particles. The results provide valuable insights into the settling process and can be applied to various industrial and environmental applications. However, further experiments are needed to investigate the effect of particle size and density on sedimentation.