Chemical Pigments Experiment

Key Stage 3

Introduction

A pigment is a small particle that does not dissolve in water. The light from the sun gets selectively absorbed by the pigment, and the colour reflected is the colour we see. This physical process is different from fluorescence, phosphorescence, and other forms of luminescence, in which the material itself emits light.

Materials that humans have chosen and developed for use as pigments usually have special properties that make them ideal for colouring other materials. A pigment must have a high tinting strength relative to the materials it colours. It must be stable in solid form at ambient temperatures.

For industrial applications, as well as in the arts, permanence and stability are desirable properties. Pigments that are not permanent are called fugitive. Fugitive pigments fade over time, or with exposure to light, while some eventually blacken.

Pigments are used for colouring paint, ink, plastic, fabric, cosmetics, food and other materials. Most pigments used in manufacturing and the visual arts are dry colourants, usually ground into a fine powder. This powder is added to a vehicle (or matrix), a relatively neutral or colourless material that acts as a binder.

A distinction is usually made between a pigment, which is insoluble in the solvent, and a dye, which is either a liquid, or is soluble in its solvent. A colourant can be both a pigment and a dye depending on the vehicle it is used in. In some cases, a pigment can be manufactured from a dye by precipitating a soluble dye with a metallic salt. The resulting pigment is called a lake pigment.

In this practical experiment, you will be making 3 different chemical pigments, Prussian Blue, Malachite Green and Cobalt Violet.
Practical
As with all chemicals they should not be swallowed. Cobalt chloride is a listed carcinogen by inhalation. Gloves should be worn to prevent skin contact (pigments will stain). Safety glasses and lab coats (aprons) should be worn at all times.

There are 6 different solutions. Check labels when you mix them together!!

- Iron(III) chloride – FeCl₃
- Potassium ferrocyanide – K₄[Fe(CN)₆]
- Copper sulfate – CuSO₄·5H₂O
- Sodium carbonate - Na₂CO₃
- Cobalt chloride solution
- Disodium hydrogen phosphate – Na₂HPO₄

To make Prussian Blue:
1. Measure 50ml of potassium ferrocyanide and put it in a beaker.
2. Use a different measuring cylinder or rinse the one you have, and measure 50ml of iron chloride.
3. Add this to the beaker containing the potassium ferrocyanide.
4. Observe what happens.
5. Flute a piece of filter paper so that it fits into the funnel. Put the funnel into the conical flask.
6. Pour the solution into the funnel slowly.
7. If there is any pigment left at the bottom of the flask, use a little water and swirl around flask. Filter this solution too.
8. Leave the pigment to dry in the evaporating dish.

To make Malachite Green:
1. Measure 50ml of sodium carbonate and put it in a beaker.
2. Use a different measuring cylinder or rinse the one you have, and measure 50ml of copper sulfate.
3. Add this to the beaker containing the sodium carbonate.
4. Observe what happens.
5. Filter and dry by the same method as for Prussian Blue.

To make Cobalt Violet:
1. Measure 50ml of disodium hydrogen phosphate and put it in a beaker.
2. Use a different measuring cylinder or rinse the one you have, and measure 50ml of cobalt chloride.
3. Add this to the beaker containing the disodium hydrogen phosphate.
4. Observe what happens.
5. Filter and dry by the same method as for Prussian Blue.

Questions

1) What did you observe when mixing the two solutions to make Prussian Blue?

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2) What did you observe when mixing the two solutions to make Malachite Green that did not happen when you made the other pigments?

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3) What caused this effect?

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4) In the pigments, it is usually the type of metal that makes them coloured.
Name the metals present in the 3 pigments you have made

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