Minor actinides transmutation technology optimization methods

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Abstract: Modern methods of minor actinides transmutation and burning out in reactors with different neutron spectrum are considered. The factors limiting the efficiency of transmutation and methods of their influence reducing are considered and analyzed. The influence of different minor actinides loads in the reactore core on the behavior of the reactor was evaluated. The effect of minor actinides loading during reacore core accidents is estimated.

Keywords: Minor Actinides, Transmutation, Curium, Americium, Neptunium

1. Introduction

The aim of this work is to analyze transmutation and burning of minor actinides in the cores of thermal reactors, fast reactors and in accelerated driven systems to make clear the factors that limit the effective transmutation.

2. Method

This work is an analytical review and identifies methods for solving the current limitations of transmutation. The sources of production, and decay chains for minor actinides, namely, Americium, Neptunium and Curium, are considered in this work. Transmutation in advanced reactor systems, both with thermal and fast spectrum in the reactor core were analyzed. To know the factors which limit the effectiveness of transmutation, and the methods to reduce their influence. The highlighted factors are: the level of gas production during transmutation, production constraints and the level of effect on transients in the reactor core.

3. Results

Table 1 is an example of the results obtained in this work and it shows the features of transmutation in a fast reactor with a homogeneous placement of minor actinides in the fuel, that was collected from many scientific works, and allow us to evaluate the effectiveness of transmutation of minor actinides in various conditions. From table 1 it is obvious that transmutation in such conditions is good for transmutation of neptunium, but not curium.

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Table 1. Features of minor actinides (MAs) transmutation in a fast reactor with homogeneous placement in fuel assembly (FA).

Neptunium	Americium	Curium
Advantages		
- Heat dissipation level of spent FA with MAs loading close to the level of the standard FA - Low neutron emission from spent FA with MAs loading	- Neutron emission from spent FA with MAs loading is slightly exceeds that of a standard FA	- Heat dissipation level of spent FA with MAs loading is slightly exceeds that of a standard FA
Disadvantages		
-	- Heat dissipation level of spent FA with MSs loading is much bigger then level of the standard FA	- Extremely high level of neutron emission from spent FA with MAs loading