A NUMERICAL SIMULATION ON IMPROVING BIOGAS COMBUSTION IN THE BLAST FURNACE

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ABSTRACT

In order to preserve non-renewable resources and lessen the environmental impact of combustion systems in terms of pollutant emissions, it is necessary to think about increasing energy efficiency and switching to alternative fuels for industrial combustion furnaces. However, their low calorific value in comparison to conventional natural gas may make their use problematic. This research paper considers oxygen enhanced combustion and oxidizer preheating as a way of improving the heating value of biogas which can be used as a substitute for natural gas in blast furnaces. Using Ansys Fluent, natural gas combustion is simulated, and biogas combustion is simulated with oxygen enhancement and oxidizer preheating. The results obtained show that the heat value of biogas increases with oxygen enhancement and oxidizer preheating.

Keywords: Blast Furnace, Biogas, Oxidizer Preheating, Oxygen Enhanced Combustion.

INTRODUCTION

Significant advancements have been made to enhance blast furnace operations, focusing on safety, increasing combustion efficiency, reducing emissions, and minimizing overall operating costs (Geerdes et al., 2020). Over time, extensive research has been conducted-and continues to be carried out—to discover new ways to further optimize blast furnace performance (Zhang et al., 2021). The combustion characteristics of pulverized coal with additives were investigated under settings simulating injection into a blast furnace. As additives, different amounts of scrap automobiles were utilized. They changed the injection rate, particle size, and coal rank. Their findings demonstrated that coal rank and injection rate had an impact on coal performance. The degree of combustion was enhanced by bigger particle sizes for oxygen/coal ratios higher than the stoichiometric value (Vamvuka et al., 1996).

Mathieson et al. (2005) conducted research to better understand coal combustion in blast furnace tuyere injection. They examined data from combustion test rigs and scale models, demonstrating that every test rig generation has tried to provide a more accurate representation of the real blast furnace scenario. Although their report examines the investigations' progress, it does not fully comprehend the intricate details of the procedures involved. In order to enhance the blast furnace's practical performance, Du and Chen (2006) conducted several numerical simulations to forecast the burning properties of pulverized coal in a blowpipe and tuyere at two distinct patterns. The predictions indicate that employing a double-lance instead of a single lance can improve the combustion efficiency of pulverized coal while maintaining the same fuel and oxidant flow rates. In a real-world blast furnace, pulverized coal