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Adsorption Property of Porous Materials for Removal of Small Content Mercury Contained in Coal Gas

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Extended Abstract

In this study, adsorption characteristics of various porous materials were investigated for removal of trace mercury contained in syngas (or coal gas) produced from coal gasification. The mercury in the coal gas is exhausted in the state of being adsorbed to the particulate dust or vaporized at a high temperature and contained in the synthetic gas. When heavy metals such as mercury are contained in the syngas, the catalyst may be poisoned in the downstream process for converting the syngas to fuel, resulting in catalyst deactivation. If the mercury leaks into the atmosphere, it may seriously affect the ecosystem [1].

In this study, the mercury capacity of zeolite, activated carbon, and alumina loaded with Cu was investigated in order to adsorb and remove mercury from the gas phase. In the adsorption tests, the concentration of mercury in the nitrogen gas was maintained at about 70 ppbv to investigate the mercury adsorption characteristics. The change of the mercury concentration with time was observed in the outlet of the adsorption column with the porous adsorbent material charged to about 5 g. In this test, the temperature of the adsorption column was maintained at room temperature. Among the various porous adsorbents, activated carbon showed a high adsorption amount of mercury, and a zeolite having a relatively high surface area showed low adsorption performance. Alumina loaded with Cu was also observed to have mercury adsorption characteristics, but showed very low adsorption performance. In the case of Cu/Al_2O_3, the experiment was carried out at elevated temperature. Mercury concentration in the outlet of adsorption column decreased above 75 ^oC and increased again at 125 ^oC. This means that Cu/Al_2O_3 exhibits mercury sorption behavior within the range of approximately 75-125 ^oC. However, the adsorption rate was low and the mercury concentration in the outlet of the adsorption column remained high. The adsorption behavior of mercury was investigated by loading EDTA on activated carbon and zeolite. However, the adsorption rate of EDTA was lower than that of non EDTA loaded materials. Thus, it was not possible to effectively remove gaseous mercury. In order to remove gaseous mercury, the adsorption rate is considered to be a very important factor. This is because the residence time of mercury in the adsorption column in the gas phase is short. Among the adsorbents with high surface area, only the activated carbon shows high performance, which means that the surface area does not have a large influence on the adsorption of mercury, and the functional groups on the surface more affect mercury adsorption. Therefore, if the functional group on surface of activated carbon will be analyzed and the effective species for mercury adsorption will be identified, it is considered that an effective high efficiency mercury adsorbent can be developed.

References

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