Using Rechargeable Batteries for Ham Radio Applications

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Title-notes

-Got ham licence 1964

-Worked on radar, satellites, etc.

Rechargeable versus Non-rechargeable

Pro:
-Cheaper
-Less Waste

Con:
-Need Charger

Notes-Rechargeable versus non-rechargeable

-Rechargeable can be recharged and reused many times, non-rechargeable only once.

-Some non-rechargeable can take a small recharge, but only poorly.

Applications for Rechargeable Batteries

-Portable equipment (radios, computers, cameras)
-Remote from power lines
-Emergency equipment
-Car batteries
-Hybrid Cars
-Electric cars

Notes- Applications for rechargeable batteries

- Can also use non-rechargeables.
- If substituting rechargeables for non-rechargeables, ensure voltage ranges are suitable.

Capacity of a rechargeable battery or cell

-defined as the product of the current multiplied by the time duration available from the fully charged state to the fully discharged state.

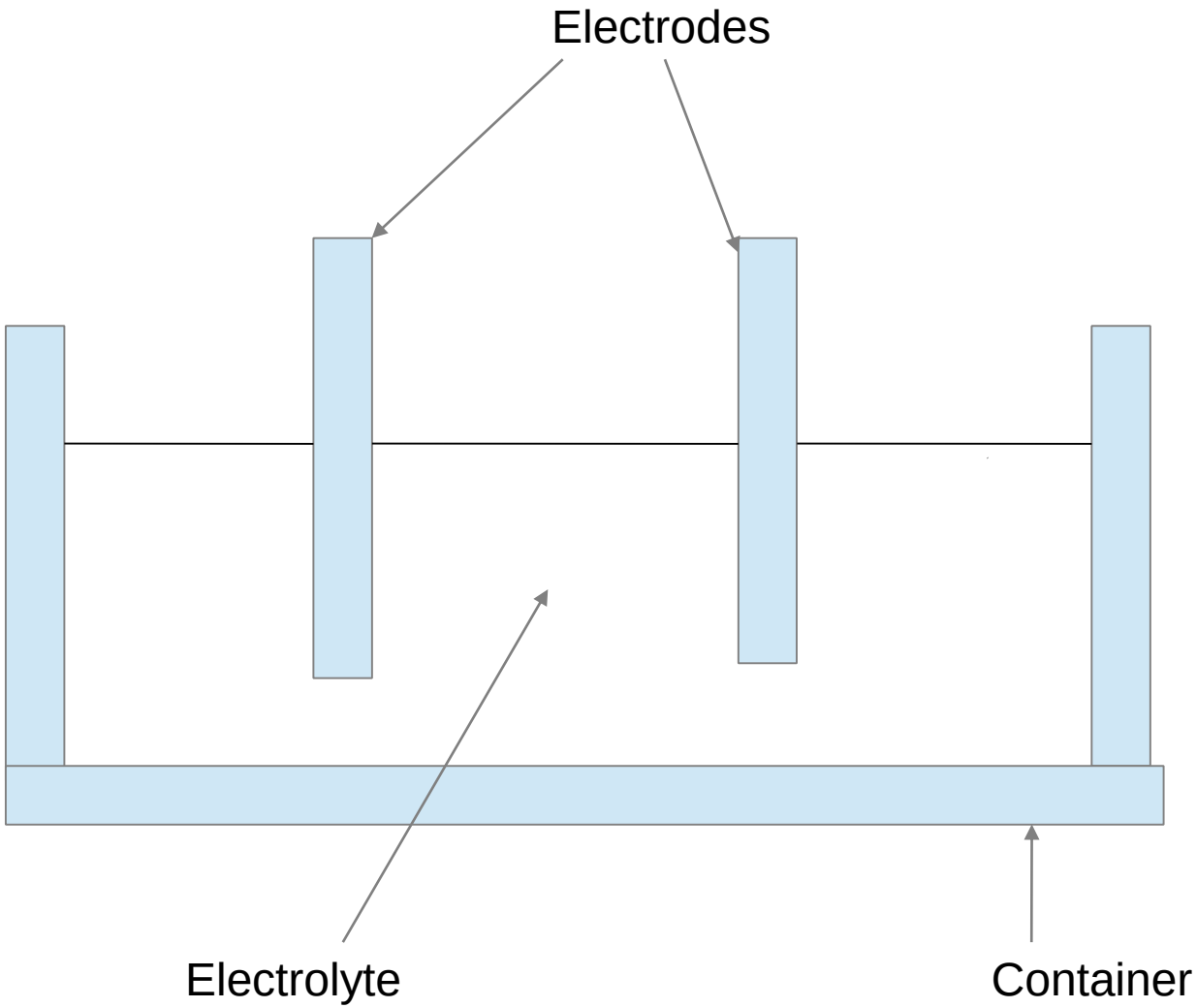
-units: amp-hours (AH) or milliamp-hours (mAH)

-When multiplied by the battery or cell voltage, equals the energy available from the unit.

Notes-Capacity of a rechargeable battery or cell

-A battery is a group of cells, usually connected in series or parallel.

Simplified Cell



Notes-Simplified cell

-A simple lead-acid cell can be made using lead plates and dilute sulphuric acid in an insulating container. It will accept and release a charge.

Characteristics-1

Battery type	Cell volts Nom.	Volts chg.	Volts dischg.	Self dischg. %/mo.	Life cycles 100% dod
Sealed lead-acid	2.1	2.0-2.4	1.7-2.2	3-4	200
Unsealed Lead-acid	2.1	2.0-2.4	1.7-2.2	3-4	500-800
Nickel-Cadmium	1.2	1.3-1.55	1.0-1.4	20	1500
Nickel-Metal Hydride	1.2	1.0-1.45	1.0-1.4	30	500-1000
Lithium-Ion, Lithium-Ion Polymer	3.6	3.0-4.2	3.0-4.0	5-10	400-1200
Lithium-Iron Phosphate	3.25	3.0-3.6	3.0-3.6	<10	2000+

Notes-Characteristics-1

-sealed versus unsealed batteries- all sealed except for second one

-under unsealed lead acid, use “deep-cycle” type, not “starting” type.

-voltages are at room temperature

-dates brought into service:

- -sealed lead-acid-1971
- -unsealed lead-acid-1890s
- -nickel-cadmium-1950
- -nickel-metal hydride-1980s
- -lithium-ion/lithium ion polymer-1991
- -lithium-ion-phosphate-1996

Characteristics-2

Battery type	Shelf life-years	Toxicity	Temp.Rng. C	Storage	Charge Technique
Sealed lead-acid	20	Very high	-15 to 40	Full chg	Voltage/ current
Unsealed Lead-acid	20	Very high	-15 to 40	Full chg	Voltage/ current
Nickel-Cadmium		Very high	0 to 45	-30 to 50 Can short	Voltage/ current
Nickel-Metal Hydride		Low	-10 to 45	-20 to 35/ 1 year	Voltage turnover
Lithium-Ion, Lithium-Ion Polymer	2-6	Low		Hold at 3.6 v.	Voltage/ current
Lithium-Iron Phosphate	>10	Low	-15 to 70	Hold at 3.2 v.	Voltage/ current

Notes-Characteristics-2

-Some of the boxes in the table are empty. In these cases, there were no or inconsistent results.

Characteristics-3

Battery type	WH/kg	WH/L	W/kg	WH/$	Safety
Sealed lead-acid	30-40	60-75	180	5-8	safe
Unsealed Lead-acid	30-40	60-75	180	5-8	Acid spill, hydrogen
Nickel-Cadmium	40-60	50-150	150	1.25-2.5	safe
Nickel-Metal Hydride	30-80	140-300	250-1000	2.75	safe
Lithium-Ion, Lithium-Ion Polymer	150-250	300	3000+	2.8-5.0	Requires ext. protect.
Lithium-Iron Phosphate	80-120	170	1400	0.7-3.0	safe

Notes-Characteristics-3

-WH/kg=watt-hours per kilogram

-WH/L=watt-hours per litre

-W/kg=watts per kilogram

-WH/$=watt-hours per dollar

-Lithium-ion types are not considered safe without external protection, but can be procured that way.

Reference book and internet site

Batteries in a Portable World-a handbook on rechargeable batteries for non-engineers

by:

Isador Buchmann

Cadex Electronics, Inc.

Internet: BatteryUniversity.com

Notes-Reference bok and internet site

-Cadex Electronics, Inc. Is a Canadian company in Richmond, B.C.

-The current book is the 3rd edition, published 2011.

Safety Issues

-Fire hazard from high currents

-explosion

electrolyte leakage/chemical burns

Notes-Safety Issues

-For lithium-ion cells, the short-circuit current is equal to 25 times the amp-hour rating. Therefore, a small, 1.5 AH cell can produce a current of 37.5 amps, which could be dangerous.

-A few years ago, the qualification of Boeing's 787 aircraft was delayed by about six months due to smoke and fire problems in the lithium-ion batteries in that aircraft. From the internet, it is not clear that the original problem has been either identified or corrected.

-Lead-acid batteries can vent hydrogen gas if they are overcharged. This gas is explosive in sufficient concentrations.

Carrying batteries on airplanes

-Lithium-ion batteries may be carried in carry-on baggage only. There is a maximum amount of lithium specified

-All batteries must be protected from shorting

Notes-Carrying batteries on airplanes

-Batteries will be inspected for signs of abuse or damage. If found, the batteries will be seized.

Disposal of old batteries

-City of Ottawa- “take it back” program, returning material to original seller or other party.

-Special waste collections

Notes-Disposal of old batteries

-In addition, see “specialized recyclers”

Battery suppliers

1) Local battery specialists:

-Total Battery

-Alexander Battery

2) Electronic suppliers:

-Active Electronics, The source, etc.

3) Electronic suppliers, general:

-e.g. Digikey, etc.

Notes-Battery suppliers

-See also “digital camera sales”

-See also “Model airplane sales (electric propulsion)

Latest Battery Developments

-Aluminum-ion battery laboratory development at Stanford University, California

Characteristics, so far:

-2.0 volts per cell

-7,000 charge/discharge cycles

-materials should be cheap

-high charge and discharge rates

-possible use for power grid stabilization

Notes-Latest Battery Developments

-This is only one of many battery developments going on at this time.

The end

Any questions?