

EMBEDDED SYSTEMS(EE30004)

Homework 12

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Find out and briefly discuss different types of batteries available in the market.

Batteries are basically classified into 2 types:

- Non-rechargeable batteries (primary batteries)
- Rechargeable batteries (secondary batteries)

Non-rechargeable Batteries

These are basically considered as **primary batteries** because they can be used only once. These batteries cannot be recharged and used again. Let's see about the regular, daily life primary batteries that we see.

- **Alkaline batteries:** It is basically constructed with the chemical composition of Zinc (Zn) and Manganese dioxide (MnO_2), as the electrolyte used in it is potassium hydroxide which is purely an alkaline substance the battery is named as alkaline battery having the power density of 100 Wh/Kg.



Advantages:

1. Cycle life is more
2. More compatible and efficient for powering up portable devices.
3. Shelf life is more.
4. Small in size.
5. Highly efficient.
6. Low internal resistance so that discharge state in idle state is less.
7. Leakage is low.

Disadvantages:

1. Cost is a bit high. Except it everything is an advantage.

Applications:

It can used in torches, remotes, wall clocks, small portable gadgets etc.

- **Coin cell batteries:** The chemical composition of coil cell batteries is also alkaline in nature. Apart from alkaline composition, lithium and silver oxide chemicals will be used to manufacture these batteries which are more efficient in providing steady and stable voltage in such a small sizes. It has Power density of 270 Wh/Kg.

**Advantages:**

1. Light in weight
2. Small in size
3. High density
4. Low cost
5. High nominal voltage (up to 3V)
6. Easy to get high voltages by arranging serially
7. Long shelf life

Disadvantages:

1. Needs a holder
2. Low current draw capability

Applications:

Used in watches, wall clocks, miniature electronic products etc.

Rechargeable Batteries

These are generally called as **secondary batteries** which can be recharged and can be reused. Though the cost is high, but they can be recharged and reused and can have a huge life span when properly used and safely charged.

Lead-acid batteries

It consists of lead-acid which is very cheap and seen mostly in cars and vehicles to power the lighting systems in it. These are more preferable in the products where the size/space and weight doesn't matter. These comes with the nominal voltage starting 2V to 24V and most commonly seen as 2V, 6V, 12V and 24V batteries. It has Power density of 7 Wh/Kg.



Advantages:

1. Cheap in cost
2. Easily rechargeable
3. High power output capability

Disadvantages:

1. Very heavy
2. Occupies much space
3. Power density is very low

Applications:

Used in cars, UPS (uninterrupted Power Supply), robotics, heavy machinery etc..

Ni-Cd batteries

These batteries are made of Nickel and Cadmium chemical composition. Though these are very rarely used, these are very cheap and their discharge rate is very low when compared to NiMH batteries. These are available in all standard sizes like AA, AAA, C and rectangular shapes. The nominal voltage is 1.2V, often connected together in a set of 3 which gives 3.6V. It has Power density of 60 Wh/Kg.

**Advantages:**

1. Cheap in cost
2. Easy to recharge
3. Can be used in all environments

4. Comes in all standard sizes

Disadvantages:

1. Lower power density
2. Contains toxic metal
3. Needs to be charged very frequently in order to avoid growth of crystals on the battery plate.

Applications:

Used in RC toys, cordless phones, solar lights and mostly in the applications where price is important.

Ni-MH batteries

The Nickel – Metal Hydride batteries are much preferable than Ni-Cad batteries because of their lower environmental impact. Its nominal voltage is 1.25 V which is greater than Ni-Cad batteries. It has less nominal voltage than alkaline batteries and they are good replacement due to its availability and less environmental impact. The power density of Ni-MH batteries is 100 Wh/Kg.

**Advantages:**

1. Available in all standard sizes.
2. High power density.

3. Easy to recharge.
4. A good alternative to alkaline which has almost all similarities and also it is rechargeable.

Disadvantages:

1. Self-discharge is very high.
2. Expensive than Ni-Cad batteries.

Applications:

Used in all applications similar to the alkaline and Ni-Cad batteries.

Li-ion batteries

These are made up of Lithium metal and are latest in rechargeable technology. As these are compact in size they can be used in most of the portable applications which need high power specifications. These are the best rechargeable batteries available. These have a nominal voltage of 3.7V (most commonly we have 3.6V and 7.2V) and have various ranges of power capacity (starting from 100s of mAh to 1000s of mAh). Even the C-rating ranges from 1C to 10C and Power density of Li-ion batteries is 126 Wh/Kg.

**Advantages:**

1. Very light in weight.
2. High C-rating.
3. Power density is very high.
4. Cell voltage is high.

Disadvantages:

1. These are a bit expensive.
2. If the terminals are short circuited the battery might explode.

3. Battery protection circuit is needed.

Li-Po batteries

These are also called as Lithium Ion polymer rechargeable batteries because it uses high conductivity polymer gel/polymers electrolyte instead of liquid electrolyte. These come under the Li-ion technology. These are a bit costly. But the battery is very highly protected when compared to the Li-ion batteries. It has Power density of 185 Wh/Kg.



Advantages:

1. These are highly protective compared to Li-ion batteries.
2. Very light in weight
3. Thin in structure when compared to Li-ion batteries.
4. Power density, nominal voltages are comparatively very high compared to Ni-Cad and Ni-MH batteries.

Disadvantages:

1. Expensive.
2. Might explode if wrongly connected.
3. Should not be bent or exposed to high temperature which may cause to explosion.

Applications: Can be used in all the portable devices which need rechargeable advantage like drones, robotics, RC toys etc.