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Qatalum's 1st Cut SPL; Treatment And Applications

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Abstract

Spent Pot Lining (SPL) is produced in thousands of tons annually as a waste from the aluminum industry. SPL is classified into two types, 1st and 2nd Cut SPL. The 1st cut, which is the material under investigation in this study, is a contaminated graphite/ceramics material (50 - 60% of graphite) that is used in lining the electrolytic cell within which aluminum is produced by the reduction of molten Al2O3. 1st Cut SPL is considered as a hazardous material since it contains many other contaminants such as fluorides, cyanides, lead and chromium in addition to its production of flammable gases when it comes in contact with water e.g. ammonia, phosphine, hydrogen and methane. The aim of this study is threefold: (i) fully characterize the 1st Cut SPL produced by Qatalum in Qatar to help in creating the materials safety data sheet (MSDS), (ii) chemically treat this 1st Cut SPL in order to extract the graphite component to use it in other applications in addition to the Cryolite and finally (iii) use the extracted graphite in removing heavy metal ions from aqueous solutions.
In this work, the first treatment for 1st Cut SPL was washing it with deionized water. The produced gases were collected in gas bags and characterized using GC-MS which confirmed the evolution of H2 gas when the 1st Cut SPL comes in contact of water. The second step was washing the 1st Cut SPL powder several times with organic solvents to dissolve the existing organic compounds and characterize the eluent using HPLC-MS technique to identify the dissolved organics. A thermal treatment to get rid of the undissolved organic materials was done. Next, surface characterization was carried out for the dried powder which confirmed the absence of any organic materials. Later, the powder was treated with cycles of different concentrations of NaOH, HNO3 and deionized water to remove the remaining inorganic contaminants. The eluents, resulted from the chemical treatment and washing processes, were collected and analyzed using HPLC-MS and ICP. The purity of the produced graphite powder was characterized using XRD to check its purity.

The produced graphite powder was functionalized through boiling in 1:1 of H2SO4 : HNO3, washing with deionized water, hot NaOH and finally with deionized water to increase the carboxylate groups on the graphite surface which increases the negative charge on the graphite's surface once mixed with water. The functionalized graphite was proved to Cu ions from aqueous solutions at different pH values with efficiency close to 100 % at pH 10.