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Combustion Chamber Sizing for Energy Recovery from Furnace Process Gas: Waste to Energy

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Abstract : The Norwegian ferroalloy industry is a world leader in sustainable production of ferrosilicon, silicon and manganese alloys with the lowest global specific energy consumption. One of the byproducts during the metal reduction process is energy rich off-gas and usually this energy is not harnessed. A novel concept for sustainable energy recovery from ferroalloy off-gas is discussed. The concept is founded on the idea of introducing a combustion chamber in the off-gas section in which energy rich off-gas mainly consisting of CO will be combusted. This will provide an additional degree of freedom for optimizing energy recovery. A well-controlled and high off-gas temperature will assure a significant increase in energy recovery and reduction of emissions to the atmosphere. Design and operation of the combustion chamber depend on many parameters, including the total power capacity of the combustion chamber, sufficient residence time for combusting the complex Poly Aromatic Hydrocarbon (PAH), NOx, as well as converting other potential pollutants. The design criteria for the combustion chamber have been identified and discussed and sizing of the combustion chamber has been carried out considering these design criteria. Computational Fluid Dynamics (CFD) has been utilized extensively for sizing the combustion chamber. The results from our CFD simulations of the flow in the combustion chamber and exploring different off-gas fuel composition are presented. In brief, the paper covers all aspect which impacts the sizing of the combustion chamber, including insulation thickness, choice of insulating material, heat transfer through extended surfaces, multi-staging and secondary air injection.

Keywords : CFD, combustion chamber, arc furnace, energy recovery
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