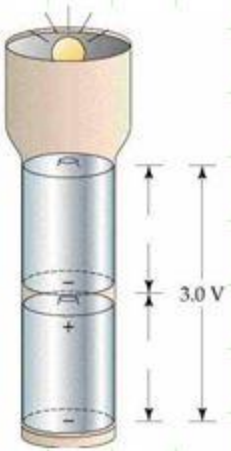
Dry Cell or LeClanche Cell

Dry Cells

Invented in the 1860's the common dry cell or LeClanche cell, has become a familiar household item. An active zinc anode in the form of a can house a mixture of MnO_2 and an acidic electrolytic paste, consisting of NH_4Cl, $ZnCl_2$, H_2O and starch powdered graphite improves conductivity. The inactive cathode is a graphite rod.



Cross-section of a dry cell

Anode (oxidation)

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} = 2e^-$

Cathode (reduction). The cathodic half-reaction is complex and even today, is still being studied. $MnO_{2(s)}$ is reduced to $Mn_2O_{3(s)}$ through a series of steps that may involve the presence of Mn^{2+} and an acid-base reaction between NH_4^+ and OH^-:

$2MnO_{2\,(s)} + 2NH_4^+{}_{(aq)} + 2e^- \rightarrow Mn_2O_{3(s)} + 2NH_{3(aq)} + H_2O_{\,(l)}$

The ammonia, some of which may be gaseous, forms a complex ion with Zn^{2+}, which crystallize in contact Cl^- ion:

$Zn^{2+}_{(aq)} + 2NH_{3\,(aq)} + 2Cl^-_{(aq)} \rightarrow Zn(NH_3)_2Cl_{2(s)}$

Overall Cell reaction:

$2MnO_{2\,(s)} + 2NH_4Cl_{(aq)} + Zn_{(s)} \rightarrow Zn(NH_3)_2Cl_{2(s)} + H_2O_{\,(l)} + Mn_2O_{3(s)}$ $\quad E_{cell} = 1.5\ V$

Uses: common household items, such as portable radios, toys, flashlights,
Advantage; Inexpensive, safe, available in many sizes
Disadvantages: At high current drain, $NH_{3(g)}$ builds up causing drop in voltage, short shelf life because zinc anode reacts with the acidic NH4+ ions.

INTRODUCTION

What is Fuel cell?

- A fuel cell is an electrochemical device that converts energy produced from a chemical reaction into electrical energy.
- More specifically it is an electrochemical device that combines hydrogen and oxygen to produce electricity, with water and heat as its by-product.
- Chemical Energy → Electrical Energy.

APPLICATIONS

- Can be used as power sources in remote areas.
- Can be used to provide off-grid power supplies.
- Can be applicable in both hybrid and electric vehicles.
- Waste water treatment plant and landfill.
- Cellular phone, laptop and computers.
- Hospitals, credit card centres and police stations.
- Buses, Car, Planes, Boats, Fork lift, Trains
- Vacuum cleaner.
- Telecommunication, MP3 players, etc.

Q. Calculate the equilibrium constant of the following reaction at 298 K:

$FeSO_4 (aq) + Cd (s) \rightleftharpoons Fe (s) + CdCl_2 (aq)$

Given,

$E^o_{Cd2+/Cd} = -0.488V$

$E^o_{Fe2+/Fe} = -0.469\ V$

Q. A zinc rod is placed in 0.1M solution of zinc sulphate at 25oC. Asssuming that the salt is dissociated to the extent of 95 percent at this solution, calculate the potential of the electrode at this temperature:

Given, $E^o_{Zn2+/Zn} = -0.76V$