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The recovery of critical raw materials from waste Li-ion batteries by bioleaching in comparison to chemical leaching - an innovative method based on geomicrobiology.

WERONIKA URBAŃSKA[1], ANNA POTYSZ[2], **EWA IZABELA IZABELA BOROWSKA**[3,4] AND MONIKA KULA-MAXIMENKO[5]

[1]Faculty of Environmental Engineering, WrocÅ‚aw University of Science and Technology

[2]University of Wroclaw

[3]The College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences (MISMaP), University of Warsaw

[4]Extremo Technologies SP. Z O.O.

[5]The Franicszek Górski Institute of Plant Physiology Polish Academy of Sciences

Presenting Author: ewa.borowska86@gmail.com

The global necessity and demand for pivotal elements in the worldwide market, and their importance in economy and trade reveal the problem of excessive acquisition, and thus the depletion of natural resources, is constantly growing.

Batteries are considered as potential secondary resources of metals whose availability from the natural assets is otherwise non-renewable and limited. Currently, one of the most popular battery groups is represented by Li-ion batteries containing metals such as Li, Co and rare earth elements (REE) classified in regulatory documents of the European Union and the United States as critical raw materials.

Taking into account the high demand for reducing the excessive exploitation of natural resources of metallic critical raw materials, a concept of laboratory tests was developed for the recovery of such metals from spent Li-ion batteries using the hydrometallurgical method (acid leaching) and comparison to bioleaching with the use of extremophilic microorganisms. Metal recovery from batteries may be achieved by hydrometallurgical and pyrometallurgical approaches, however, their environmental soundness has often been questioned due to generation of the waste residues and toxic gases emissions. To stress the importance of using selected microorganisms, the study on geomicrobiological experiments was also developed and planned. To optimize extraction from waste Li-ion battery powder two types of experimental approaches were proposed and examined: (i) acid leaching with the use of inorganic and organic acids as leaching agents and (ii) bioleaching carried out starting from bacteria: *Acidithiobacillales,* subsequently cyanobacteria and selected strains of volcanic algae from acidic environments.

The decomposition process of electro-waste violates natural biogeochemistry and geomicrobiology of groundwaters, soils, and sediments and later has an impact on contaminations of seas and oceans by metals. We conclude that peculiar bioleaching is an environmentally sound green approach for the treatment of spent Li-ion batteries and will have a major bearing on the future eco-extraction of metals from such wastes.