

# Chemistry

## Laboratory report 3 – Oxygen absorber

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Title of the experiment: Oxygen absorber

Aims: To analyse qualitative an oxygen absorber sample taken from moon cake package.

Introduction: In a moon cake package, there is often a packet of oxygen absorber provided with each moon cake. In this experiment, we will plan and carry out an investigation to find out the chemical nature of the oxygen absorber.

### Perparation

Before having the experiment, we have searched for the information about the chemical principles of oxygen absorber. We have found that iron powder and sodium chloride are the major components of the oxygen absorber. Some of the oxygen absorber may also contains sodium carbonate.

### Safety precaution

We should wear the safety gown and the goggles during the experiment. We should not contact with chemicals directly. For the reactions which can produce toxic gas, they should be done in the fume cupboard.

### Materials and apparatus

$K_3Fe(CN)_6$  (aq) ( rust indicator ), 1M  $H_2SO_4$  (aq),  
0.4M NaOH (aq), 1M HCl (aq), conc. HCl (aq),  
0.001M  $K_2Cr_2O_7$  (aq), 0.1M  $HNO_3$  (aq), 0.05M  $AgNO_3$  (aq),  
0.5M  $NH_3$  (aq), lime water

Test tubes, test tube rack, test tube holder, spatula, Bunsen burner, fireproof mat, evaporating dish, wooden splint, nichrome wire, tongs, watch glass, delivery tube, droppers, oxygen absorber for food packaging

## Procedure

### Test for iron:

1. The magnet had been used to attract the oxygen absorber.
2.  $\text{K}_3\text{Fe}(\text{CN})_6$  (aq) was added to the sample and the colour change was observed.
3.  $1\text{M H}_2\text{SO}_4$  (aq) was added to the sample. Then,  $0.4\text{M NaOH}$  (aq) was also added and changes had been recorded. After that, the excess  $\text{NaOH}$  was added to the solution.
4.  $1\text{M HCl}$  (aq) was added to the sample and  $0.001\text{M K}_2\text{Cr}_2\text{O}_7$  (aq) was then be added drop by drop. Any changes had been observed.  $0.4\text{M NaOH}$  (aq) was added to the resulting solution. The change had been recorded
5.  $1\text{M H}_2\text{SO}_4$  (aq) was added to the sample. Colourless gas was given out. A wooden splint was then be used to test for the gas.

### Test for $\text{Na}^+$ :

1. The cleaned nichrome wire was dipped into the conc.  $\text{HCl}$  (aq).
2. Then, the same nichrome wire was dipped to the sample.
3. The nichrome wire was put to the Bunsen burner. The flame colour had been observed.

### Test for $\text{Cl}^-$

1.  $0.05\text{M AgNO}_3$  (aq) was added to the test tube which contains the sample. The change was observed.
2. Then,  $0.1\text{M HNO}_3$  (aq) is added to the resulting solution in 1. Any of changes had been marked.
3. Finally,  $0.5\text{M NH}_3$  (aq) was added to the solution from 2. The change had been recorded.

### Test for $\text{CO}_3^{2-}$

1.  $1\text{M HCl}$  (aq) was added to the test tube containing the sample.
2. Colourless gas was formed. The gas was then passed though the delivery tube to another test tube containing lime water.
3. The end of test tube which the  $\text{HCl}$  added was then heated by Bunsen burner for a faster gas evolution. The result was recorded.

## Results and observation

### For the iron:

#### Physical reaction

magnet	The sample can be attracted.
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#### Chemical reaction

1. sample + $\text{K}_3\text{Fe}(\text{CN})_6(\text{aq})$ ( rust indicator)	The rust indicator shows deep blue colouration.
2. (a) sample + $1\text{M H}_2\text{SO}_4(\text{aq})$ + $0.4\text{M NaOH}(\text{aq})$  (b) ppt from (a) + excess NaOH	Dirty green precipitate is formed.  The ppt. solely turning brown.
3. (a) sample + $1\text{M HCl}(\text{aq})$ + $0.001\text{M K}_2\text{Cr}_2\text{O}_7(\text{aq})$  (b) solution form (a) + $0.4\text{M NaOH}(\text{aq})$	The colour of the solution change from orange to greenish brown.  Reddish brown ppt. is formed.
4. sample + $1\text{M H}_2\text{SO}_4(\text{aq})$	Colorless gas is given out. It does not give 'pop' sound with burning splint.

### For the $\text{Na}^+$ :

#### Flame test

Sample + heat	Golden yellow flame is observed.
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For the Cl<sup>-</sup>:

Chemical reaction

1. (a) Sample + 0.05M AgNO <sub>3</sub> (aq)	White curdy ppt is formed.
(b) ppt. from (a) + 0.1M HNO <sub>3</sub> (aq)	Ppt. insoluble.
(c) solution from (b) + 0.5M NH <sub>3</sub> (aq)	Ppt. redissolved.

For the CO<sub>3</sub><sup>2-</sup>:

Chemical reaction

1. Sample + 1M HCl (aq)	Colourless gas is given out. It turns lime water slightly milky.
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## Discussion

For the iron:

1. When the K<sub>3</sub>Fe (CN)<sub>6</sub> is added to the sample, this rust indicator turns from yellow to blue. It indicates Fe<sup>2+</sup> ions are presented. It is because the Fe(CN)<sub>6</sub><sup>3-</sup> ions react with Fe<sup>2+</sup> ions to form deep blue coloration.  
(  $3 \text{ Fe}^{2+} + 2\text{Fe(CN)}_6^{3-} \rightarrow \text{Fe}_3[\text{Fe(CN)}_6]_2$  )

2. When H<sub>2</sub>SO<sub>4</sub> is added to the sample, the colour of the solution turns from colorless to pale green. It is because iron metals react with sulphuric acid to form iron (II) ions. (  $\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$  ).  
NaOH is added to the solution, neutralization occurs so that the test tube becomes warm. (  $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$  ). Meanwhile, NaOH also reacts with FeSO<sub>4</sub> to form Fe(OH)<sub>2</sub> which is a dirty green precipitate. (  $\text{Fe}^{2+} + 2\text{OH}^- \rightarrow \text{Fe(OH)}_2$  ). Finally, excess NaOH is added and the dirty green precipitate slowly turning brown.

3. When HCl is added to the sample, the colour of the solution turns from colourless to pale green. It is because iron metals react with hydrochloric acid to form iron (II) ions. (  $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$  ).

Orange  $\text{K}_2\text{Cr}_2\text{O}_7$  is then be added to the solution. The colour of the solution changes from orange the greenish brown. It is because  $\text{Fe}^{2+}$  ions are oxidized by  $\text{Cr}_2\text{O}_7^{2-}$  ions to form  $\text{Fe}^{3+}$  ions which are brown.  $\text{Cr}_2\text{O}_7^{2-}$  ions are reduced to  $\text{Cr}^{3+}$  ions which are green. (  $6\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 6\text{Fe}^{3+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$  )

Using the resulting solution above, add NaOH. Reddish brown gelatinous precipitate is formed which are the  $\text{Fe}(\text{OH})_3$ . (  $\text{Fe}^{3+} + 3\text{OH}^- \rightarrow \text{Fe}(\text{OH})_3$  )

4. By adding the  $\text{H}_2\text{SO}_4$  to the sample, colourless gas is given out which is hydrogen. (  $\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$  ). However, the volume of gas is not enough to give out 'pop' sound with the burning splint.

For the  $\text{Na}^+$ :

During the flame test of burning the sample, golden yellow flame can be observed. It can indicate that  $\text{Na}^+$  is presented.

For the  $\text{Cl}^-$ :

After adding the  $\text{AgNO}_3$  to the sample, white curdy precipitate is formed. It is because the  $\text{Ag}^+$  ions react with  $\text{Cl}^-$  ions to form  $\text{AgCl}$  which is a white solid and is insoluble in water. (  $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}_{(s)}$  )

Hence, conformation test is done.

When  $\text{HNO}_3$  is added to the solution, the ppt. will not redissolve.

Finally,  $\text{NH}_3$  solution is also added to the solution, the ppt. is redissolved.

(  $\text{AgCl}_{(s)} + \text{NH}_4\text{OH}_{(aq)} \rightarrow \text{AgOH}_{(aq)} + \text{NH}_4\text{Cl}_{(aq)}$  )

For the  $\text{CO}_3^{2-}$ :

By adding HCl to the sample, a very small amount of colourless gas is given out to turn lime water slightly milky. The gas given out is carbon dioxide.

(  $2\text{HCl} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$  ). It indicates that there is a very small amount of sodium carbonate in the oxygen absorber.

## Conclusion

After the whole experiment, we can find out that iron powder and the sodium chloride are the main components of the oxygen absorber. Besides, there is also a small amount of sodium carbonate presents in the oxygen absorber.

Apart from placed at the moon cake package, it can also prevent dried meat and fish product such as ham, sausage, pork or beef jerky. Moreover, it can protect dehydrated fruits and vegetables like walnuts, peanut, against moth, growth of mold, colour degradation etc.