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Innovative applications of abrasive waterjet for irradiated graphite dismantling and decommissioning

The characterization, dismantling and pre-disposal management of radioactive materials have an important role in view of safe decommissioning of nuclear facilities. One of the main challenges is related to the management of irradiated graphite (i-graphite) used as moderator and reflector in several nuclear power plants and research reactors. In addition to common radioprotection issues typical of most radioactive waste, easily volatizing long-living radionuclides (above all 3H, 14C, and 36Cl) and stored Wigner energy can be released during imprudent retrieval and processing of i-graphite, that hence require careful considerations and precautions. It is well known that Wigner energy release can be avoided by monitoring the i-graphite temperature, that must be kept below its irradiation temperature, with about 50 ℃ safety margin. This is especially important for those blocks irradiated below 100 ℃. With this regard, among all cutting techniques, the abrasive waterjet (AWJ) can be a promising technical solution that achieves all the thermo-mechanical and radioprotection objectives.

In this work, the application of AWJ to segmentation of graphite blocks has been explored, aiming at optimizing the retrieval, storage and disposal of such waste. This would have benefits from the points of view of both safety, management, and costs. AWJ technology may represent a valuable alternative to mechanical dismantling techniques from the perspective of the following process requirements:

• Restraint of suspended dusts;
• Low cutting temperature;
• Limitation of secondary waste;
• Easy remote use;
• Low cost.

This work was aimed at characterizing the AWJ machining capability of 100x100x600 mm blocks of non-irradiated graphite. Several factorial experiments were designed to investigate the effects of the machining process parameters (e.g. traverse speed, abrasive mass flow rate, water pressure) on graphite temperature and on the material removal rate for the purpose of secondary waste evaluation.

The preliminary results obtained in this work promote AWJ as a valid alternative to other conventional techniques. The main advantages are:

• The presence of water favours the control of temperature and suspended dust;
• The temperature increase during the machining process was found to be significantly lower compared to threshold temperature for Wigner energy release;
• Secondary waste can be restrained by optimizing the abrasive mass flow rate;
• AWJ machining cost was found to be competitive compared to other dismantling techniques;
• The proposed approaches could lead to savings on waste management costs.

Do you wish to participate as a Young Professional?

No

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Do you wish to be considered for a Young Professional grant?

No

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