Valorization of Automotive Shredder Residues in metallurgical furnaces

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Project REFORBA

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According to the directive n°2000/53/CE 85 % by weight of an end-of-life vehicle (EVL) must be recycled. The current state of practice comprises four steps. Liquids from battery, gearboxes casing, brake fluid, coolant and air conditioning circuit are first collected. Tyres, catalysts, windscreens and windows are then manually removed, prior to the shredding of the car. A magnetic separation is processed on the shredded materials, to recover valuable ferrous components. The remaining part (Automotive Shredder Residue – ASR) undergoes successive separation steps, leading among others to two potentially valuable fractions, one mostly composed of plastics (P_1) and the other of iron oxides (P_2). Currently, P_2 and P_1 are respectively landfilled or used as a fuel source in various processes. In the blast furnace (BF) and the electric arc furnace (EAF) routes, P_1 could be used as substitute for coal or coke, and P_2 could replace part of the ore, provided some elements (Cl, Cu, Zn) are removed. Chlorinated compounds (PVC) can release toxics (dioxin) or corrosive metal chlorides, detrimental to the installations and the environment. Copper can spoil the cast-iron produced, and zinc favors the development of scabs that modify the flow configuration inside the BF. The whole objective of REFORBA is to assess the possibility of using "purified" fractions P_1 and P_2 in the BF and the EAF, as reducing agents or "iron ore". This would provide steelmakers with raw materials cheaper than coke. As additional potential benefits the amount of CO_2 generated in the processes and the volume of landfilled shredded residues would be lowered. Representative fractions of P_1 and P_2 are obtained by sampling an industrial line of treatment. Comprehensive chemical characterization (ICP-AES, SEM, FTIR, thermal analyses) is performed to know the global content and localization of materials containing chemicals to remove. Sorting operations (grinding, screening, magnetic, eddy current, and sink float separations) are then performed on P_1 and P_2, until the modeled BF global heat and flow profiles match the classical configuration. The possibility of using P_1 in place of C and CO is evaluated by a lab-scale thermochemical characterization of the iron oxides reduction, and of the quality of the cast-iron processed with some percent of P_2 in the ore feed. This will give estimations of P_1 and P_2 nominal contents to use in the BF, and assess the feasibility of a pilot-scale demonstration.

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