

Thorium Research Activities in Japan

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The nuclear energy policy in Japan is based on the Uranium-Plutonium fuel cycle with Light Water Reactors (LWR) and Fast Breeder Reactors (FBR). After the accident at Fukushima-Daiichi Nuclear Power Plant, the Japanese government recognizes the importance to ensure the flexibility for future nuclear power generation and then, it was specified in the latest Japanese strategic energy plan.

Two research groups related to thorium fuelled nuclear systems and fuel cycle was set up in the Atomic Energy Society of Japan in 2013. One is a “Research Committee on Nuclear Applications of Molten Salt”. The committee was established to discuss the current molten-salt technology including molten-salt cooled reactor, molten-salt fuelled reactor, accelerator driven system, fusion reactor blankets and dry reprocessing processes. Throughout two years discussion, the committee summarizes a current state of the art and issues of molten-salt application systems. Committee also discussed the handling technologies for molten-salt reactors especially in China and United Kingdom, issues of molten-salt application to fusion reactor, dry reprocessing of spent nuclear fuel, and non-nuclear application of molten-salt. Term of the committee will be extended for further research activities.

The other is a “Working Group for thorium fuel application in light water reactor and fast reactor”. The Working Group was launched before Fukushima accident to enhance the basic studies for application of thorium-loaded fuel, which has the potential for long-life reactor and plutonium burner. The objective is to summarize a status and issues for application of solid-form thorium fuel in LWR/FBR fuel cycle and prepare the knowledge base for thorium application. The working group summarized a report concerning current status of thorium-loaded fuel research in March 2015. The report discuss the physical and chemical properties of thorium oxide fuel, effect of inert materials and/or fission products in fuel pellet, application of thorium-plutonium mixed oxide fuel, neutronics of thorium-loaded nuclear reactors, and status of nuclear data preparation for thorium cycle (cross sections, burnup chain, fission product yields and delayed neutron emission fraction). International activities are also surveyed and summarized in the report. For preparing basic data for physical/chemical/neutronic properties, it is recognized in the report that the shorter number of the measurements results comparing to the uranium-plutonium fuel should be compensated, especially for the fuel properties in accidental conditions. As for the application of thorium fuel into power generation cycle, several significances to maintain competitiveness in price and proliferation resistance are expected.

Japan Atomic Energy Agency proposed a concept of ADS using liquid molten-salt fuel for the effective transmutation of Americium (Am) and Curium (Cm), those affect the design of the geological repository because of their long half-lives and radioactivity. In the concept, Am and Cm are used as a chloride molten-salt fuel. The system consists of a 10MW-class cyclotron, tungsten disk spallation target and subcritical core. Liquid fuel is reprocessed to separate fission products and adjusting the concentration of Am and Cm. Energy balance and subcriticality of the system is designed to recover overall electricity to drive system itself during the lifetime of the reactor. The concept of molten-salt fuelled ADS and dedicated fuel cycle will be introduced for instance.

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Dr. Toshinobu Sasa is currently working in Target Technology Development Section, J-PARC, Japan Atomic Energy Agency Center as a Section leader. Since 1993, He was engaged the design study of sodium-cooled and molten-salt fueled ADS for transmutation of minor actinides. Since 1998, engaged the design and R&D for Transmutation Experimental Facility which planned to be build in the framework of J-PARC (Japan Proton Accelerator Research Complex) project. From April 2009 to March 2012, He was transferred to Secretariat office of Japan Atomic Energy Commission to prepare the data to revise the national policy on nuclear power generation and nuclear fuel cycle (It was abandoned by Fukushima Accident) Dr Sasa Returned JAEA at April 2012 to continue R&D for J-PARC Transmutation Experimental Facility and ADS transmutor.

