Chemical Changes

Introduction

Chemical changes occur around us all the time. Perhaps one of the most common chemical changes that we have seen for a number of years is the destruction of marble and limestone sculptures by acid rain. The acid rain comes about by the reactions of various oxides of sulfur (di- and tri-oxides) and nitrogen (oxide and di-oxide) with the water from rain, e.g., (reactions representative and not necessarily balanced):

$$SO_2 + H_2O \rightarrow H_2SO_3$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

$$NO + H_2O \rightarrow HNO_2$$

$$NO_2 + H_2O \rightarrow HNO_3$$

producing sulfurous, sulfuric, nitrous and nitric acids, respectively.

The sources of these oxides are auto emissions and some factory emissions.

An example of a change in physical property is the solvation of table salt in water. Table salt in the box is a solid and can be identified by one of its physical properties: taste.

If the salt is dissolved in water, it has only ionized in the water (much like it does on your tongue when you taste it) and not been destroyed. The salt, therefore, has only undergone a physical change -- with evaporation, it will be recovered in the same form with which you started.

This physical change is different from a chemical change in that with chemical changes, it is not always possible to recover that which you had, e.g., marble statues destroyed by acid rain.

Experimental

Obtain the following as you need them, keeping in mind that your instructor will demonstrate some of these experiments in the interest of time and safety:

Copper wire	Magnesium strip	Matches
Concentrated nitric acid	6 M sodium hydroxide	Concentrated sulfuric acid
Iodine crystals	crucibles	6 M hydrochloric acid
100 mL beaker	charcoal	Potassium nitrate
Sulfur flowers	Gun powder	Ruler
4 disposable test tubes	Red and blue litmus paper	Crucible tongs

Instructor Demonstrated Experiments

Experiment 1

Examine a sample of iodine crystals in the evaporating dish that your instructor has prepared.

1) What color are the crystals?

Observe what happens after the evaporating dish is placed on the hot plate.

1) What happened to the iodine as it was heated up?

2) Is this (HINT: sublimation) a physical or chemical change?

Experiment 2

Examine a small strip of magnesium metal. Describe, below, how it looks.

Your instructor is going to light it and burn it. Do NOT look directly at the burning strip -- use your peripheral vision.

1) Describe the strip after it was burned.

2) Is this a physical change or a chemical change?

Experiment 3

Examine the container of charcoal as it is passed around. Do not shake it or stick your nose in it. What does it look like?

Examine the container of potassium nitrate as it is passed around. What does it look like?

Examine the container of sulfur flowers as it is passed around? What does it look like? What does it smell like?

Examine the container of black gun powder as it is passed around. What does it look like? Is this a physical or chemical change?

Your instructor will ignite a sample of the gun powder. Give about 8 feet of space around the container. What happened? Is this a chemical change or a physical change?

Experiment 4

Your instructor will pour a small amount of 6 M hydrochloric acid into a test tube and a small amount of 6 M sodium hydroxide into another test tube. In the table, below, record the results of the effects of these 2 solutions on red and blue litmus:

	6 M HCl	6M NaOH
Red litmus		
Blue litmus		

Are these changes chemical or physical changes? HINT: litmus is a dye.

Student Performed Experiment

Obtain a 10-cm piece of wire and roll it into a flat loop. Place it into a 100-mL beaker, take it to a hood and add about 5 mL concentrated nitric acid IN THE HOOD.

1) Describe the copper wire.

2) Describe the nitric acid.

3) Describe the reaction mixture.

4) Describe the final product.

To this final solution, when there are no more brown vapors being emitted, add 50 mL 6 M NaOH slowly and without stirring. You may do this part at your lab bench.

1) Describe what happens as you are pouring the sodium hydroxide into the solution.

2) Now stir the reaction mixture. What happened?

Heat the reaction mixture on the hot plate for 10-20 minutes. Be careful to not let it get so hot so as to "bump", "spatter" or bounce off the hot plate. What happened?

Remove your sample from the hot plate and take it to your work area. Let the solid settle to the bottom and pour off the liquid (supernatant). To the remaining solid, add 25 mL water and SLOWLY add enough concentrated sulfuric acid to dissolve the solid. What happened to the mixture?

Slowly add about a pea-sized amount of mossy zinc to this solution. What happens?

After a short period of time, e.g. 3-6 minutes, what changes are occurring in the mixture? What is settling out in the mixture? Describe the solid.

References

1. Neal, R.E.: Short Laboratory Course in General Chemistry (Macmillan: NY) © 1932, p.5.
2. Roberts, J.L., Hollenberg, J.L. and Postma, J.M.: General Chemistry in the Laboratory, 3d Ed. (Freeman: NY) © 1991, p. 61.

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