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Re-using of coal-fired fly ash for arsenic vapors *in-situ* retention before SCR catalyst: Experiments and mechanisms

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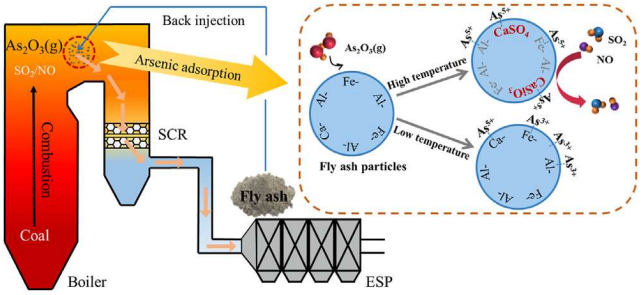
HIGHLIGHTS

- Coal fly ash back into the furnace showed certain capacity in $As_2O_3(g)$ capture.
- Ca/Al/Fe-compounds reacted with $As_2O_3(g)$ by forming arsenates or arsenites.
- Ca-sulfates/silicates in fly ash were confirmed to be pivotal in arsenic retention.
- SO_2/NO had few effects on arsenic *in-situ* retention in high temperature furnace.

GRAPHICAL ABSTRACT



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ABSTRACT

Arsenic is easily evaporated with coal combustion, which not only causes serious environmental issues but also leads to the deactivation of selective catalytic reduction (SCR) catalyst. This study focused on the re-using of coal-fired fly ash for arsenic vapors *in-situ* retention before SCR catalyst in the furnace. Experiments were carried out to estimate the effects of typical fly ash compounds (Ca-, Fe-, and Al-bearing components) as well as acid gases (SO_2/NO) on arsenic capture at temperatures of high-temperature furnace stage (900 °C) or SCR system entry stage (450 °C). The results demonstrated that, regardless of collection plants, all the ash samples showed certain capacity in arsenic vapors retention and the capture performance was enhanced at 900 °C than at 450 °C. Both physical and chemical adsorptions occurred for arsenic capture at low temperature, while chemical adsorption by effective mineral components dominated at high temperature. The role of Ca-compounds was more remarkable than Fe/Al-compounds and $CaSO_4$/calcium silicates were identified as the key calcium compounds that acted on arsenic adsorption by fly ash. Insignificant effects were found regarding the acid gases (SO_2 and NO) on arsenic retention by fly ash owing to the high resistance of $CaSO_4$ and calcium silicates to acid gases. These findings provided reference for the *in-situ* retention of arsenic by reusing fly ash that enriched in specific compositions.

1. Introduction

Arsenic (As) is a hazardous toxic trace element which could enter human body through digestive tract, respiratory tract and

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