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High temperature H_2S adsorption using copper-titanate nanoparticles

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Direct desulfurization of syngas is an important measure to further increase the efficiency of IGCC systems. Solid-phase, metal oxide adsorbents which sequester the sulfur by converting H_2S to a metal sulfide are the only desulfurization technology capable of withstanding the combustion temperatures present at the outlet of the gasifier. Copper oxide is of particular interest due to its favorable thermodynamics across a wide range of temperatures. Cu-ETS-2 is a copper exchanged form of the sodium titanate ETS-2 and functions analogously to CuO for the conversion of H_2S into CuS at temperatures ranging from ambient to 950 °C. The results of this study show that Cu-ETS-2 is capable of removing H_2S from H_2S/He mixture to concentrations below a mass spectrometer's detection limit at temperatures as high as 950 °C. Temperature is, however, only one of the challenges facing a direct desulfurization adsorbent; high concentrations of H2 and water vapor are present in the syngas stream which can influence the oxidation state of the metal and the efficiency of H_2S removal. In an attempt to prevent reduction of CuO, chromium was successfully used to stabilize the oxidation state of copper oxide and maintain constant adsorption capacity throughout the whole temperature range. While several studies have examined the effect hydrogen in the feed, there are few studies exploring the influence of water vapor on the efficiency of H_2S removal and none that explore the effect of water vapor at elevated temperatures. This study can be considered the only study to investigate the influence of water vapor on the desulfurization of a dilute H_2S stream at temperatures between 350 and 950 °C using copper oxide-based adsorbents. The findings demonstrate that the presence of water vapor promotes production of H_2, resulting in faster reduction of CuO to Cu_2O and elemental copper, leading to less adsorption capacity. Finally, the ability of the adsorbent for regeneration and use as a multi-cycle adsorbent was investigated. The results indicate that the adsorbent is capable of regeneration for at least four times with no sign of reduction in capacity. The results also indicate that the exothermic nature of oxidation reaction results in temperatures up to ~1700 °C causing the partial melting of the quartz glass tube. However the adsorbent can withstand such high temperatures and does not lose adsorption capacity after the first oxidation step. This phenomenon is due to having nano titanate ETS-2 as the support in the adsorbent.

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Sorbent capacities and intensities of activated carbon from one-way thermochemical pyrolysis of palm nut shell for the removal of waste water dye stuff

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This paper presents evaluation of the feasibility of using palm nut shell activated carbon from one-way thermochemical pyrolysis and its adsorption properties for removal of industrial dye stuffs from waste water. The relationship between the ordinary (k_f), maximum (qm) and theoretical saturation capacities (q_D) were also investigated to follow the order; $q_m > q_D > k_f$. H_3PO_4 catalyzed sorbent dwell at a longer activation time. SS/A/15 -presented a higher adsorption capacities (q_m=6.024 mgg-1, q_D=4.189 mgg-1 and kf=0.628) and higher sorption intensity (1/n=0.714), than the other 3 series. The high % dye removal (%RE up to 84.80%) adsorption normalcy (1/n<1 and RL<1) and good applicability (R^2>0.869) are critical for considering palm nut shells as precursor for generating low cost active bio-sorbents.

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