Student's Card

Gold panning for beginners

General Introduction

This toolkit helps teachers to demonstrate and students to understand a diverse mineral processing method, the separation based on density, through an interesting application, using only a simple physical property of materials. With the help of the experiment, it will be easy to distinguish between a high and low density material, even if the actual densities are unknown.
The target age group is 10 years and older students, as no chemicals are needed, and the experiments can be done in a few very easy steps:

- The two materials with unknown densities should be thoroughly mixed and put in the gold pan
- Put water in a bowl or basin that is bigger than the gold pan, then carry out the separation of the materials

Density is one of the basic physical properties of materials, which is determined by the mass and the volume of the material. In case of mixed primary raw materials, the density of the mixed materials is one of the most important property that can help with the separation. Thus, the useful material can be separated from the not useful gangue. The density based separation is the basis for gold panning as well.

Keywords:

Sustainability, Recycling, Hazardous waste

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Extended background information

The definition of density

Density is the substance's mass per unit of volume. There is a linear relationship between the mass and the volume, which means that if the density stays the same, but the volume is doubled, the mass of the material will double as well.

Various different material pairing can be used in the toolkit, but they have to meet two important criteria: the size of both materials has to be similar (very small), and the density difference should be notable, so that the separation would be easier.

The Greek ρ (rho) is used to illustrate density, the measurement unit can be e.g. g/cm^3 or kg/m^3. The density of different materials can be calculated with the following formula:

$$\rho = \frac{m}{V}$$

where ρ – density
m – mass
V – volume

This means that if the volume of two materials is the same, the one with the higher mass will have higher density, but in the case of two materials with the same mass, the one with lower volume will have higher density.

The conversion of the measurement units can be done as follows:

$$1\frac{g}{cm^3} = 1\frac{kg}{dm^3} = 1000\frac{kg}{m^3}$$

Thus 1 kg/m^3 = 0.001 g/cm^3
1 kg/m^3 = 0.001 kg/dm^3
1 kg/dm^3 = 1 g/cm^3

Can we use density based separation for raw material processing?

During the processing of primary raw materials, numerous dry and wet methods can be used to separate the constituents based on the difference in density. This step is important for the proper preparation of the raw material, as in most cases, not only the useful ore is mined, but the ensuing rock formation, the gangue material as well. Thus, we should be able to separate the useful and not useful parts of the mined material, as the gangue will decrease the quality and applicability of the final product.

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For example, in case of coal mining, the separation of the gangue is of utmost importance, as having gangue in the final product would greatly decrease the energetic (calorific) value of the coal during burning. On the other hand, as a result of the continuous technological development, we can re-process old mining waste-heaps to recover even more coal, which could not be extracted in the past using older technologies. Thus, not only further raw materials can be obtained, but the amount of waste heaps can be decreased as well, which is also favourable for environmental protection.

The density of some solids

- Basalt: 3.0 g/cm^3
- Brick: 2.5 g/cm^3
- Cement: 1.44 g/cm^3
- Clay: 1.38 g/cm^3
- Concrete: 2.4 g/cm^3
- Copper: 8.92 g/cm^3
- Glass: 2.6 g/cm^3
- Gold: 19.3 g/cm^3
- Gypsum: 2.32 g/cm^3
- Iron: 7.86 g/cm^3
- Magnesium: 1.74 g/cm^3
- Pyrite: 5.03 g/cm^3
- Quartz: 2.65 g/cm^3
- Salt: 2.15 g/cm^3
- Sand: 1.2 g/cm^3
- Silver: 10.5 g/cm^3

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Laboratory work

List of tools

- Mixing bowl
- Mixing spoon
- Gold pan
- Bigger bowl or basin for water

Laboratory work

During the experiment, the separation of two fine particle sized material with different densities can be practiced. The first step is to measure approximately the same amount of the two materials (~50-50 g) from both fine-sized materials, and thoroughly mix it together. Then put a small amount od mixture in the gold pan.

Put water in the bigger bowl / basin.

Add a small amount of water to the gold pan by submerging it in the water, but be careful so that the material mixture could not leave the pan. By moving the pan back and forth, or in a circular motion, the separation of the two materials can already be seen. The higher density material sinks down to the bottom of the pan and the lower density will move to the top of the material bed. As soon as this process starts, by slightly tilting the pan towards the ridged part. The lower density particles will start to leave the pan, but the ridges will help to retain the higher density particles.

Add fresh water to the pan and repeat the steps until most of the lower density material is removed from the gold pan.

Additional safety information

There are no chemicals or dangerous materials involved in this experiment. The use of protective equipment is not necessary.

Calculations

There are no calculations for this experiment.

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