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EAF long term industrial trials of utilization of char from biomass and waste residues as fossil coal substitute

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Biomass is a renewable resource having a steady and abundant supply, especially those biomass resources that are by-products of agricultural and industrial activity. Its use is by supplying neutral carbon, can displace fossil fuels, and help reduce GHG emissions while closing the carbon cycle loop. Every year End of life vehicles (ELVs) generate about 8 M tons of waste of which the ferrous fraction represents about 70-75%, nonferrous metals about 5%. The remaining 20-25%, the ASR, contains rubber, ferrous and non-ferrous metals, textile, fiber material, wood, glass and a relevant fraction (~40% wt) of polymers with high calorific value (~25 MJ/kg). With a start date of January 1st 2015, the EU directive 2000/53/EC establishes the reuse and recovery of a minimum of 95% ELV total weight. Therefore different ASR management options, such as further material and energy recovery, must replace the landfilling. Steel produced starting from scrap, already needs less energy with beneficial effects on environment and economy that are greater as increases the share of fossil fuels in total energy feeding. The replacement, in EAF practice, of fossil fuels with char and syngas obtained from biomass, waste residues (i.e. plastics, automotive shredder residue (ASR), petrochemical sludge, etc.) can further improve the environmental performance and the attractiveness of the EAF based route, eventually increasing the amount of chemical energy respect electrical one, with beneficial effects on environment, economy and flexibility of the EAF process. The feasibility of biochar as fossil coal substitute as charge material in EAF has already been proved in two previous European projects (GREENEAF and GREENEAF2) were an intensive industrial utilization of biochar was foreseen. A test sequence of six consecutive heats was carried out replacing standard anthracite with biochar. The results of the industrial tests indicate that utilization of char as charge material can be done, but operating practice, environmental evaluation of off-gas emissions, for these new applications needs to be optimized with long term experimentation. The results of industrial long term trials confirmed the feasibility of the use of biochar as charge material, without significant modification in steel and slag analysis. This paper describer the industrial long term trials with biochar in EAF, with the final target to replace fossil coal and new laboratory trials with plastic, ASR and petrochemical sludge.

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Effect of surface treatment on oxidation behavior of Ni-base superalloys

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The materials used at high temperature, like in gas turbines or jet engines, need to fulfill a number of requirements, e.g. high creep strength and oxidation resistance at a wide range of operating temperatures, environments and loading condition as well as a suitable ductility at low temperature. Such properties are obtained in Ni-base superalloys, due to their microstructure consisting of thermodynamically stable γ-Ni matrix with combination of strengthening γ'-Ni_3Al phase. However, when one exposes the alloys at high temperature, an oxidation process occurs and the material starts to form an oxide scale. The Ni-Cr-Al based alloys can be classified into the three groups of materials in term of formed oxide scales: NiO-forming, chromia layer forming and an alumina forms alloys. Formation of protective oxides like Al_2O_3 or Cr_2O_3 substantially increase the lifetime of the component exposed at high temperature. To provide a resistance against oxidation a protective coatings such as MCrAlY (where M is mainly Ni or Co) or β-NiAl which are an alumina forming materials are applied. However, coatings production is time consuming, results in additional component costs, and can negatively affect alloy mechanical properties, such as fatigue strength. Therefore, another method to force material to form a protective oxide scale is proposed in the present study. Namely, a different surface preparation of Ni-base superalloys, like grinding, polishing, sand blasting, etc., on oxide scale formation during exposure at high temperature in Ar-O_2 atmosphere will be presented. It was found that material ground material formed less non-protective NiO compared to polished one (Figure 1). The effect of surface treatment on oxidation kinetics and oxide scale formation will be described as well.

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