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Wet sieving and magnetic separation for the treatment of radioactive secondary waste produced from waterjet abrasive suspension cutting

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Abstract. Dismantling of reactor pressure vessels and their built-in components is an enormous challenge in the deconstruction of a nuclear power plant. Due to the years of exposure to neutron radiation, the activated components can only be dismantled and packaged remotely. For reasons of radiation protection, preference is given to techniques that can be used underwater due to the shielding effect. A cutting method that meets these requirements is the waterjet abrasive suspension cutting technique (WAS). The cutting tool is capable of slicing metallic internals and other materials using a pure jet of water mixed with an abrasive substance at high velocity and pressure. The process offers numerous technical advantages, but it has a major disadvantage in producing secondary waste. Due to the addition of the abrasive substance, the WAS process produces a waste mixture of inactive abrasive particles and radioactive steel particles (activated by neutron radiation) during the dismantling of steel components in nuclear facilities. Since the steel particles are radioactive when the reactor pressure vessel (RPV) and its internals are dismantled, this particle mixture currently has to be disposed of as radioactive waste. This leads to a doubling of the radioactive waste. Despite the technical advantages, the WAS process used for cutting purposes is a severely disadvantage from an economic point of view, considering the significant disposal costs of the radioactive waste.

The research project NaMaSK (wet sieving and magnetic separation of grain mixtures to minimise secondary waste in the dismantling of nuclear facilities), funded by the German Federal Ministry of Education and Research (BMBF), aims to separate the two fractions (abrasive and steel particles) with the help of magnetic separation and wet sieving. For this purpose, a prototype separation system MaSK (magnetic separation of grain mixtures to minimise secondary waste in the dismantling of nuclear facilities) with a magnetic filter and sieve has already been built and tested, and it can separate up to 98 % of the steel particles from the mixture. The separation process aimed to reduce the total amount of secondary waste by reusing abrasive particles for further WAS cutting.

In the new test plant NaMaSK, the mode of operation will be converted from a batch process to continuous operation to highlight the economic aspect of the separation process. In this regard, an efficient design of the sieve structure and magnetic filter, followed by process optimisation, will be implemented. These new developments and the first results will be presented at the conference.

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