Electrical Principles - Part 1

Storage and transfer of electrical energy

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Objectives

- Describe the major features of cells
- Know the two major types of cells

Battery Classification

- Primary Cells: Cannot be recharged as the chemical reactions cannot be reversed.
- Secondary Cells: Can be recharged by passing a current through the cell in the opposite direction.

Battery Chemistries: Lithium Polymer (LiPo)

- Type: Secondary cell
- Chemistry: Lithium-ion and polymer (gel) electrolyte
- Pros: High energy content, light, can be produced in any shape
- Cons: Physical damage, over charge or too high temperature can cause cells to fail catastrophically (fire, explosion)
- Voltage: 2.7-4.2V
- Usage: personal electronics (laptops, cell phones), RC vehicles, International Space Station (since 2017)
- Invented by Sony in 1991

Battery Chemistries: Lithium Iron Phosphate (LiFePO4 aka LFP)

- Type: Secondary cell
- Chemistry:
- Pros: Constant discharge voltage, stable and safe (compare to LiPo), many recharge cycles
- Cons: Lower energy density
- Voltage: 3.2V per cell
- Usage: Electric vehicles, power tools, RC vehicles

Battery Chemistries: Lead-Acid Battery

- Type: Secondary cell
- Chemistry: Lead, lead dioxide, electrolyte concentrated sulfuric acid
- Pros: High energy density, many recharge cycles, cheap
- Cons: Effectiveness reduced at low temperatures, self-discharges, contains lead and concentrated sulfuric acid
- Voltage: 2V per cell
- Usage: Vehicle starter and ignition, backup power supplies (computer UPS units)
- Oldest type of rechargable

Battery Chemistries: NiCd

- Type: Secondary cell
- Chemistry:
- Pros: Long Shelf life,many recharge cycles, good performance at low temperatures, can produce very large instantaneous currents (1000-8000A for a second)
- Cons: Contains Cadmium (heavy, expensive and toxic), corrosive electrolytes
- Voltage: 1.2V per cell
- Usage: Portable electronic equipment, e.g. flash lights, aircraft and satellite systems, starting large disel engines and turbines.

Battery Chemistries: NiMH

- Type:
- Chemistry:
- Pros:
- Cons:
- Voltage:
- Usage:

Fuel Cells

- Fuel and oxidant are continuously supplied from the outise while vaste products are removed.
- Pros: High-efficiency of energy conversion, no harmful waste products, no need to recharge
- Cons: Expensive, fuel gases must be stored in high-pressure tanks, moderate power output
- Use: The space shuttle and Apollo space program, military submarines