MODULE:

Chemistry in manufacturing: Corrosion of iron in a chloride solution

DESCRIPTION OF PRACTICAL:

We will learn about the corrosion of iron in the chloride medium and explain the course of redox reactions in individual metal areas. Moreover, we will explain how the coupling with other metals such as copper have influence on corrosion performance.

Corrosion is one of the more destructive processes in nature, which is particularly pronounced, e.g. in salt water due to presence of NaCl. Salt water is among the more aggressive and most common corrosion media. To simulate the process, a 3.5 % NaCl solution will be used as a corrosive medium, which is the average salinity of naturally occurring salt water. Corrosion takes place in two separate areas, where cathodic (reduction) and anode reaction (oxidation) takes place. In the anodic part, the metal dissolves, while on the cathode part hydroxide ions are formed in the reduction of water. Iron corrosion products can be stained with potassium hexacyanoferrate(III) $K_3[Fe(CN)_6]$ x 3 H_2O. In corrosion, iron ions are formed with potassium hexacyanoferrate(III), which form a coordination compound having a characteristic colour called Parisian blue. On the other hand, on the cathode side, the pH value locally increases due to the formation of hydroxide ions. Changing the pH value can be determined by adding a pH indicator, such as Phenolphthalein, which results in the change of the colourless solution into pink coloured.

MATERIAL:

- Petri dish
- Dropper
- A piece of iron, 3 nails, a piece of copper
- Emery paper
- 50 ml flask
- Potassium hexacyanoferrate(III)
- Alcoholic solution of phenolphthalein
- NaCl

Figure 1: Basic supplies for experiment.

METHODS OF WORK:

1. Weigh 1.5 g of NaCl into a 50 ml flask and add 0.2 g of $K_3Fe(CN)_6$, add some water, mix and then add 2 drops of alcoholic solution of phenolphthalein. Dilute the flask to the mark. The solution is yellowish-green.

2. A piece of iron ground with emery paper, washed with water and placed on the bottom of the Petri dish. Add a few drops of solution on the surface to cover the surface. Leave for a few minutes and monitor the local colour change, illustrating the different cathodic and anodic reactions.

3. Use 3 nails. Two nails ground with emery paper and washed with water. All three nails placed on the bottom of the Petri dish. One of the ground nails connect with the piece of copper. Add a few ml of solution to cover the nails. Leave for a few minutes and monitor the local colour change, illustrating the different cathodic and anodic reactions.

4. After the end of the exercise, pour the solution into a chemical collector, rinse the metal, and return it to the assistant.

RESULTS:

Enter the changes you see in the table.

	0 min	5 min	10 min
Colour in the middle of a drop			
Colour on the edge of the drop			

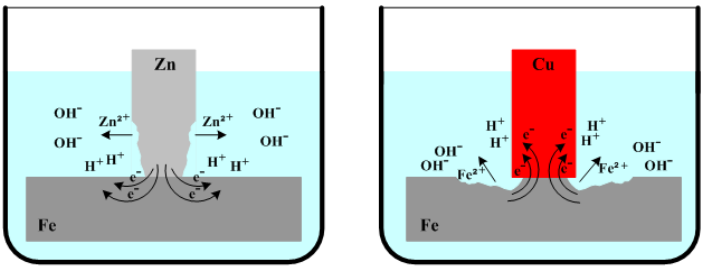
REPORT:

Observe the experiment and answer the questions.

QUESTIONS:

1. What are the coordination compounds?
2. Write down the reaction of iron corrosion that takes place on the anode.
3. Write down the water reactions that take place on the cathode.
4. Why is the solution of phenolphthalein coloured pink during corrosion?
5. Explain why iron is usually protected with galvanising.
6. Which nail corrodes the fastest and which the slowest? Why?

7. Explain the picture below; why in the first case does the zinc dissolve and why in the other case the iron?



EVALUATION OF THE PRACTICAL:

Knowledge for practical			
Experimental Exercise			
Results and answers			
Compliance with security rules:			
Review date:		Supervisor signature:	