

Nuclear Fuels for Fast Reactors-A Review

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This paper reviews the status of fast reactor fuels. The main focus of the development of fast reactor fuel is their potential for actinide transmutation and high burn up. Metallic, oxide, carbide, nitride and dispersion type fuels are being used as fast reactor fuels. Metallic fuels, because they produce an extremely hard neutron spectrum, are neurotically ideal for fast reactors. As compared to other fuels,the thermal and mechanical performance of metallic fuels provide high breeding ratio and large safety margins in normal and accident conditions. U-Pu-Zr are considered best metallic fuels and their properties are well documented.U-Pu-Zr fuel system contains up to 8% minor actinides (MA) and mixture of rare earth element and has excellent compatibility with coolant. U-Mo based alloy fuel system is anticipated to have benefits avoiding phase separation, and increased fuel thermal conductivity. In addition, the fabrication of these metallic fuels is easy and economical.

However other fuels such as oxide fuels have been studied for its potential to be used in fast reactor for normal and transient conditions. Low density, poor thermal conductivity and chemical reaction with coolant are main drawbacks of oxide fuels.Despite these, mix oxide fuel (U,Pu)O₂ has been widely used for fast reactor because of its high melting point and excellent irradiation behavior. Considered as advanced fuel concepts, carbide and nitride fuels have been investigated as an alternative of metallic and oxide fuel for fast reactor. The nitrides fuels have better thermal conductivity and safety margins as compared to oxide fuels. Dispersion type fuel concept were developed to increase the transmutation rate of minor actinides .Use of minor actinides in special mechanical fuel forms is reported to be useful for reduction of high level radioactive waste inventory.These fuel options have been considered w.r.t. fabrication, characterization, irradiation performance, design, high burn up and safety criteria. The technical issues related with the innovative fuels for advanced fast reactors and several irradiation test performed have been discussed and experience research programs of different countries summarized. The recently completed, currently ongoing and planned projects on fast reactors and related fuel cycles of different countries are also part of this paper. By comparing the data of fuel types and reactor designs,the future plan for deployment of a fast research reactor and commercial FBRs in combination with PWRs as sustainable energy system scenarios in Pakistan are also discussed in this paper.

Country/Int. organization

Pakistan

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