# Cathode Active Material Synthesis and Battery Performance Tests for Li-ion Batteries from Domestic Raw Materials

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The energy requiremenet brought by technological developments from the past to the present evolves depending on the society's desire to be mobile, which is increasing day by day. Many technological devices such as electrical vehicles, smart phones, computers, drones, cameras meet the required energy from rechargeable lithium-ion batteries. However, the increasing world population and the increasing specifications of the technological devices developed in parallel with the per capita energy consumption by making the raw material resources needed for the production of these technological devices even more important. Nickel, cobalt and manganese compounds, which are the main raw materials used in the cathode production of NMC type lithium-ion batteries, are among these chemicals of strategic and critical importance, and the production of these chemicals in appropriate quality is of great importance for the industrial development of lithium-ion-based domestic battery technologies in our country.

Meta Nikel Kobalt A.Ş., which is the first and the only nickel-cobalt plant in our country at industrial scale. In Gördes plant, nickel-cobalt-manganese hydroxide intermediate product concentrate (MHP) is produced from Gördes lateritic ore using high-pressure acid leaching technology and is currently completely exported to overseas. However, due to the responsibility of transforming domestic resources to high value-added technological products and obtaining value-added products, research in this field has been regarded and the necessary technological infrastructure and specific knowledge have been created.

Within the scope of this study, precious metals in the MHP intermediate product obtained from Gördes lateritic ore were leached and valuable elements are taken to the liquid phase and crystallized after further purification processes such as solvent extraction and ion exchange. As a result, metal salts with purity up to 99.99% were obtained. The obtained nickel, cobalt and manganese sulphate salts were precipitated together with the developed co-precipitation process to obtain precursor in the form of NMC 622. After that, the precursor is treated with lithium and the cathode active material (CAM) is obtained by going through various heat treatments.

Figure 1. MHP product and produced sulfate salts (nickel, cobalt and manganese sulphate respectively) and CAM

The coin cell made with the CAM obtained from domestic raw materials showed a capacity of 184.55 mAh/g at 0.1C. It showed a capacity of 170.58 mAh/g in the first cycle and 157.45 mAh/g in the 50th cycle at 0.5 C, and the capacity conservation was calculated as 92.3% after 50 cycles at 0.5 C. The CAM obtained in the pilot-scale studies carried out according to the lab-scale developed process andsent to TUBITAK RUTE to make pouch type battery.

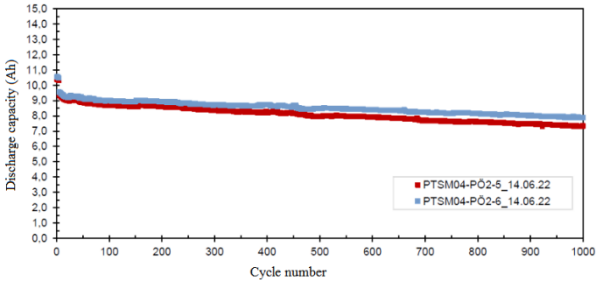


Figure 2. Pouch type battery cycle number and discharge capacity graph

In the 10 Ah capacity cells of the produces pouch type, 82% capacity conversation has been achieved as a result of 1000 cycles at a charge/discharge rate of 0.5 C at 100% CoC(Dept of Discharge) in the voltage range of 3-4.15V.

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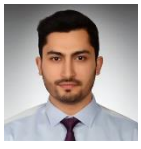
**References**

[1] Wapperhorst, Sandra. The end of the road? An overview of combustion-engine car phase-out announcements across Europe. International Council on Clean Transportation, 2020.
[2] Yuan-Li Ding, Zachary P. Cano, Aiping Yu, Jun Lu, Zhongwei Chen. Automotive Li-Ion Batteries: Current Status and Future Perspectives. 2018.
[3] D. Darvishi, D. F. Haghshenas, E. Keshavarz Alamdari, S. K. Sadrnezhaad. 2011. Extraction of Zn, Mn and Co from Zn-Mn-Co-Cd-Ni Containing Solution Using D2EHPA, Cyanex 272 and Cyanex 302. IJE Transactions B: Applications.
[4] S. Krueger, C. Hanisch, A. Kwade, M. Winter, S. Nowak. 2014. Effect of Impurities Caused by a Recycling Process on the Electrochemical Performance of Li[Ni0.33Co0.33Mn0.33]O2. Journal of Electroanalytical Chemistry.



Melih Özduran, graduated from Sivas Cumhuriyet University, Department of Chemical Engineering, with a bachelor's degree in 2017 and a master's degree in 2020. As a research area of interest; purification of precious metals (with leaching, neutralization, SX-IX methods) and energy storage systems.
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