

Alkaline Button Cell (Zinc/MnO₂ in KOH)

CATEGORY: Primary (Throwaway) Zinc Family

KOH

CONSTRUCTION:

The alkaline dry cell. The anode is a paste of zinc, KOH, and water, which donates electrons to the cell base via a brass collector. The cathode is a paste of MnO₂, graphite, and water, which takes electrons from the inner steel case. A plastic sleeve separates the inner steel case from the outer steel jacket

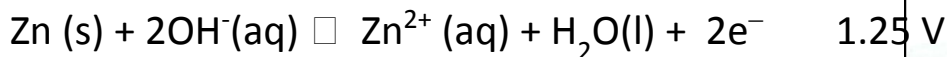
REDOX REACTIONS

Nominal cell voltage = +1.5 V

Positive terminal:

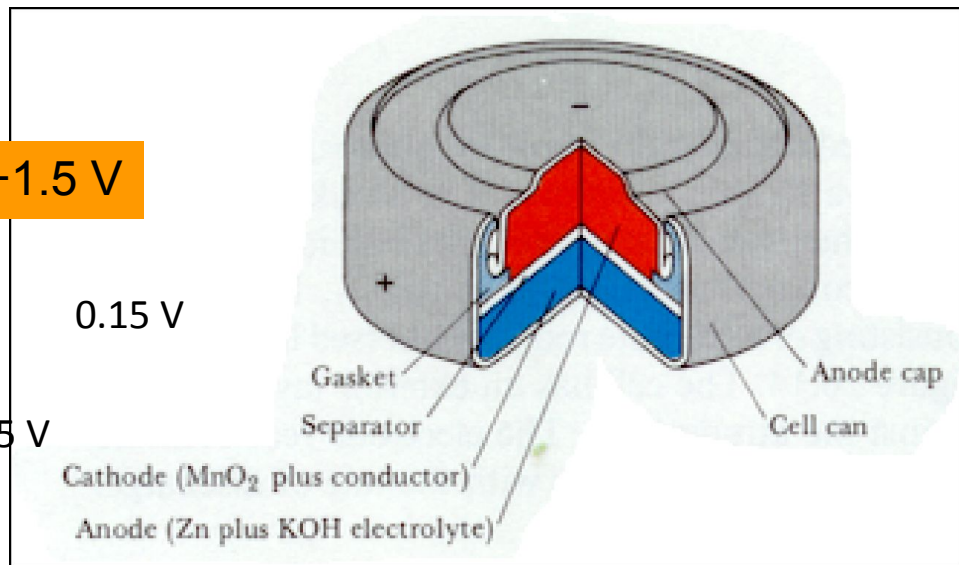


Negative terminal:



COMMENTS

Apart from the different type of container, the chemistry of this cell is the same as that of the standard alkali dry cell.



Lithium (Li/MnO₂ in KOH)

CATEGORY: Primary (Throwaway) Lithium Family

CONSTRUCTION:

Very similar to alkaline cell in design, except much more MnO₂ paste is used compared to Li due to the light weight of Lithium metal.

REDOX REACTIONS

Positive terminal:

Nominal cell voltage = +3.0 V



Negative terminal:



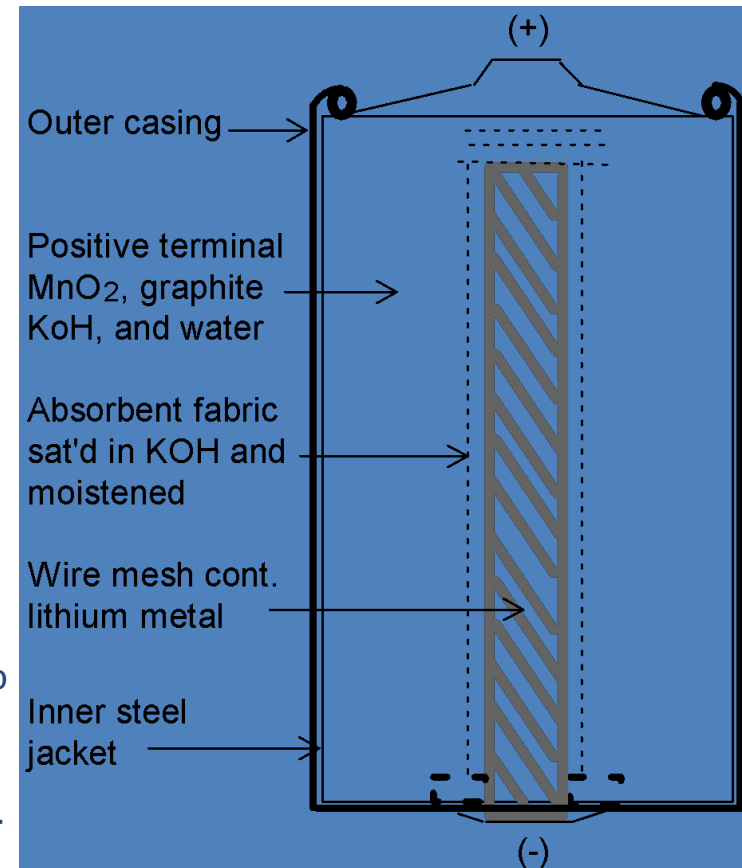
COMMENTS

The electrolyte consists of between 20 and 40% by mass of KOH, which is impregnated on the absorbent material between the two half-cells. This is only one of a whole family of Li based batteries.

Others are:

Li/SO₂, Li/SOCl₂, Li/CuO, Li-poly(vinyl pyridine)/I₂ solid electrolyte.

Thus the lithium batteries can replace the zinc family of batteries with a whole new range of high-power, low mass cells. The next 10-20 years should see substantial development in this area.



Mercury (Zn/HgO in KOH)

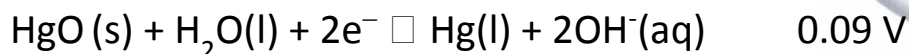
CATEGORY: Primary (Throwaway) Zinc Family

CONSTRUCTION:

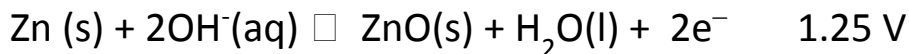
A mercury battery. A zinc-mercury amalgam is the anode; the cathode is a paste of HgO, graphite, and water, Mercury batteries, some of which are smaller than a pencil eraser, deliver about 1.34 V.

REDOX REACTIONS

Positive terminal:

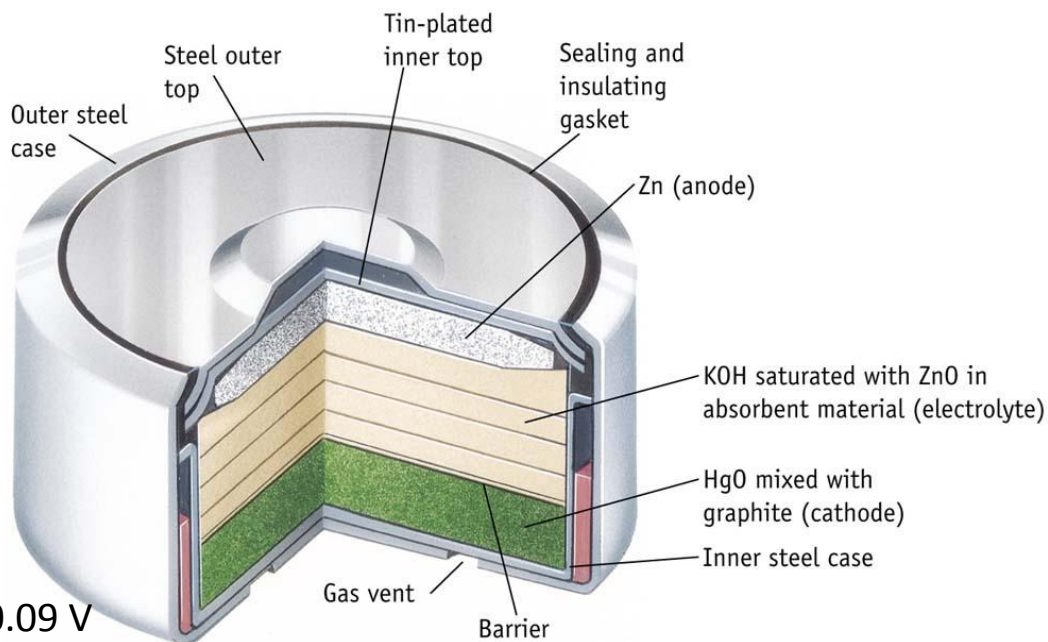


Negative terminal:



COMMENTS

The mercury cell, developed in 1942, is another zinc dry cell devised for use in small appliances such as watches, and is usually produced as a button battery. It delivers only 1.34 V, which is significantly less than the 1.5 V of a standard dry-cell. It has the advantage of maintaining a fairly constant voltage during its lifetime.



Nominal cell voltage = +1.34 V

Silver oxide (Zn/Ag₂O in KOH)

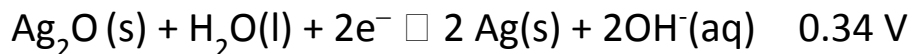
CATEGORY: Primary (Throwaway) Zinc Family

CONSTRUCTION:

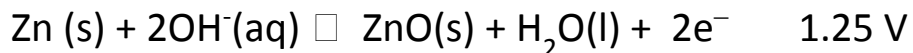
A silver oxide button battery, similar to the mercury and alkaline manganese cell. Also a reliable source of voltage. Used in medical devices, calculators, older cameras.

REDOX REACTIONS

Positive terminal:

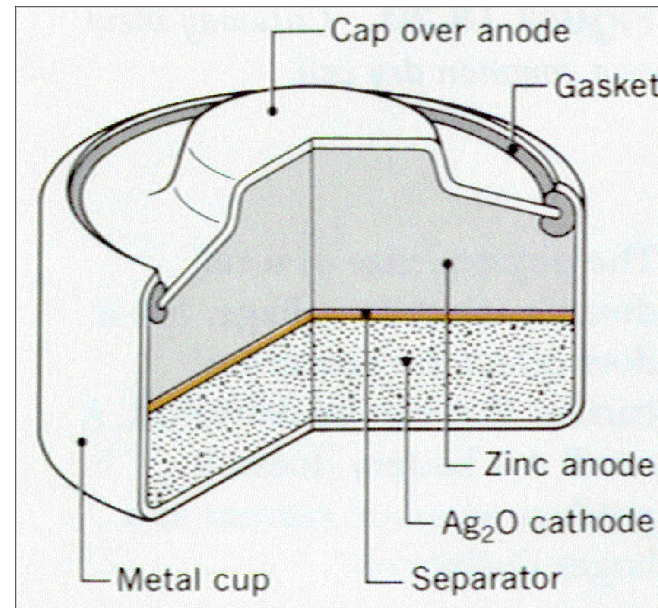


Negative terminal:



COMMENTS

Because no solution species is involved in the net reaction, the quantity of electrolyte is very small, and the electrodes can be maintained very close together. The storage capacity of a silver-zinc cell is about six times as great as a lead-acid cell of the same size. They are expensive because of the use of silver oxide.



Nominal cell voltage = +1.5 V

Zinc-Air (Zn/O₂ in KOH)

CATEGORY: Primary (Throwaway) Zinc Family

CONSTRUCTION:

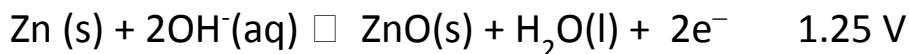
Constructions very similar to mercury or silver oxide button cells. But there are holes in the base to allow air in!

REDOX REACTIONS

Positive terminal:

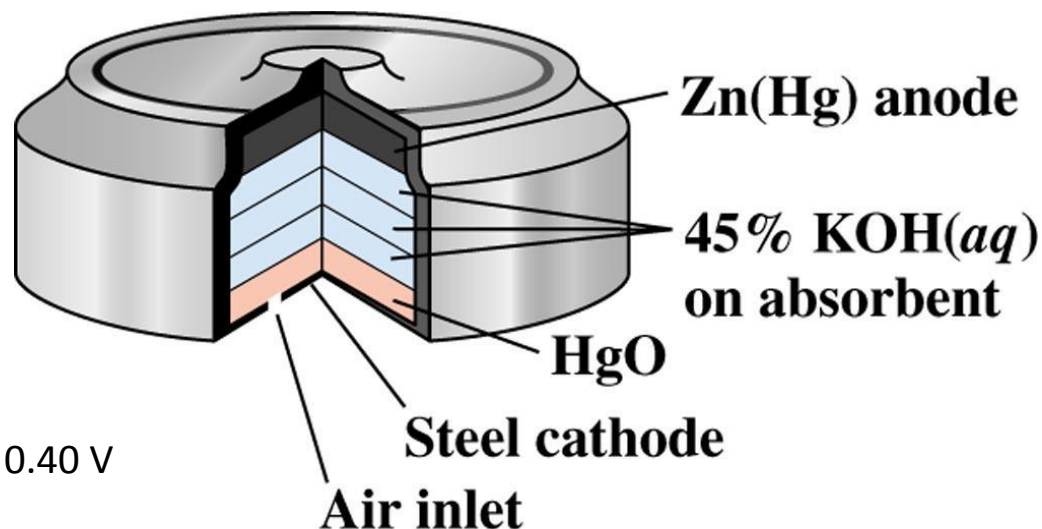


Negative terminal:



COMMENTS

Mercury is added to the zinc, forming a liquid mixture called an amalgam, which prevents the formation of an insulating layer of zinc oxide. The zinc-air cell is sold with a patch covering the air holes. This patch must be removed before the battery develops a voltage. When oxygen gas from the air percolates into the hydroxide solution in the positive half-cell, reaction commences and a voltage develops in the cell. Can you see why the voltage is *less* than predicted by E° ?



Nominal cell voltage = +1.4 V

$p(\text{O}_2) \approx 0.20 \text{ atm}$

