Improvement of a separation method for the reduction of secondary waste from the waterjet abrasive suspension cutting technique

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Abstract

Disassembling the reactor pressure vessel and its built-in components is a huge challenge in the deconstruction of a nuclear power plant. After being exposed to neutron irradiation for years, the activated components need to be disassembled and packed by remote controlled techniques. Underwater disassembling systems have the advantage of the shielding effect of water against radiation. To avoid the generation of aerosols, cold cutting processes are preferred. A cutting method that meets these requirements is the waterjet abrasive suspension cutting technique (WASS). This method provides high flexibility and is immune towards mechanical stress in the components. During the cutting process, a mixture of abrasive particles and radioactive steel particles from the cut components is generated. Depending on the operational conditions, the amount of this secondary waste increases substantially. Therefore, despite of its intrinsic technical benefits, WASS has a serious disadvantage towards other cutting techniques due to the huge disposal costs of secondary waste.

During our previous joint research project between KIT and AREVA GmbH called NENAWAS („New Disposal Methods for the Secondary Waste Treatment of the Waterjet Abrasive Suspension Cutting Technique“, funded by the German ministry for education and research, BMBF), a prototype separation device for WASS secondary waste was developed and tested. Using a magnetic filter, steel particles could be successfully separated from the rest of the secondary waste.

The separation process is examined using elemental analysis (ICP-OES) for quantification of the separation grade. Additionally, morphologies of particles and particle aggregates before and after the separation process were examined by scanning electron microscopy (SEM). In the abrasive particle fraction after separation of the

steel particles a remaining contamination by tiny steel particles could be detected by elemental and microscopic analysis. In addition, the microscopic analyses showed that abrasive particles are considerably larger than steel particles. Therefore, the grade of separation is related to the particle size distribution. For this reason, a measurement device was installed to measure the particle size distribution during the separation process. Based on the particle size distribution a good estimate of the separation grade could be given during the separation process. However, further optimization and additional understanding of the separation process is still needed to improve the performance of the setup.

This is the main goal of the subsequent project MASK ("Magnetic Separation of granular mixtures from waterjet cutting to minimize secondary waste from the decommissioning of nuclear facilities", funded by BMBF), i.e. the improvement of the separation grade. For this purpose, a numerical simulation of the fluid flow inside the magnetic filter unit will be performed. Furthermore, experimental studies using radioactive abrasive-steel grain mixtures are envisaged, to demonstrate the applicability of the method to real radioactive contaminated secondary waste. For this purpose, a small scale separation device for the use in a radioactive controlled area will be constructed and tested.

In this presentation the MASK separation device and the experimental procedures will be explained. In addition, new results obtained with the NENAWAS separation device will be presented.