

Partially Phosphorylated Polyvinyl Phosphate-PPVP Composite: Synthesis and Its Potentiality for Zr (IV) Extraction from an Acidic Medium

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Abstract : Synthesized partially phosphorylated polyvinyl phosphate derivative (PPVP) was functionalized to extract Zirconium (IV) from Egyptian zircon sand. The specifications for the PPVP composite were approved effectively via different techniques, namely, FT-IR, XPS, BET, EDX, TGA, HNMR, C-NMR, GC-MS, XRD and ICP-OES analyses, which demonstrated a satisfactory synthesis of PPVP and zircon dissolution from Egyptian zircon sand. Factors controlling parameters, such as pH values, shaking time, initial zirconium concentration, PPVP dose, nitrate ions concentration, co-ions, temperature and eluting agents, have been optimized. At 25 °C, pH 0, 20 min shaking, 0.05 mol/L zirconium ions and 0.5 mol/L nitrate ions, PPVP has an exciting preservation potential of 195 mg/g, equivalent to 390 mg/L zirconium ions. From the extraction-distribution isotherm, the practical outcomes of Langmuir's modeling are better than the Freundlich model, with a theoretical value of 196.07 mg/g, which is more in line with the experimental results of 195 mg/g. The zirconium ions adsorption onto the PPVP composite follows the pseudo-second-order kinetics with a theoretical capacity value of 204.08 mg/g. According to thermodynamic potential, the extraction process was expected to be an exothermic, spontaneous and beneficial extraction at low temperatures. The thermodynamic parameters ΔS (-0.03 kJ/mol), ΔH (-12.22 kJ/mol) and ΔG were also considered. As the temperature grows, ΔG values increase from -2.948 kJ/mol at 298 K to -1.941 kJ/mol at 338 K. Zirconium ions may be eluted from the working loaded PPVP by 0.025M HNO₃, with a 99% efficiency rate. It was found that zirconium ions revealed good separation factors towards some co-ions such as Hf⁴⁺ (28.82), Fe³⁺ (10.64), Ti⁴⁺ (28.82), V⁵⁺ (86.46) and U⁶⁺ (68.17). A successful alkali fusion technique with NaOH flux followed by the extraction with PPVP is used to obtain a high-purity zirconia concentrate with a zircon content of 72.77 % and a purity of 98.29%. As a result of this, the improved factors could finally be used.

Keywords : zirconium extraction, partially phosphorylated polyvinyl phosphate (PPVP), acidic medium, zircon

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