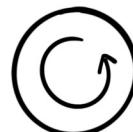


How Things Work

Introduction to -

- Battery
- Types of battery
- Range and Application



Lesson Aims:

1. Summarize Different Categories of Battery
2. Identify Different Types of Battery Applications.
3. Classify Total Tower Rating-Wise Identification.

What do you mean by battery?

What do you mean by Primary Battery?

How to calculate battery power?



Battery

Take a bottle and fill it with water ask students about what happens and suddenly turn the bottle upside down, now what happens

here is energy is stored in some bottle we use this energy in a different way.

(It will be like a charge stored in the battery).



Do you have a snack box?

"Same like that electrical energy can store in a tiffin and it is called a battery"

You might have come across at least a couple of different types of batteries in your life. Some of the common places where you use batteries are wall clocks, alarms, or smoke detectors, which use small disposable batteries, for cars, trucks, and ks motorcycles, which use relatively large rechargeable batteries.

Batteries have become a very important source of energy in the last decade or so. Even before that, they were an integral part of our lives in powering several portable devices like transistor radios, Walkman, handheld games, cameras, etc.

But with the development of advanced smartphones, tablets, laptops, solar energy, and electric vehicles, the research into powerful batteries that can last longer and can deliver the necessary energy has been at its peak.

The 2019 Nobel Prize in Chemistry has been awarded to three scientists John B. Goodenough, M. Stanley Whittingham and Akira Yoshino for the development of lithium-ion batteries.

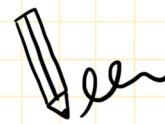
What is a Battery?

A Battery is a chemical device that stores electrical energy in the form of chemicals and using an electron chemical reaction, it converts the stored chemical energy into Direct current (DC) electric energy. Alessandro Volta, an Italian Physicist, invented the first battery in 1800.

The electrochemical reaction in a battery involves the transfer of electrons from one material to another (called electrodes) through an electric current.

Brainstorming on Application:

In the last few decades, the usage of small sealed batteries in consumer applications has been exponential. Primary or rechargeable batteries in small form factors are being used in a huge number of appliances. Some of them are mentioned below.



Portable Electronic Devices: Watches, Cameras, Mobile Phones, Laptops, Camcorders, Calculators, and testing equipment (Multimeters).

Entertainment: Radios, MP3 players, CD Players, all infrared remote controls, toys, games, keyboards.

Household: Clocks, Alarms, Smoke Detectors, Flashlights, UPS, Emergency lights, toothbrushes, hair trimmers and shavers, Blood Pressure Monitors, Hearing Aids, pacemakers, portable power tools (drills, screwdriver).

Selecting a battery for your application can be dialed down to just two Characteristics:

Performance and Cost. But if we dig a little bit deeper, then the following are determining factors in choosing the right battery for your application.

- Primary or Secondary
- Energy or Power
- Shelf Life
- Energy Efficiency and Recharge Rate
- Battery Life
- Battery Temperature



Types of Battery:

All electrical cells and batteries are classified into two types:



Primary (non-rechargeable) and Secondary (rechargeable)

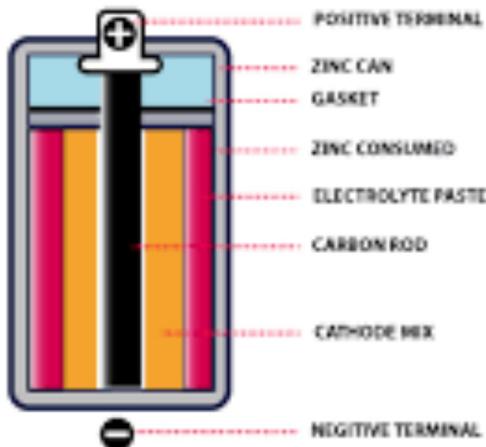
Even though there are several other classifications within these two types of batteries, these two are the basic types. Simply speaking, Primary Batteries are non-rechargeable batteries i.e., they cannot be recharged electrically while Secondary Batteries are rechargeable batteries i.e., they can be recharged electrically.

Primary Batteries

A Primary Battery is one of the simple and convenient sources of power for several portable electronic and electrical devices like lights, cameras, watches, toys, radios, etc. As they cannot be recharged electrically, they are of "use it and when discharged, discard it" type.

Usually, primary batteries are inexpensive, lightweight, small, and very convenient to use with relatively no or less maintenance. The majority of the primary batteries that are used in domestic applications are single-cell types and usually come in cylindrical configurations (although, it is very easy to produce them in different shapes and sizes).

PRIMARY BATTERY



Secondary Batteries

A Secondary Battery is also called a Rechargeable Battery as it can be electrically recharged after discharge. The chemical status of the electrochemical cells can be "recharged" to their original status by passing a current through the cells in the opposite direction of their discharge.

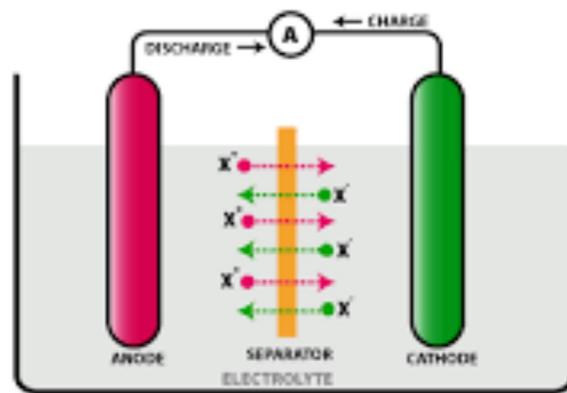
Secondary batteries can be used in two ways:

In the first category of applications, the secondary batteries are essentially used as energy storage devices where they are electrically connected to the main energy source and also charged by it and also supplying energy when required. Examples of such applications are Hybrid Electric Vehicles (HEV), Uninterrupted Power Supplies (UPS), etc.

The second category of applications of secondary batteries is those applications where the battery is used and discharged as a primary battery. Once it is completely discharged (or almost completely discharged), instead of discarding it, the battery is recharged with an appropriate charging mechanism. Examples of such applications are all the modern portable electronics like mobiles, laptops, electric vehicles, etc.

The Energy Density of secondary batteries is relatively lower than that of primary batteries but have other good characteristics like high power density, flat discharge curves, high discharge rate, and low-temperature performance.

SECONDARY BATTERY



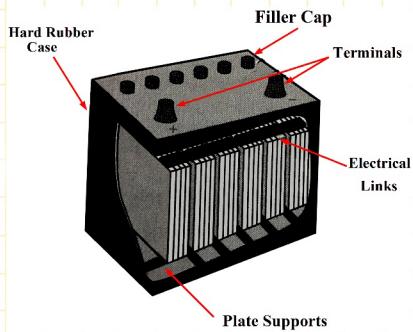
Activity

Different types of batteries like, Lead-acid, Lithium-ion, and Lithium-polymer batteries

Battery capacity formula

As you might remember from our article on Ohm's law, the power P of an electrical device is equal to voltage V multiplied by current I:

$$P = V \times I$$



As energy E is power P multiplied by time T, all we have to do to find the energy stored in a battery is to multiply both sides of the equation by time:

$$E = V \times I \times T$$



Hopefully, you remember that amp hours are a measure of electric charge Q (the battery capacity). Hence, the final version of the battery capacity formula looks like this: $E = V \times Q$,



where:

E – Energy stored in a battery, expressed in watt-hours;

V – Voltage of the battery; and

Q – Battery capacity, measured in amp-hours.

How to calculate amp hours?

Let's assume you want to find out the capacity of your battery, knowing its voltage and the energy stored in it.

Note down the voltage. In this example, we will take a standard 12 V battery.

Choose the amount of energy stored in the battery.

Let's say it's 26.4 Wh.

Input these numbers into their respective fields of the battery amp hour calculator. It uses the formula mentioned above:

$$E = V \times Q$$

$$Q = E / V = 26.4 / 12 = 2.2 \text{ Ah}$$

The battery capacity is equal to 2.2 Ah.

Battery capacity calculator: advanced mode

If you open the advanced mode of this battery capacity calculator, you can compute three other parameters of a battery.

C-rate of the battery. C-rate is used to describe how fast a battery charges and discharges. For example, a 1C battery needs one hour at 100 A to load 100 Ah. A 2C battery would need just half an hour to load 100 Ah, while a 0.5C battery requires two hours.

Discharge current. This is the current I used for either charging or discharging your battery. It is linked to the C-rate with the following equation:

$$I = \text{C-rate} \times Q$$

Runtime to full capacity. It is simply the time t needed to fully charge or discharge the battery when using the discharge current, measured in minutes. You can calculate it as $t = 1/C$.



Reflection

- 1) Calculate what is on the battery
- 2) What is a battery?
- 3) What is the legal meaning of battery?
- 4) What are batteries and their types?
- 5) Why it is called a battery?
- 6) How long battery will last?
- 7) How much energy is in a battery?
- 8) What is the importance of battery?

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