Technical Visit to Samsung SDI Energy (M) Bhd – A Green Energy Solution Provider

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The participants at SDIEM.

The Institution of Engineers, Malaysia, Negri Sembilan branch (IEMNS) organised a technical visit to Samsung SDI Energy (Malaysia) Plant or SDIEM, at Tuanku Jaafar Industrial Zone, Sg Gadut, Negri Sembilan on 24 May, 2016.

The delegation of 11 participants from an engineering consultant firm, the corporate sector, universities and IEMNS office, spent half a day touring SDIEM, the sole manufacturing plant in Malaysia producing rechargeable lithium ion battery or LIB, which is currently used in handphones, laptops, cordless power tools and e-bike industries.

The participants arrived at SDIEM at 9.30 a.m. and was welcomed by the Manufacturing Director cum Deputy Managing Director, Ir. Dr Oh Seong Por. Participants were briefed on factory establishment, product portfolio, production capacity and total workforce. Ir. Dr Oh also took the opportunity to explain the working principle of charging and discharging a lithium ion battery.

Then the participants visited the production lines to see the manufacturing of cylindrical and prismatic model LIBs. They also witnessed the world's fastest speed 310 ppm (310 parts per minute) cylindrical production line and the complex process of preparing the electrode, the key component of the battery. After the tour, participants were served lunch at the VIP lounge in the company cafeteria. The visit ended with a photograph session and the presenting of a certificate and souvenir.

BASIC MANUFACTURING PROCESS OF LI-ION BATTERY

The upstream process is the mixing of slurry chemical to make cathode and anode electrodes. For the cathode, lithium cobalt oxide is used and for the anode, graphite C6 is the core component. Cathode and anode slurry are mixed separately in giant mixers, called combi and planetary despa tanks respectively.

When completed, the slurry is coated on thin foil with a thickness ranging from 8 to 30 microns. Coating is performed inside a coater machine. Lithium cobalt oxide slurry is coated on aluminum foil to make the cathode electrode while carbon C6 slurry is coated on copper foil to form the anode electrode.

The electrode is then pressed, using hydraulic rolls, to the required thickness of 90-45 microns. The thin electrode is then slit to the desired width which actually determines the length of the final product battery. The final electrode preparation process is when the slit electrode is dried inside a vacuum chamber.

A pair of cathode and anode electrodes is needed to make a battery. However, there must not be any direct contact of cathode and anode, to prevent short circuit which can lead to overheating, fire or, in extreme cases, explosion. To ensure this, a thin film of polyethylene separator is positioned between the cathode and anode electrodes. All three materials are inter-wound in a winding process to form either rolling jelly roll for cylindrical models or folding jelly roll to make a prismatic battery. Next, the jelly roll is inserted into a can, followed by the injection of electrolyte lithium salt. Finally the can is sealed, either by crimping (pressing for cylindrical battery) or laser welded (ball pressed for prismatic model).

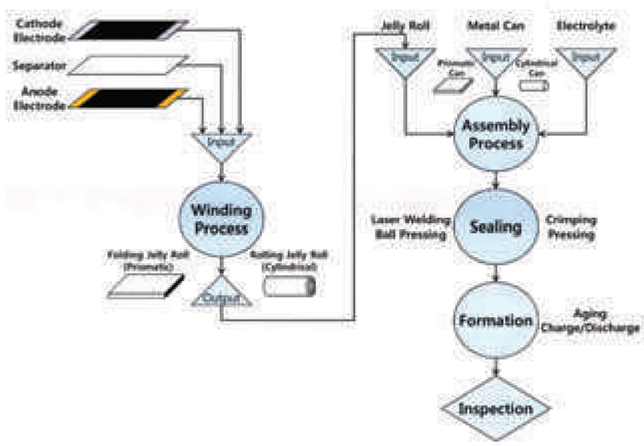
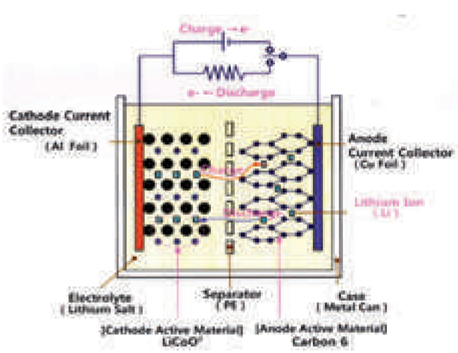


Figure 1: Process flow of LIB.

The next process is called "formation" where batteries are placed in an enclosed storage for 72 hours to allow for complete absorption of the electrolyte into the jelly roll. After this, batteries are charged and discharged with specific voltages. This is meant to activate chemical components of electrodes before they are subjected to various inspection gates in which good cells are packed for customers. Figure 1 illustrates the major process flow of manufacturing LIB.

WORKING PRINCIPLE OF LI-ION BATTERY.

The movement of lithium ion through electrolytes between cathode and anode and vice versa creates a potential difference which induces electrons to flow through a conducting wire that connects the cathode and anode (Figure 2).



MAJOR COMPONENT AND FUNCTION:

Cathode electrode – lithium cobalt oxide.

Anode electrode – carbon 6 that acts as Li-ion collector.

Electrolyte – lithium salt which provides medium for Li-ion to flow.

Separator – polyethylene film that prevents direct contact between cathode and anode.

Figure 2: Charge / Discharge Principle.

When electric energy is supplied by an external power source (charger), electrons move from cathode to anode via a conducting wire while Li-ion losing electrons flow through electrolyte from cathode to anode where they are stored between layers of carbon C6. This is called charging state where electric energy is converted to chemical energy and stored in the battery.

In the reverse state, when the circuit is closed, potential difference induced in the charged battery will cause electrons to flow back from anode to cathode through the conducting wire to power the electrical device. Inside the battery, Li-ion losing electrons will flow through the electrolyte from anode to cathode. This is known as discharging state, when chemical energy is transformed to electric energy to power the electrical device.

Therefore by charging and discharging, a Li-ion battery can be used repeatedly as a green energy provider.