SO2 absorption from industrial emissions in a fluidized bed of metal oxides

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Abstract:

Among the air pollutants in the world, sulfur dioxide has been given special emphasis for posing danger to the environment. SO2 emissions in the air have harmful effects on human health and the environment. Respiratory problems, respiratory diseases and exacerbation of heart diseases are among dangerous symptoms for human health, especially when high concentrations of SO2 are emitted. Therefore, in the present study, a wide variety of dry and wet processes were investigated to identify an appropriate process to reduce the amount of sulfur dioxide. Ultimately, the use of a fluidized bed containing metal oxides which is a dry process was selected with regard to the factors such as simplicity of the process, having a minimum of waste water and gas, ability to reduce pollution levels to acceptable environmental standards. In order to examine the performance of this type of fluid beds, a laboratory scale unit was developed to investigate effects of various operational parameters including temperature, inlet gas rate and concentration, etc. on the amount sulfur dioxide emission by copper oxide.

Key words: Sulfur dioxide, fluidized bed, copper oxide, desulfurization

1. Introduction

Desulfurization of raw material and products is inevitable in oil and gas refineries. SO2 emissions in the air have harmful effects on human health and the environment. Respiratory problems, respiratory diseases and exacerbation of heart diseases are among dangerous outcomes for human health, especially when high concentrations of SO2 are emitted. In addition, SO2 causes acid deposition of fine droplets in the environment. This acid deposition makes the water acidic in rivers and lakes, accelerates degradation of buildings facade, destroys ancient constructions/monuments and changes the soil chemical composition. SO2 pollution appears in the environment most often as "acid rain" with its adverse effects on objects, buildings and ... (However, acid rain better to be called acidic deposition in many cases may happen in wet or dry conditions [1]. The wet type (called wet deposition) is in the form of rain with acidic pH, acid fog or snow which flows on the ground and affect a variety of plants and animals. The level and severity of these impacts depend on the amount of rain acidity, soil chemistry and buffering capacity of soil and type of fish, trees and living organisms (whose life is reliant on water). The dry type of acid deposition (dry deposition) is referred to acidic gases and particles suspended in air which are gradually deposited on the ground. Over 50% of these acidic particles suspending in the air are deposited on the ground and are moved on buildings, cars, homes and trees by wind. These dry sediments washed out of the trees by the rain and hail and therefore increase the water rain acidity, worsening their effects on the environment. Figure (1) is a schematic graph of production cycle of acid gases, their emissions into air and their return to the soil and Figure (2) shows a schematic picture of production and precipitation mechanism of acid rain. Various experiments and studies conducted by scientists reveal that SO2 and NOX are the main causes of acid rain. Reaction of these gases with water, oxygen and other chemicals in the air generates various acidic compounds whose production