

Could calixarenes be a viable solution for radioactive decontamination of mine waters from Romania?

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The present contribution aims to be only the beginning of a future much more detailed research study. Uranium industry has registered in Romania a very high development beginning with the 1950's, when uranium-bearing ore bodies were found and exploited in three main regions, namely Banat, Apuseni Mountains and the Eastern Carpathians¹.

After 1990, these uranium extraction and processing activities were closed in almost all European countries and in Romania as well and the emphasis changed to environmental rehabilitation activities in the areas affected by uranium exploration, exploitation and ore processing. On the other hand the uranium industry is a very well known pollution source, which generates huge amounts of radioactive contaminated wastewaters. A very important part of them is represented by the mining waters, which are a serious threat for the environment and for the people living nearby as well. Under this context it was compulsory for the research scientists to come up with some reliable and efficient solutions to radioactive decontaminate them in order to be recycled and included into the hydrographical network. Our institute has accomplished a lot of research studies and basically the proposed technological solution consists of collecting all these radioactive mining waters into ditches dogged at the basis of the waste dumps and then to conduct them to the water treatment station.

The methods² used for the radioactive contaminated mining water's treatment were as follows:

1. Physical ones, which are mainly based on the adsorption, absorption and ion exchanging processes using organic or inorganic substances;
2. Chemical ones, which are involving redox processes;
3. Biological ones, which are involving the micro - organisms' growth reaction, which is based on an electron transfer mechanism.

Despite of their extremely encouraging results each one of these procedures presents some weak points such as is the case of the bioremediation processes, where everything is beautiful until the poor micro-organisms are dieing and all the radioactive metals accumulated by their bodies are returning into the natural circuit. It is important not to ignore the fact that now the science made significant progress in getting to understand intimately the chemical behaviour of uranium and his daughters at molecular level such as in the supramolecular chemistry's case and has reached a point in which is able to filter molecules (see the reverse osmosis units, nano- and ultra-filtration ones as well). Unfortunately they are in many cases too expensive to afford it. Many research studies have been carried out worldwide in order to synthesize extremely selective organic molecule able to discriminate between the competing ions and to retain uranium and to decontaminate the radioactive mining waters. In their quest for the appropriate answer they discovered a very promising class of organic compounds known as calixarenes. Calixarenes are macrocyclic molecules formed by 4, 6 or 8 para-substituted phenolic units linked by methylene bridges ortho to the OH functions. Thus, molecules of different ring sizes are formed. It was reported³ recently that especially calix [6] arenes functionalized with carboxylic, hydroxamic and sulfonic groups on the lower rim are suitable to separate uranium from aqueous solution. The study of their chemical behavior toward uranium and its decaying daughters contained by the radioactive contaminated mining waters is still a challenge for many of the research scientist worldwide and we do consider that it could be a very good answer to our potential difficulties in decontaminating radioactive mining water. The right answer shall be obtained at the end of our future detailed research study.

1. Information available on the institute's website: www.icpmrr.ro
2. I.C. Popescu, et al., "Consideration concerning the role played by uranium organo-metallic complexes during the treatment of radioactive waste waters resulted from uranium mining industry" International Symposium "Environment and Industry", Bucharest, Romania (2005)
3. Schmeide, K, et. al., "Complex formation between uranium (VI) and calix [6] arenes studied by time-resolved laser-induced fluorescence spectroscopy information available on the following website address: <http://www.fjfi.cvut.cz/radchem/formmeet/radchem2002/confprog/session6.html> (2002)