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Uranium extraction from seawater using radiation-grafted UHMWPE fiber: from laboratory to pilot scale

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Owing to the fast economic growing and the concern over greenhouse gases and air pollution, uranium extraction is one important option to meet the nuclear fuel consumption in the future. The uranium reserve is one thousand times that in land; however, the big challenge of feasibility is the extremely low uranium concentration in ocean (ca. 3.3-3.5 ppt). Polyethylene fiber modified by radiation-induced graft polymerization of acrylonitrile and following amidoximation has been recognized to be the most suitable material for uranium extraction from seawater, in terms of durability, extraction capacity and selectivity.

Concerning the feasibility of uranium extraction from seawater, a lot of challenges have to be overcome, e.g. mass production of fiber adsorbents at a reasonable cost, high adsorption capacity and selectivity for uranyl ion in seawater, deployment of adsorbents in ocean, stripping of uranyl from adsorbent and reuse of the fiber adsorbent. About five year ago, we started a project on the uranium extraction from seawater, supported by the Chinese Academy of Sciences.

In this talk, we will present our progress in the development of UHMWPE (ultra-high molecular weight polyethylene) fiber adsorbent and uranium adsorption evaluation in simulated seawater as well as in real seawater. UHMWPE fiber is adopted owing to its high tensile strength and excellent durability in seawater. A facility for production of UHMWPE fiber adsorbent will be established in 2014, with the use of 0.5 MeV accelerator, appropriate under-beam system and grafting polymerization system. We also set up a facility for the evaluation of fiber adsorbent in which 1500 L of simulated seawater is flowed through 12 columns in 24 h. It is our target to do marine test in China coastal area in 2014-2015.

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