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Feasibility studies of DEMO potential waste recycling by proven existing industrial-scale processes

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This paper is focused on the analysis of existing industrial-scale process for recycling of DEMO steel components (Eurofer, AISI 316L) and Lithium orthosilicates breeder. The aim is the assessment of their practical feasibility and the individuation of preparatory activities to be performed for facilitating and improving the recycling.
In detail, the thermodynamic analysis of recovering 14C from Eurofer and AISI 316L steels by decarburization processes was performed, based on practices used in steelmaking. The mass of species in the formed phases: gas, oxide, metal, were quantified. The effect of decarburization process on other critical elements contained in the steels like Cr, Mn, W, Ni and Mo was investigated as well.
The decarburization of steel is a process, currently used in steelmaking for producing Ultra Low Carbon (ULC) Steel and High Chromium Steel, based on the reaction between Carbon and Oxygen, both dissolved in liquid steel, by forming CO gas that is removed by operating under vacuum and/or by inert gas like Argon or Nitrogen. Another process analyzed is the recovery of the expensive 6Li, from used Li4SiO4 solid breeder pebbles, in order to reuse it in the manufacture of fresh solid breeder and to evaluate the way of removing detrimental radioactive impurities. The most promising candidate process is the melting of pebbles with addition of new 6Li enriched material.
A general trend in the modern steelmaking industry is toward a higher degree of robotization and remote control; this evolution is in line with the need of processing of potential radioactive wastes taking into account the issue of their decay heat and dose rate. The study performed aims to identify and select existing and emerging steel melting technologies that might be suitable for recycling of activated steels and breeder materials of DEMO.

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