

Advanced Design Project in Mongolia: Recycling of Lithium-Ion Batteries



TECHNISCHE
UNIVERSITÄT
DARMSTADT

at the German-Mongolian Institute for Resources and Technology (GMIT)
Nalaikh, Mongolia, May 04 - May 22, 2020



In the project, students from mechanical, chemical, process, environmental, and industrial engineering from Mongolia, Germany, and the USA will collaborate.

Professors from Mongolia, Germany, and the USA will supervise the project.

The project takes place from May 4 to May 22, 2020 in Nalaikh, Mongolia. Two weeks additional work are required to finalize the report. The final report is due June 7, 2020, 23:59:59 UTC

Institute for Nano-
and Microfluidics
Thermal Process
Engineering Group



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Project Description

Recycling of lithium-ion batteries is an unsolved problem in America, in Europe, in Japan, and in Mongolia. 70 % of all cars imported to Mongolia are used Toyota Prius cars. At the end of life of these cars, the lithium-ion batteries have to be disposed of.

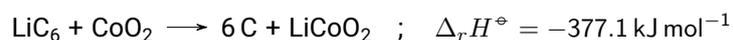
However, in designing lithium-ion batteries in the past, the designers did not provide for the decommissioning of these devices. The problem is rapidly increasing, as not only car batteries but also lithium-ion batteries of mobile phones, vaping and other electronic devices at the end of their life are piling up.

Dismantling used lithium-ion batteries is a risky operation, as the batteries will be partially charged and will vigorously react if anode and cathode get accidentally into contact.

In this project, the task for the mechanical engineers will be the design of a shredder and a mill for all types of lithium-ion batteries. The batteries are to be milled into fine particles that are further processed.

The milled particles will consist of lithium carbide (LiC_6), cobalt dioxide (CoO_2), graphite (C), lithium cobaltite (LiCoO_2), aluminium (Al), copper (Cu), organic solvents, lithium hexafluorophosphate (LiPF_6), lithium perchlorate (LiClO_4), various polymer substances, and to a lesser amount iron, manganese, and nickel compounds.

The task for the chemical and process engineers is the safe reactor design for the highly exothermic reaction between the milled lithium carbide and cobalt dioxide particles



and the development of the separation and reaction sequence to obtain marketable products for recycling.

Environmental engineers focus on the legal framework for reprocessing lithium-ion batteries in Mongolia, Germany and the USA, and evaluate the carbon dioxide footprint and the water footprint in comparison to mining lithium and cobalt ores.

Industrial engineers analyze and calculate the production cost and develop marketing strategies.

