Processing: Chemical Reactions

Lab Manual – Gr. 10

Part 1: Sort a Mixture

Materials:

- Soil sample
- Sifters
- Vinegar dropper bottle
- Water
- Glass container

Personal Protective Equipment:

- Goggles
- Gloves

You have a soil sample which contains waste, called tailings, from a mine site which is extracting limestone. Large slabs of limestone can be sold, but in order to reduce waste, smaller samples of limestone are going to be extracted from the tailings and processed into lime. That lime will be used to restore the soil when we move on from this mine site.

Your first task is to sort the limestone from the tailings.

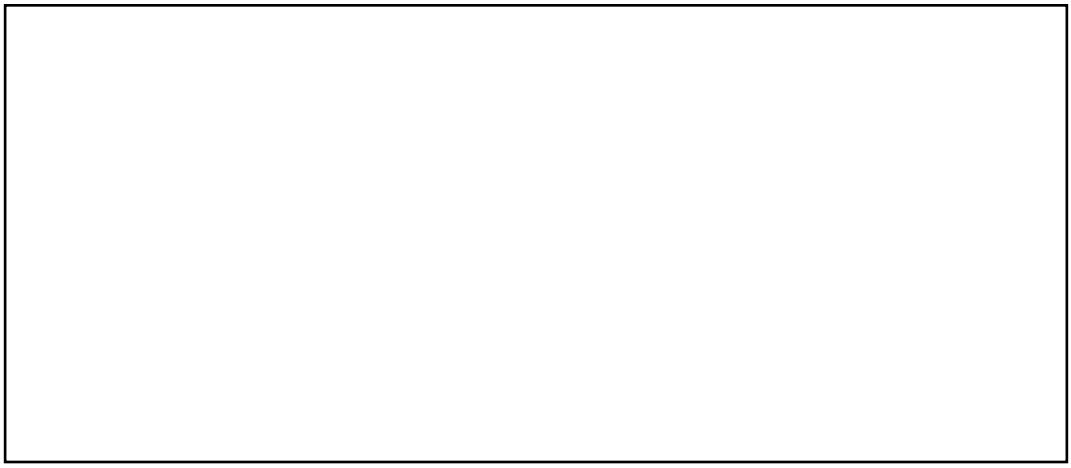
1. What safety equipment do you need to wear?

   _____

Steps:

A. Put your sifter over your container.
B. Pour your soil sample into the sifter.
C. Wiggle and bounce your sifter until the soil has all been sifted out.

2. What do you observe in your sifter? Draw your observations.



D. Discard your soil in the compost.
E. Rinse your container clean.
F. Put your remaining rock sample in the class container and rinse them clean.

We need to figure out which rock is limestone, and which is just rock. Limestone is usually:

- Grey, white, yellow, or brown
- Soft (can be scratched easily)
- Reacts with acid

G. Scratch rocks against each other to test their softness.
H. Separate the ones you think are limestone.
I. On each pebble you predict to be limestone, drop a single droplet from your vinegar dropper bottle.
J. Test each pebble. If it reacts with the vinegar, it is limestone.
K. Sort your limestone and your pebbles into two separate piles.
L. Discard the pebbles outdoors.

3. What happens when vinegar touches limestone?

_____

4. Is each reaction physical or chemical? How can you tell?
    a. Scratching rocks:

_____

_____

b. Vinegar and rocks:

_____

_____

Part 2: Refine the Product

Materials:

- Vinegar
- Glass container
- Limestone sample
- Stir stick
- Indicator

Personal Protective Equipment:

- Goggles
- Gloves

We still need to process our limestone into lime. We already know that limestone reacts with vinegar.

The chemical formula for vinegar is CH_3COOH. The chemical formula for limestone is $CaCO_3$.

This reaction creates water, carbon dioxide, and lime. The chemical formula for water is H_2O. The chemical formula for carbon dioxide is CO_2. The chemical formula for lime is $Ca(CH_3COO)_2$.

1. What is the unbalanced equation for this reaction?

   _____

2. How many of each element are on the left hand side of the equation?
   a. Carbon: _____
   b. Hydrogen: _____
   c. Oxygen: _____
   d. Calcium: _____

3. How many of each element are on the right hand side of the equation?
    a. Carbon: _____
    b. Hydrogen: _____
    c. Oxygen: _____
    d. Calcium: _____

4. What is the balanced equation for this reaction?

    _____

The carbon dioxide escapes as the bubbles we see in that reaction. What is left will be a lime solution.

<u>Steps:</u>

A. Put a pebble of limestone into your glass container.
B. Fill the glass container with enough vinegar to cover your pebble.
C. Leave overnight to dissolve.

5. Is this a chemical or a physical reaction? How can you tell?
    _____
    _____
    _____

D. Use your indicator to test the acidity of your sample.
E. Add and dissolve limestone until your sample is neutral.

6. Is each of these substances an acid or a base?
    a. Vinegar: acid / base
    b. Lime: acid / base

Part 3: Isolate the Product

Materials:

- Glass container
- Hot plate
- Lime solution

Personal Protective Equipment:

- Goggles
- Gloves

The lime has been refined from limestone, but it is still in solution, which means it is dissolved in water. We want our lime to be in a solid state. That means there is one step still left in the processing phase.

Steps:

A. Plug in and turn on the hot plate.
B. Put your glass container with the lime solution in it on the hot plate.
C. Bring your lime solution to a boil.
D. Let it boil until there is a thick slurry in the container.

7. Is this a chemical or a physical reaction? How can you tell?
   _____
   _____
   _____

Without more specialized equipment, we cannot completely dry the lime solution. The final step would be to put our slurry in a dehydrator for many, many hours. At that stage, we would have a fine powder.

Congratulations! We have produced lime powder which our mine can use in order to restore the soil when our operations are done.

1. Is the final product neutral, acidic, or basic? How do you know?

   _____
   _____
   _____

2. What would the environmental impact of this process by on a large scale?

   _____
   _____
   _____

3. Lime can be used to restore acidic soil, making it an important substance for environmental remediation. However, its production releases CO_2 into the atmosphere. What other refining processes do we currently need to help the environment which also come at a cost?

   _____
   _____
   _____