POSCO E&C continuously has paved the way to new business fields and has gained tangible results from nonferrous industry as well.
Paving the Road to the Nonferrous Industry Market

The First Production of Lithium by POSCO in Korea

On 7th February, 2017, a POSCO Lithium Extraction (PosLX) plant with an annual capacity of 2,500 tons was completed at Gwanyang Works in Korea and the completion ceremony was held on the same day. More than 100 people attended the ceremony including Mr. Oh-joon Kwon, CEO of POSCO and Mr. Chan-kun Han, CEO of POSCO E&C together with various business and government officials – Mr. Jae-chun Song, Chairman of Gwangyang City Council, Mr. Hyun-bok Jeong, Mayor of Gwangyang city, Mr. Gi-jong Woo, Deputy Governor of South Jeolla Province, Mr. Ung-beom Lee, President of LG Chem and Mr. Nam-seong Cho, President of Samsung SDI.

“We are planning to continuously foster new growth business with technology competitiveness in the energy material business such as development of lithium for batteries, high purity nickel and cathodes materials.” Mr. Oh-joon Kwon, CEO of POSCO, said in this ceremony.

POSCO E&C has played an important role in this project as a single EPC contractor, in which all discipline of works were organically executed and ended up being completed successfully within the planned schedule – one year from engineering to commissioning. With the successful completion of this innovative nonferrous plant, POSCO E&C has seized an opportunity to step into the highly promising business area of producing lithium, with a proven EPC capability to complete successfully in a relatively short time with compact process compared to the conventional one.

As demand for lithium-ion secondary batteries has increased explosively thanks to the continuous expansion of mobile products, worldwide demand for lithium carbonate for batteries has rapidly swelled from 6,000 tons (in 2002) to 66,000 tons (in 2015). Considering an increase in the use of electric vehicles and energy storage systems (ESSs) in future, its demand will balloon to over 180,000 tons by 2025. POSCO plans to strengthen its position as a global lithium production base by establishing production systems with an annual production capacity of 40,000 tons of lithium at home and abroad, starting with the PosLX Plant at Gwangyang Works.

The PosLX plant will produce 2,500 tons of lithium carbonate per year and it is the first commercial production in Korea since developing its own technology for 7 years. POSCO’s lithium extraction technology is a process of converting lithium phosphate extracted from salt water through chemical reaction into lithium carbonate. POSCO has a plan to supply lithium carbonate to LG Chem, Samsung SDI, etc.. With the foundation of the PosLX plant, the procurement of raw material for these kinds of companies is expected to be much easier than before since there were no domestic suppliers to provide lithium as raw material and difficulties in importing it so far for making rechargeable batteries.
Optimized Technology for Customers’ Needs

PosLX (POSCO Lithium eXtraction) Technology

PosLX (Posco Lithium eXtraction) Technology has been developed proprietarily by POSCO since 2010. POSCO spent seven years to independently develop the eco-friendly lithium extraction technology. This technology is a method that extracts lithium phosphate ($\text{Li}_3\text{PO}_4$) from brine and converts it into lithium hydroxide (LiOH) & lithium carbonate ($\text{Li}_2\text{CO}_3$) by chemical reaction. Since lithium can be easily ionized in the air, it is stabilized and distributed as a form of lithium carbonate.

PosLX technology stands out in having a high production efficiency compared to the conventional solar evaporation method. When it comes to the production lead time making use of the conventional method with natural evaporation, it takes 12 to 14 months on average. On the other hand, this new technology only takes up to 3 months in producing battery-grade products. In addition, the recovery rate of lithium using the new technology is more than compared to that of which ranges from 20 to 40%. Last but not least, there is one more advantage when applying this new technology from the environmental point of view.

PosLX technology minimizes environmental effects to soil and ecosystem and discharges less amount of inorganic tailings such as NaCl, $\text{CaSO}_4$, etc. without any hazardous organic material in use. POSCO has completed to verify the competitiveness and feasibility of technology by operating pilot plants using various brines from Latin America and POSCO already filed for more than 100 patents on lithium extraction in Korea and overseas.

POSCO envisions to secure its own lithium salar (salt lake) for further production in lithium compounds, planning to make a stable supply of $\text{Li}_2\text{CO}_3$, the raw material of secondary batteries, in the domestic battery market.

The core unit technology of PosLX Process had been developed and verified through operating Pilot Plant 1. Then, the verification of continuous process, mass productivity and quality was achieved sequentially through additional pilot plant tests. Finally, PosLX Technology succeeded in realizing commercialization through the 1st commercial plant with 2,500 tons/year capacity in February of this year.

### Progress of PosLX Technology

<table>
<thead>
<tr>
<th></th>
<th>PP1</th>
<th>PP2</th>
<th>PP3</th>
<th>Commercial Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>2 TON/Y</td>
<td>20 TON/Y</td>
<td>200 TON/Y</td>
<td>2,500 TON/Y</td>
</tr>
<tr>
<td>Period</td>
<td>’11. 04 – ’12. 12</td>
<td>’12. 07 – ’13. 07</td>
<td>’13. 08 – ’15. 08</td>
<td>’17. 02 –</td>
</tr>
<tr>
<td>Object</td>
<td>Core Unit Technology Development</td>
<td>Continuous Process Verification</td>
<td>Mass Productivity &amp; Quality Verification</td>
<td>Commercialization</td>
</tr>
</tbody>
</table>

### Characteristics of PosLX Technology

**Conventional Process [Solar Evaporation]**

- Brine $\rightarrow$ Evaporation $\rightarrow$ High conc. Brine $\rightarrow$ Chemical Extraction $\rightarrow$ Conversion $\rightarrow$ High Purity Lithium Hydroxide
- Brine $\rightarrow$ Evaporation $\rightarrow$ Low conc. Brine $\rightarrow$ Chemical Extraction $\rightarrow$ Purification $\rightarrow$ High Purity Lithium Carbonate

**PosLX Process**

- Minimized Evaporation $\rightarrow$ Brine $\rightarrow$ Low conc. Brine $\rightarrow$ Chemical Extraction $\rightarrow$ High Purity Lithium Hydroxide
- Inorganic process $\rightarrow$ Brine $\rightarrow$ Low conc. Brine $\rightarrow$ Chemical Extraction $\rightarrow$ High Purity Lithium Carbonate

- Innovative Production Lead Time : 12 – 14 months $\rightarrow$ 3 months
- Outstanding Li Recovery Rate : 20 – 40% $\rightarrow$ 80 – 90%
- Smaller Dependency on Climate / Weather & Environment
- Flexible Production of Lithium Hydroxide & Lithium Carbonate
- Battery Grade Li Compounds without Additional Purification Process
Introduction of Newly Launched Business Area

Based on top-class engineering technology such as automotive manufacturing plants, food plants and clean rooms, we are carrying out EPC projects across all industrial plants. As a result of merging with POSCO Engineering last year, POSCO E&C expanded its business portfolio to meet the customers’ needs as below:

<table>
<thead>
<tr>
<th>Electronics (Semi-con./ LCD/OLED)</th>
<th>Pharmaceuticals / Food Plants</th>
<th>Automotive &amp; Industrial Plants</th>
<th>Material Handling &amp; Warehouses</th>
<th>Other Industrial Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Semi-Conductor FAB.</td>
<td>- Pharmaceuticals</td>
<td>- Assembly &amp; Arrangement Plants</td>
<td>- Logistics Center</td>
<td>- Aircraft Manuf. Facilities</td>
</tr>
<tr>
<td>- LCD/OLED FAB.</td>
<td>- Food Processing</td>
<td>- Food Processing</td>
<td>- Automotive Warehouses</td>
<td>- Paint &amp; Coating</td>
</tr>
<tr>
<td>- Other Electrics &amp; Electronics FAB.</td>
<td>- HACCP Facilities</td>
<td>- HACCP Facilities</td>
<td>- Refrigeration Warehouses</td>
<td>- Manuf. Plants</td>
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<td></td>
<td>- GMO/GMP Facilities</td>
<td>- Chassis &amp; Body Manufacturing</td>
<td></td>
<td>- Electronics Raw</td>
</tr>
<tr>
<td></td>
<td>- Feed Manuf. Facilities</td>
<td>- Control Module &amp; Part Plants, etc.</td>
<td></td>
<td>- Material Plants</td>
</tr>
</tbody>
</table>

Appointed as a Supplier for a Multi-Purpose Gas Holder in Indonesia

POSCO E&C got awarded from PT. Krakatau POSCO collaborating with POSCO in Korea and PT. Krakatau in Indonesia for a multi-purpose gas holder. This Project is aimed to make up for issue of maintenance and contain more gas needed in the extended plant whose capacity is approximately 80,000 cubic meters. It is the first time to apply a multi-purpose gas holder in POSCO that can be utilized in two functions according to the operation mode as BFG (Blast Furnace Gas) or COG (Coke Oven Gas) holder.

The project representative of POSCO E&C said, “POSCO E&C is the renowned EPC provider in Indonesia. The reason is that we already have built the biggest Integrated Steel Mill in Indonesia and the client was satisfied.” With aforementioned EPC experience, we are ready to supply the best quality and price to clients.

Step Forward to an Optimized EPC Solution Provider in the Field of Industrial Plant

On 3rd March, 2017, POSCO E&C was appointed as the final successful bidder by Korea Aerospace Industries, Ltd. The construction cost of this project is about 20 million dollars.

This construction project is to build a launch vehicle manufacturing facilities and logistics center at the Jong-po General Industrial Complex area in Sacheon city, Korea. This construction project will be completed in December, 2017.

POSCO E&C held on 24th February, 2017 the Factory Opening Ceremony for Seagate Korat Building 6 Project, of which POSCO E&C was in charge of construction for manufacturing external hard disk drive and test facilities. Over 200 people attended the opening ceremony, including Mrs. MahaChakriSirindhorn, Princess of Thailand, Senior Government Officials in Thailand, Mr. Glyn T. Davies, USA Ambassador of Thailand, Mr. Hong-Keun Son, Project Manager of POSCO E&C and local clients.

As a main technical leading company, POSCO E&C proved its optimized construction capability to clients with its accumulat-ed experiences and know-hows throughout this project successfully.

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