On the long-term safety of nuclear waste disposal: Scientific solution & Political approach

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1. Introduction

Nuclear waste disposal inevitably entails the long-term safety precautions, especially for actinide-bearing waste, e.g. spent fuel and/or reprocessing rests, for which the time-scale extends many thousand years. The long-term safety measures are concerned with all discharges from both the present fission reactors and the future spallation/fission systems (ADS: accelerator driven system) that are intended to burn-up actinides to generate energy. After a few hundred years cooling, the dominant radioactive inventory of all such discharges is attributed to long-lived actinides, such as Pu, Am, Cm and Np. Once produced, their existence cannot be obliterated but the amount can partially be reduced physically by a spallation/fission system (ADS). One cycle burn-up rate of fuel in a conventional fission reactor is around 5%, whereas the envisaged ADS reactor burns up max. 20% fuel per cycle. Multiple recycling of fuel in both systems is however for technical and economical reasons not desirable. After all, a geological disposal of actinide-bearing waste is inevitable and thus becomes the ultimate solution.

2. Significance of aquatic actinide chemistry

Chemical immobilization and physical confinement in a suitable geological site may enable the long-term disposal of actinide-bearing waste. Nonetheless, permanent isolation of waste from water intrusion is not predictable, since the geological environment may change with time, especially for a long period of time envisaged for a given repository. The long-term safety of nuclear waste disposal therefore has to assume all possible geochemical behavior of actinides in the repository site aquatic environment. This fact entails relatable knowledge on what makes them ***mobile*** vs. ***immobile***. The mobilization of actinides in natural aquatic system is promoted by aquatic colloids, which are ubiquitous in natural water. Concentration of such colloids is very often higher than that of the radiological limitation imposed, for example, for Pu (<1 nmole). For such reasons, the appraisal of generation process of actinide-bearing aquatic colloids is crucial for the long-tem safety assessment of a given repository site. As a result, knowledge on the aquatic actinide chemistry is significant for this purpose.

3. Epilogue

The presentation summarizes briefly the generation of actinides in fission reactors, the characterization of wastes and safety measures of long-term disposal. Discussion is concentrated on the appraisal of the geochemical behavior actinides, particularly formation of mobile species, namely aquatic colloids, and the consequence for the long-term safety assessment in regard of actinide-bearing waste. Scientific solutions must therefore precede political approach.

References

[1] J.I. Kim (2006): Significance of Actinide Chemistry for the Long-safety of Waste Disposal, Nucl. Eng. & Techn. **38**, 459-482.