Silica-Titania Composites: An Advanced Oxidation Technology for Low Level Mercury Removal

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An advanced oxidation technology, silica-titania composites under ultraviolet illumination, was applied to 100 ppb Hg solutions to determine the degree of mercury removal that could be accomplished. Silica-titania composites are a porous, high surface area silica substrate (> 200 m^2/g), manufactured using sol-gel methodology, impregnated with TiO_2 nanoparticles (a photocatalyst material) that can be tailored by altering the material pore size. It is expected that the combination of photocatalytic reduction of Hg in combination with a large surface for adsorption, exceptional Hg remoal can be realized. The performance of this material along with its precursors, silica and Degussa P25 TiO_2 were compared. Synthetic mercury waters were prepared from a $Hg(NO_3)_2$ standard solution and employed with the selected media in a sealed magnetically stirred reactor equip with an insertable 254 nm 9 W mercury lamp. A series of batch experiments were performed with variation of time, UV illumination and temperature. All effluents were filtered with a 0.45 µm filter and analyzed by cold vapor atomic absorption spectrometry. Interestingly, the silica-titania composite was detrimentally affected by the presence of UV irradiation. However, under adsorption alone (no UV illumination), silica-titania composites were able to achieve approximately 90% removal of mercury, which is comparable to that of Degussa P25. Silica alone performed poorly in comparison and was not affected by UV illumination. It was concluded that elemental Hg was formed under UV irradiation and did not sorb well to the silica surface, but is indifferent to TiO_2 and therefore did not alter its removal capabilites.

Key words: mercury, removal, photocatalysis, sol-gel, titania