Mineral processing of Zarigan thorium - uranium ore deposit

M. Eskandari Nasab
Mining Engineering department, Technical Collage, Shahid Bahonar University, Kerman, Iran meskandarim@yahoo.com

A. Sam*
** Mining Engineering department, Technical Collage, Shahid Bahonar University, Kerman, Iran Asam574@yahoo.com*

Saeed Alamdar Milani[3]
Nuclear Fuel Cycle Research School, Nuclear Science and Technology Research Institute, AEOT, Tehran-Iran Salamdar@yahoo.com

ABSTRACT

Due to low contents of radioactive materials in the Zarigan ore, the beneficiation process is necessary. X- ray diffraction analysis revealed that the ore contains numerous amounts of minerals such as SiO_2, Fe_2O_3, TiO_2 and rare earths. In this study, the upgrading of thorium and uranium in Zarigan deposit has been investigated by gravity, magnetic and electrostatic separations methods. The output of Jaw crusher was ground to 100% - 85 micron using ball mill. Then about 95% of SiO_2 was removed by shaking table. Processing of heavy concentrate of shaking table using high intensity magnetic separator eliminated other impurities and the rest of liberated silica. The obtained magnetic concentrate was treated by low intensity magnetic separator and its efficiency for thorium separation was high. Finally, the non magnetic concentrate was processed with electrostatic separation. The contents of thorium and uranium in the final non magnetic concentrate increased to 4000 and 5000 ppm respectively and only 15 % of initial feed (ore) was transferred to this concentrate. Therefore, this will result to decrease of acid consumption and increase the efficiency of next leaching process. The beneficiation circuit of the ore was proposed as Jaw crusher-ball mill-shaking table-high magnetic separator-low magnetic separator.

Keywords: Beneficiation, Thorium, Uranium, Zarigan, Gravity separation, magnetic separation, electrostatic separation

INTRODUCTION

Thorium and uranium have been used in various industries such as nuclear energy production, Illuminates, Glasses, Mantles and Ceramics (Habashi, 1993). Thorium is much more abundant throughout the world than uranium (about five fold) and the element itself cannot be used to produce weapons (Charles, 2005). So there is a worldwide belief that thorium fuel will be one of the most important fuels for the world in the future (Dennis and Mushakov, 2006). Up to 0.2 % of impurities such as rare earths have no undesirable effect on the thorium applications, but smaller amounts of impurities, especially neutron absorbance elements, need for nuclear uses (Parkash et al., 1962). Purity requirements for thorium and its compounds, especially in nuclear technology, and economical aspects of purification process of low grade ores are of great importance. Therefore the pre-concentration of minerals containing thorium is very important. Beneficiation operations typically serve to separate and concentrate the mineral values from waste material, remove impurities, or prepare the ore for further refinement

Mineral processing or pre-concentration, leaching and final purification steps has been considered as the main steps in the almost processes of thorium and uranium ores concentration (Cathbert, 1958). Decreasing of the ores grade during the time has been reported as an important reason for using mineral processing process before leaching step (Habashi, 1993).

The composition of thorium ores varies form one deposit to another. Therefore the methods used for ore beneficiation are different. Previous investigations have used the some of different methods for thorium/uranium concentration in the different beneficiation processes (Habashi, 1997; Vijayalakshmi et al., 2001; Narayanan, 1988; Raslan , 2008).

For ore preparation from Indian coastal sands, the sand is subjected to gravity separation. The second step is magnetic separation. Ilmenite and magnetite are first removed by the weakest magnets; garnet is removed by magnets of the next higher strength, and coarse and fine monazite is successfully removed in the two next stages. The monazite concentrate obtained has a purity of up to 98% (Habashi, 1997).