

THE

BATTERY

CHRONICLES



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A Design Engineer's Prospective on Work with the New & Improved Lithium-ion Battery Recycling Equipment Line Under Project STREAMS

Our institute, UkrNIIElectrotherm (UNE), is a leading engineering organization in furnace and process design in Ukraine. Our portfolio of clients includes international companies from within Ukraine, as well as from companies from abroad, to include: European Union, Kazakhstan, Mongolia, Oman, the USA, Azerbaijan, and beyond. Within the scope of UNE's responsibilities under STREAMS project as a participant in the lithium-ion battery recycling, my role as a designer of thermal and specialized process equipment involves developing fluidized bed furnaces, electric arc furnaces, and a roller hearth calcination furnace. The latter can be used for lithiation of cathode active material as well as for heat treatment of surface coated anode active materials alike. I was also responsible for designing cooling water supply and drainage systems for water-cooled components, routing protective atmosphere (nitrogen) supply lines, and engineering mechanization lines and auxiliary equipment for battery dismantling, graphite disc sawing, and other process operations in Work packages 2 and 5, closely collaborating with STREAMS partner AETC. Additionally, my duties include participating in the development and revision of layout solutions of the scaled up production facility floor plans. The aforementioned facility will house the most promising technologies identified in STREAMS for scale up and will be used as part of exploitation strategy of the project even after it reaches the end of life (WP8).

The complexity of the work resulted from periodically changing baseline data and process requirements. This was understandable, given that we were working on a novel, unproven technology and collaborating closely with experts from the Ukraine, EU and the USA.

The complexity and occasional pressure of the design work were driven by the technology being new to us, strict process requirements for furnace atmosphere purity and, consequently, airtightness, and baseline data that changed as variants were analyzed, laboratory results were received from our colleagues, and new engineering ideas emerged. It was necessary not only to modify equipment designs but also to reintegrate the thermal equipment, cooling systems, gas supply, mechanization, and material handling systems into a unified process stream, as well as to revise the layout of the production workshop and its dedicated sections. Our regular communications with specialists from AETC greatly facilitate prompt decision-making and advance our parts of the project. I particularly enjoy the positive attitude of our partners from STREAMS who rely on our prior industry experience, consistently welcoming our ideas aimed at improving equipment reliability, ensuring higher precision in maintaining temperature profiles of custom heat treatment furnaces, and relaying on our recommendations for controlling the required atmosphere in reactors. I am deeply grateful to them.

The value of the spent cathode is more intuitive, as it contains a mix of metals: lithium, nickel, manganese, and cobalt. Unrolled cathodes are processed to separate active material from the aluminum foil current collectors. AETC partners of STREAMS project in Ukraine (ISPE and UNE) then convert the recovered end-of-life cathode active material into solid manganese dioxide and a nickel-cobalt alloy. Lithium is recovered in two ways. First, it comes out of the cathode and anode wash as a mixture of LiF and Li₂CO₃ salts. Then, lithium metal can be obtained from the cathode active material via electroplating, a process operating at ISPE. Overall recovery is high, reaching up to 60% of cathode ingredients which were recovered through AETC's Direct Recycling process. Finally, the manganese salt, lithium components, and nickel-cobalt alloy undergo further reactions to create fully healed NMC ready for use in a new round of cell. The latter operation is performed by UOULU, a prominent consortium member of STREAMS.

I am very grateful to have had the opportunity to participate in such an ambitious project—STREAMS. It has contributed significantly to my professional growth, providing me with valuable experience, new knowledge, and enhanced communication skills with the international community. Furthermore, being part of an environmentally sustainable cause which forms the heart of STREAMS, has reinforced my confidence that humanity can take meaningful steps to care for our shared home. I truly enjoy being part of a project aimed at improving the quality of life in Europe and promoting sustainable resource management. I would gladly participate in similar projects should such an opportunity arise in the future.



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