



Saft's Approach to High Quality Lithium Ion Products

Glen Bowling

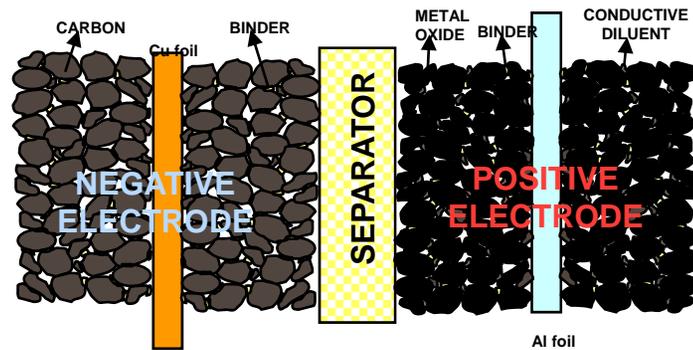
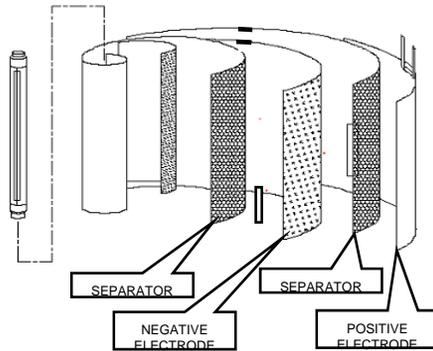


Cylindrical Li Ion Cell

Structure in a nutshell

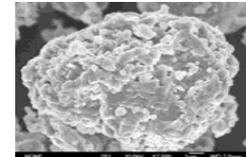
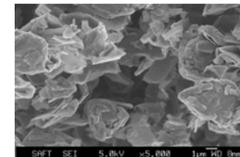
Li-Ion Architecture

- Cell assembly with electrodes
- Porous electrode
- Particle morphology



NEGATIVE PARTICLE

POSITIVE PARTICLE



Geometrical Surface Area
(Measured electrode area)

+

True (Fractal) Surface Area
(Materials specific surface area)

Quality Control Standards for Li-ion manufacturing?

- At least 28 standards that define performance and safety of Li-ion. There are none which focus on manufacturing quality.
- Several reasons?
 - > ISO 9001, AS 9100 provide meaningful and viable quality systems that work well
 - > Li-ion is not one thing. It is a multitude of chemistries, technical approaches and designs. Manufacturing will be very different for some technologies.
 - > Small commodity cell manufacturers use process controls only and large cell makers use both process and quality controls (due to volume of production)

Materials and Process Control (contamination control)

- Incoming materials are controlled using QA procedures against a very precise specification for the material, including allowable impurities.
- Cells are produced in Class 6 dry and clean rooms.
- Equipment is specified and designed to prevent introduction of particle contamination
- No touch labor is used in the processes where contamination can be introduced
- Multiple inspection points are included to detect contamination
- Final formation process detects contamination with a high probability of success

What types of validation testing are performed?

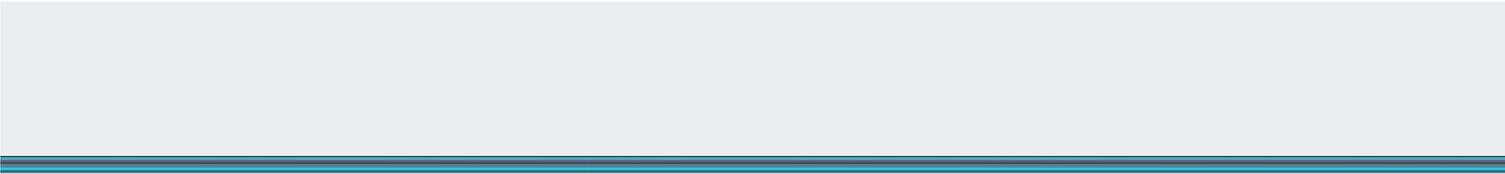
- 100% of our cells are tested before being used
- Batteries are tested and certified to applicable industry standards
 - > UN Transportation
 - > NAVSEA 9310 / SG270
 - > The other 28 Standards...
 - > Controlled by law or regulation
- Batteries are tested and validated to customer specific requirements.
 - > These could include Electrical Performance, Life, Safety, Shock, Drop, Vibe, EMC/EMI, Thermal, Radiation....
 - > Controlled by contract

How is quality control maintained during production?

- Use of materials and parts which have been supplied by qualified suppliers with certified content
- Use of processes which are in control and constantly monitored
- Inspection steps throughout the manufacturing process chosen as critical function points.
- Any cell failing to meet inspection criteria is considered a reject, and triggers a number of actions including stop of production until the issue is understood and a corrective action completed.
- Acceptance of product at the end of production is at 100% inspection level

What steps does a manufacturer take prior to shipment?

- 100% of cells undergo complete formation process and cell evaluation testing prior to release for use.
- There is full traceability for all materials and process for every cell leaving the plant.
- 100% of modules are tested during and after completion for key criteria
- 100% of batteries are tested for all acceptance criteria
 - > Can be 4 hours or 4 months depending on the application
 - > Can include significant documentation
- Before any production a qualification process is done often lasting years, with extremely comprehensive testing



Glen Bowling

Glen.bowling@saftbatteries.com

410 568 6421

THANK YOU