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Effect of anion concentrations on Hg^{2+} reduction from simulated desulphurization aqueous solutions

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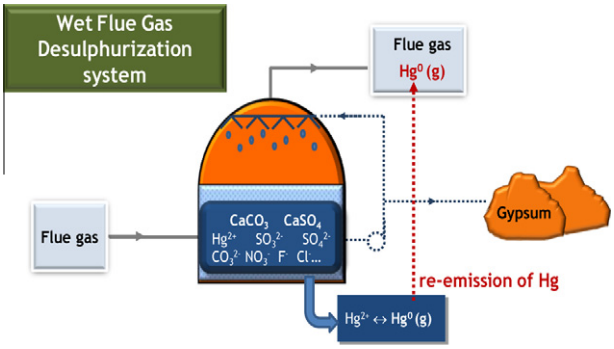
HIGHLIGHTS

- The influence of different anions on the stability of mercury in scrubbing solutions containing sulphite ions was evaluated.
- Fluoride, chloride, bromide, nitrate, sulphate and carbonate ions influence mercury retention in WFGD systems.
- pH is an important parameter for control of mercury re-emission in desulphurization systems.

GRAPHICAL ABSTRACT



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ABSTRACT

The influence of different anions on the stability of mercury in absorbing solutions containing sulphite ions was investigated. The re-emission of gaseous mercury in the presence of fluoride, chloride, bromide, nitrate, carbonate and sulphate ions from the scrubbing solution was determined. Fluoride, chloride and bromide ions contribute to mercury stabilization, bromide being the most efficient anion for retaining mercury in sulphite aqueous solutions. High carbonate concentrations prevent the reduction of mercury by sulphite ions due to the stabilization of the complexes formed between oxidised mercury, hydroxide and sulphite ions or through the formation of mercury carbonate species. However, nitrate and sulphate ions do not influence the equilibrium between mercury and sulphite ions and, as a consequence, the re-emission of mercury is not modified. The results of this study suggest that the pH is one of the most important parameters for achieving an efficient control of mercury pollution in desulphurization systems. The re-emission of mercury was observed to increase when the pH value of the slurries was higher than six due to the stabilization of the mercury in the form of $Hg(SO_3)_2^{2-}$, $Hg(OH)^+$, $Hg(OH)_2$, $HgHCO_3^+$, $HgCO_3$ or $Hg(CO_3)_2^{2-}$. Since the pH depends on the concentration of SO_2 in the flue gas and the type of limestone, the alkalinity that comes from the sorbent used in the scrubber may play an important role in mercury capture in such systems.

1. Introduction

Due to the high volatility of its compounds and long time residence in the atmosphere, mercury is one of the most toxic metals found in the environment. Mercury is easily bioaccumulated through the food chain and poses a great threat for human health via the route of fish consumption [1,2]. Energy production is responsible for more than 50% of mercury emissions to the air according to the European Pollutant Release and Transfer Register [3]. The mercury species present in coal are evaporated during combustion and subsequently transformed into a number of other forms which include elemental mercury (Hg^0) and other compounds generally referred to as oxidised mercury (Hg^{2+}). Both

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