Extracting copper from malachite

Oxidation and reduction both occur together. If one substance is oxidized, another is reduced. A process where oxidation and reduction are taking place together is called Redox Reaction. An example is shown below for my explanation-

If I take a mixture of Lead Oxide and Carbon heated together, the following reactions shall take place-

Pbo (s) Pb(s) + CO (g)

Lead Oxide + Carbon Lead + Carbon Monoxide

In the above reaction, Lead Oxide is losing oxygen and forming lead. Lead oxide is, therefore, being reduced. Carbon is gaining oxygen when it forms Carbon Monoxide: Carbon is being oxidized. Oxidation and reduction are both taking place. This is called a Redox Reaction.

Carbon is the substance which is necessary for the reduction to take place because it removes the oxygen. Carbon is called the oxidizing agent. A reducing agent is a substance which reduces some other substances but it is itself oxidized.

Common reducing agents include Hydrogen, Carbon, Carbon Monoxide and metals.

Common Oxidizing agents include Oxygen, Chlorine, and concentrated Sulphuric acid and concentrated Nitric acid.

Method

1. I had placed 5g of Malachite powder into a large test tube and had heated it gently until it turns black and stops rising in the test tube.

2. I had then, allowed the test tube to cool for a while.

3. Then I had, added 4g of Carbon powder and had mixed it well.

4. Then I had, heated the mixture strongly until it had turned red.

5. Then I had, left the mixture to cool for a while again.

6. Then I had, separated the Copper from the waste by half filling the test tube with water and then pouring the mixture into a beaker of cold water.

7. Then I had left it for 2 minutes and had poured off the dirty water.

8. Then I had kept on adding cold water to the mixture and pouring off the dirty water till I saw the pink Copper at the bottom of the test tube.

9. Then I had, placed the Copper onto the filter paper to make it dry. Then I had measure out the mass of the dried Copper. This is known as the Actual yield.

10. Then lastly, I had calculated the percentage yield.

Shown below are some equations related to this reaction-

2CuCO3 2Cuo + 2Co2

2Cuo + C 2Cu + Co2

Safety

* I had worn goggles while using the Bunsen burner.

* I was careful while using the Malachite powder as it was labelled harmful.

* Long hair of were tied back wile using the Bunsen burner.

* While I was dealing with the Copper Carbonate I was careful as it s an irritant.

* I was careful while handling the test tube.

* Hands were washed before and after the experiment.

Equipment

* Malachite powder.

* Carbon.

* Test tube.

* Large Beaker.

* Filter paper.

* Bunsen burner.

* Bunsen stand.

* Glass rod.

Conclusion

Calculation of the cost-

Copper Carbonate = ï¿½10. 20p per 500g 4g = 0. 02

Carbon = ï¿½2 per 500g 4g = 0. 02

Test tube = 0. 18

Beaker = 2. 00

Gas = 0. 80p per hour 1/2hr = 0. 40

Labour = ï¿½10. 00 per hr 1 hour = 10. 00

Filter paper = ï¿½1. 30 for 100 1 = 0. 13

Total cost = ï¿½14. 01

We made = 0. 07g

Per gram = 14. 01/ 0. 07 = ï¿½2. 14p

Results

Calculation of the yield-

Relative Atomic mass = Copper = 63. 5g

Oxygen = 16g

Carbon = 12g

Relative molecular mass for Copper Carbonate CuCo3 = 63. 5 + (3×16) = 63. 5 + 48 = 123. 5g

123. 5g of Copper Carbonate should make 63. 5 of copper.

5g of Copper Carbonate was used.

Theoretical yield = 5 x 63. 5 / 123. 5 = 2. 57g of copper.

Actual yield = 0. 07 / 2. 57 x 100 = 2. 57%.

Some other important equation used in the experiment as given below-

Copper Carbonate Copper Oxide + Carbon di Oxide

2CuCo3 2Cuo + 2Co2

Copper Oxide + Carbon Copper + Carbon di Oxide

Cuo + C Cu + Co2

Evaluation

The reason why we didn’t get 100% yield is mentioned below-

* Firstly, when I had to measure out the Carbon and the Malachite powder I could have made a mistake in mistake which would have lead my experiment inaccurate.

* Secondly, while I was heating the test tube some of the Malachite powder could have popped out while it was raising, again leading my experiment inaccurate.

* Thirdly, while I was separating the Copper from its waste, some of the Copper might have been thrown down the drain while I was throwing away the dirty water until I could see the Pink copper at the bottom of the test tube.

* Lastly, when I was to put the dried Copper onto the filter paper some of it might have remained in the test tube.

Vocational Aspects

In the industry, they would use an easier and much simpler way of extracting copper as they would heat it u in a blast furnace and they would have a lot more people doing this job.

This way it would be much easier and quicker to do their job because there would be a lot more people doing the same job. They would have a small place for heating things up and it would be a lot cheaper. The industrial processes are described below-

* Crush the ore into 25cm pieces.

* Using water and a 13cm steel ball the ore is ground into 1cm pieces.

* Froth floatation concentration the ore with unwanted rock setting out.

* Copper ore is then burnt with oxygen in a flash furnace to produce matte.

* The iron is taken off as a slag. Sulphur then comes off as Sulphur dioxide.

* The copper melt is cast into anodes.

* Anodes in copper sulphate are electro and are the refined.

Blast Furnace

The purpose of a blast furnace is to chemically reduce and physically convert iron oxides into liquid iron called ‘ Hot Metal’. The blast furnace is huge, steel

stack lined with refractory brick, where iron ore, coke and limestone are dumped into the top, and preheated air is blown into the bottom. The raw material requires around 6- 8 hours to descend to the bottom of the furnace where they become the final product of liquid slag and liquid iron. These liquid products are drained from the furnace at regular intervals. The hot air that was blown into the bottom of the furnaces ascends to the top in 6- 8 hours after going through numerous chemical reactions. Once a blast furnace is started, it will continuously run for four to ten years with a short stop for maintenance.

Image for Blast Furnace

Definitions related to Extraction

Metallurgy – This is a process that involves the extraction of metals from their ores and refining them is known as Metallurgy.

Minerals – The natural material in which the metals or their compounds occur in the earth are called minerals.

Ores – Those minerals from which the metals can be extracted profitably are called Ores.

Gangue – The rocky impurities and earthly particles, present in an ore are called Gangue.

Extraction of Aluminium

Aluminium is extracted from purified Aluminium oxide by electrolysis. However, Aluminium Oxide has a high melting point and is readily not soluble in water.

Aluminium Extraction

At the working temperature of the cell, the oxygen reacts with the Carbon of the anode to produce the Carbon di oxide. The anode therefore, has to be replaced frequently. At this process it requires a large amount of electricity which is an inexpensive source.