

Abstract

The purpose of this study is to provide a sound design for the production and recovery of sulfur dioxide. The plant is simulated and analyzed by Aspen Plus. In the simulation stage, the reaction behavior, heat recovery, and operational sensitivity are considered. This involves the combustion of liquid sulfur and air in a furnace, followed by heat recovery stages. In the combustion stage, a high-temperature gas is produced and cooled with water in liquid, vapor, and two-phase states. The main objective of this work is to develop a complete process model that represents plant configuration and outlet conditions to assess the impact of key operating parameters on the overall system performance.

The simulation was carried out in a steady-state flowsheet that includes reactors and multiple heat exchangers (as the furnace), a separator–reboiler vessel, and other equipment such as pumps, valves, and control elements. The heat recovery system consists of six heat exchangers in series within the furnace. After the combustion, the temperature of the process gas is reduced from approximately 1700 °C to 266 °C. A Separator (Reboiler) unit was modelled with a heating coil to ensure proper heat balance in the system. To improve energy efficiency, a heat recovery scheme was considered, and the furnace outlet stream was simulated to preheat the inlet air or the feed water. This enhances the thermal integration of the process and reduces the requirement for external heating utilities.

Design specifications were imposed on the inlet streams of the economizer and the superheater to help maintain the critical operating conditions. In the model, stream split fractions were modified to match the target outlet stream conditions, with mass and energy balance for the entire system. A sensitivity analysis was performed to study the effects of inlet air flow rate, humidity, oxygen purity, and temperature on the process performance. The influence of these parameters was studied on the selected variables with particular attention to the formation of SO_3 , H_2SO_4 , and acid dew point temperature. Results show that humidity and temperature affect secondary reaction pathways that are directly related to corrosion and operational stability.