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Chemical Engineering Research and Design

journal homepage: www.elsevier.com/locate/cherd

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Review

Research progress of hot gas filtration, desulphurization and HCl removal in coal-derived fuel gas: A review

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A B S T R A C T

The present review paper highlighted on the recent progress of hot gas filtration, desulphurization and HCl removal in coal-derived fuel gas for combined cycle power generation (IGCC) or molten carbonate fuel cells (MCFC) technologies. As a critical process in the gasification system, hot gas filtration in the particulate control device (PCD) was introduced with enhanced understanding of equipment and operation, filter element and failsafe material properties, and gasification ash characteristics. The issues associated with the commercialization of hot gas filtration were also addressed, and some novel systems and methods were also discussed. The hot gas desulphurization in coal-derived fuel gas has concentrated on developing regenerable sorbents including the single and composite oxides of Zn, Fe, Cu, Mn and other species, and the reduction of metal oxides in the highly reducing atmosphere followed by vaporization of elements can be a problem for reactivity and regeneration. With regard to the removal of HCl, the studies have indicated sorbents prepared by pelletizing the powders of naturally available alkali metal and alkali earth metal substances can rapidly react with HCl vapor and reduce the HCl vapor concentration to less than 1 ppmv, and some sorbents lab-made have very high chlorine capacity. The sorbents based hot gas cleaning also has some challenges. Kinetics studies showed that unreacted shrinking core (USC) can be applied to the modeling of H₂S and HCl removal by sorbents at high temperature, and the surface chemical reaction and reactant diffusion by product layers between solid sorbents and gases were very important mechanisms. The paper also proposed and discussed a rational concept for the simultaneous removal of multiple contaminants including ash, H₂S and HCl, which will offer a possible cost reduction by two or more processes in a single vessel for hot gas cleaning.

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Keywords: Hot gas cleaning; Sorbents; Hot gas filtration; H₂S; HCl

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Received 29 September 2011; Received in revised form 7 April 2012; Accepted 19 April 2012

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<http://dx.doi.org/10.1016/j.cherd.2012.04.009>