2023 NEA GLOBAL FORUM RISING STARS WORKSHOP

SEPARATION PROCESS FOR REDUCTION OF SECONDARY WASTE FROM WATERJET ABRASIVE SUSPENSION CUTTING

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Introduction

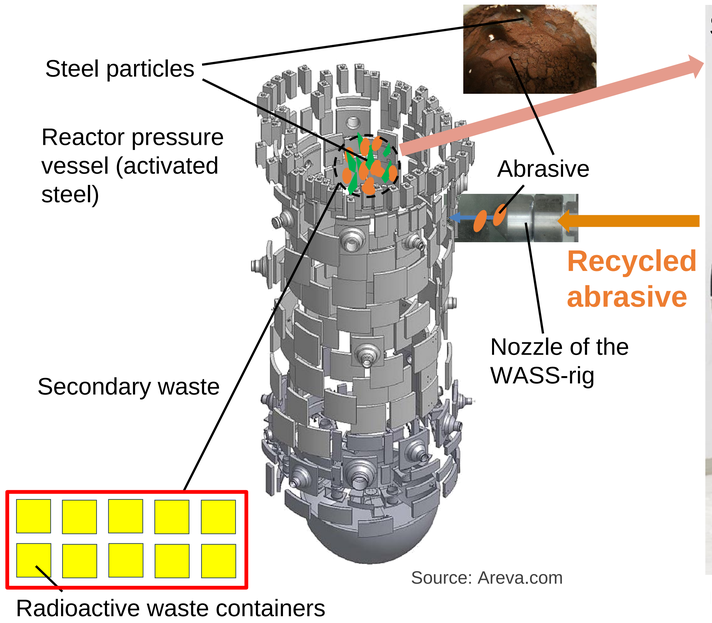
After the Fukushima accident in 2011, the German government decided to stop nuclear power. Presently, all nuclear power plants (NPP) are shut down and 29 NPP's are in deconstruction phase. A huge challenge is associated with the disassembling of the reactor pressure vessel and its built-in components. 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).

Functionality of the WASS-rig

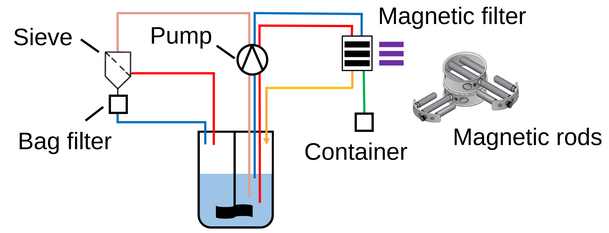
Water mixed with abrasive is pumped at high pressure through a small nozzle. The resulting waterjet, targeted on the activated component, cuts through the material. A mixture of abrasive and steel particles is produced, which has to be treated as radioactive waste.

→ Separation of the steel particles

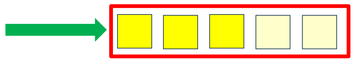
1. Secondary waste treatment in batch process



Patent number: DE 10 2018 110 204 A1

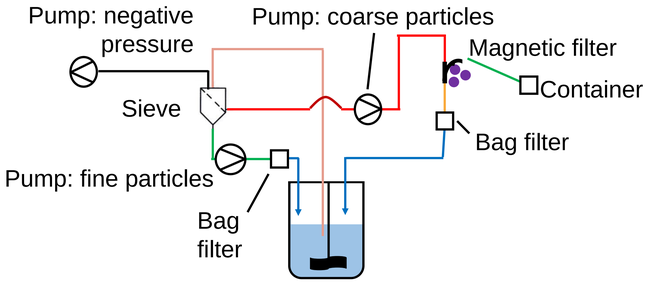


Step 1: Sieving the abrasive steel mixture
→ Fine particles
Step 2: Preparing the coarse fraction
Step 3: Magnetic filtration of the coarse particles
→ Recycled abrasive
Step 4: Cleaning the Magnetic filter
→ Magnetic steel particles



Reduction in secondary waste by 50-70%

2. Transformation from batch to continuous process



Reasons for transformation:

- Better handling and control of the process
- Overloading of magnetic filter can be prevented
- Cleaning cycles of sieve and magnetic filter can be skipped
- Increased separation capacity and performance

Acknowledgements

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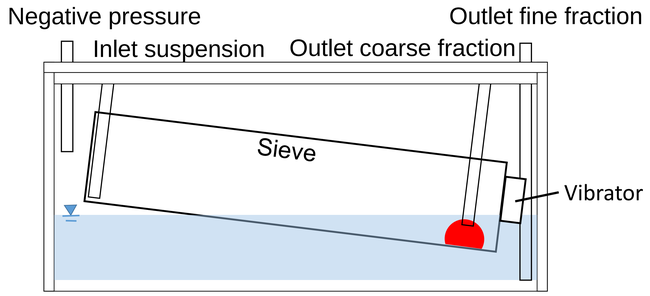
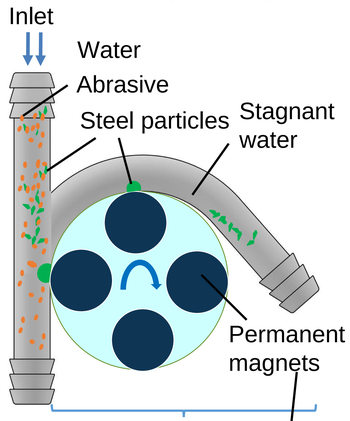
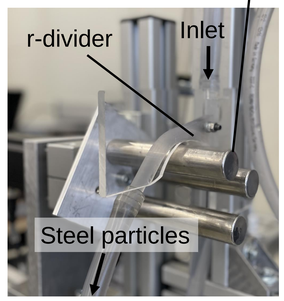
2.1. Development of a new continuous, closed sieve



- Abrasive steel suspension is pumped to the sieve surface by creating a vacuum in the housing
- Continuous wet sieving facilitated by a vibrator separates coarse fraction
- Coarse fraction is continuously pumped and sent to the magnetic filter for steel removal
- Similarly, fine fraction is continuously removed for disposal

2.2. Development of a continuous, closed magnetic filter (filed as a patent)





- Abrasive steel suspension is pumped through a 3D-printed structure, the so-called r-divider
- Along the r-divider, there are rotating permanent magnets
- As the magnetic particles enter the separator-pipeline, they interact with the rotating magnets
- Steel particles are separated and move along the curved pipe containing stagnant water

The magnetic filter efficiently separates steel particles, removing approximately 0.5% to 1% of the steel particles in one cycle.

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