Recovery of Lithium and Cobalt from spent Lithium-ion batteries and dechlorination of chlorinated polyvinyl chloride (CPVC) in hydrothermal treatment

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The energy growth demand for consumer electronics and electric vehicles (EV), they increased the Lithium-ion battery consummation(Liu, 2016). Additionally, this can be automatically increasing the production of metal which are containing the hazardous waste(Itoh, 2006). The absence of adequate recycling technologies of Lithium–ion batteries (LIBs), may cause many problem like environment pollution and loss of valuable metals(Armand, 2008) . However, recovery and recycling of main components from the spent LIBs especially the Cathode materials can provide us a beneficial way to prevent our environmental pollution and valuable elements from cathode and anode materials.

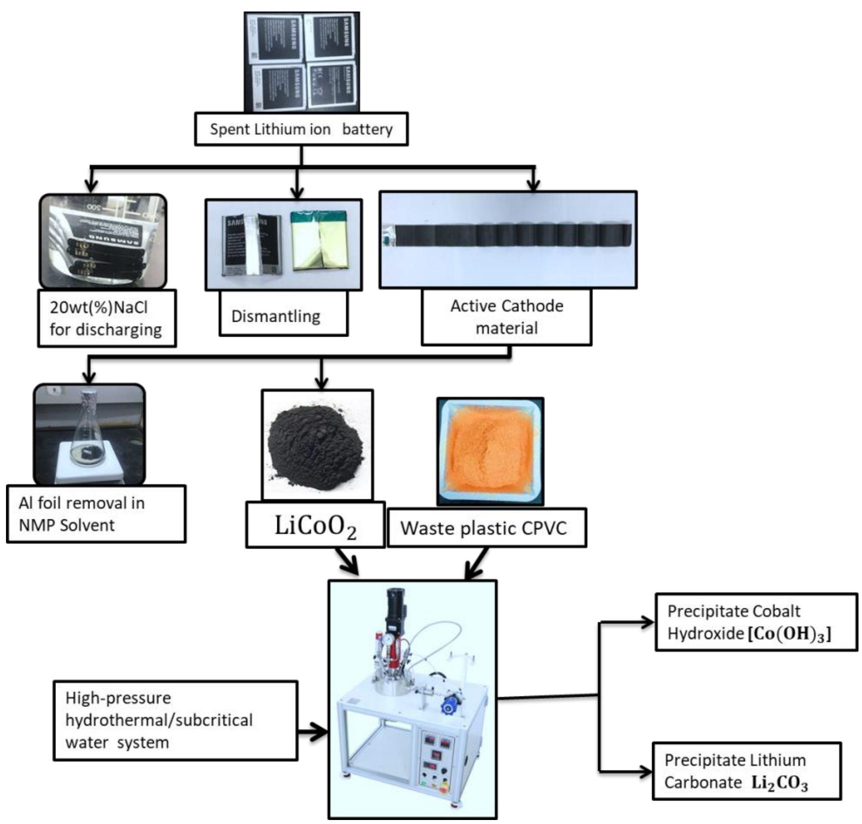

Figure 1. Schematic diagram for Co and Li recovery from spent Lithium-ion batteries

Generally, this work was focused on an effective and environmental friendly recovery of valuable metals such as Lithium (Li) and Cobalt (Co) from the spent Lithium-ion batteries and the same time dechlorination of waste plastic chlorinated polyvinyl chloride (CPVC) in hydrothermal subcritical water process as shown in fig 1.Waste plastic Chlorinated polyvinyl chloride was grinded and sieved to obtain fine CPVC powder. Pre-treatment stage, spent lithium-ion batteries was full discharged in 20(wt%) NaCl solution and dismantling. After Al foil removed from cathode electrodes by using 50ml of N-methyl-2- pyrrolidone (NMP) solvent. Then the $LiCoO_2$ surly were filtrated and dried. $LiCoO_2$ powder was measured by inductively coupled plasma optical emission spectrometer (ICP-OES) after digestion with aquaregia. The results indicated that Li was accounted for 4.99% and 54.90% for Co as shown from table 1.

Table 1. The element content of LiCoO2 powder from ICP-OES results

Symbol	elements	wt% content
Li	Lithium	4.99
Co	Cobalt	54.90

Co-treatment stage, $LiCoO_2$ powder and waste plastic CPVC will be co-treated in temperature range of 200℃ to 450℃ by subcritical waster oxidation, in which CPVC will be used as a hydrochloride acid (HCl) source to promote metal leaching. The expected results from ICP-OES will show us that more than 96% Cobalt and nearly 97% Lithium will be recovered under the optimum conditions of 350℃, CPVC/$LiCoO_2$ ratio 3:1 and time 40min respectively. As conclusion, the process includes 2 main steps: (1) pre-treatment; from Li-ion battery full discharge until $LiCoO_2$ powder formed. (2) Co-treatment ; from leaching process until recovery of Li and Co in form of $Li2CO_3$ and $Co(OH)_3$.This innovative work of hydrothermal subcritical water technology is sufficient, environmental friendly and appropriate for Co and Li recovery from spent lithium-ion batteries.

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