Whole-of-System Analysis Using CFD to Reduce Emissions of Fugitives Gases Inside a Copper Smelter Building

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ABSTRACT

The smelter building at Sarcheshmeh Copper Complex, Iran, houses two reverberatory furnaces and five Pierce-Smith converters. Under normal operating conditions SO_2 emissions fill the building, posing a major health problem for all workers in the building, and reducing their ability to maintain the plant.

The converter fume extraction system was analysed using plant measurements, engineering modelling of the entire system and CFD modelling of the extraction hoods.

By applying fundamental engineering concepts, a user-interactive computer program was developed that enabled plant engineers and operators to gain a detailed understanding of the system. In conjunction with plant measurements, the model quantified the amount of in-leakage throughout the system, identifying it as a significant contributor to the poor extraction performance. Furthermore, it enabled investigation of the effects of hood gates, converters on line, hood dampers, flue insulation, electrostatic precipitator (ESP) operation, and inclusion of an acid plant. The model gave unprecedented insight into the operation of a counter-intuitive buoyancy-driven extraction system.

CFD modelling of the Pierce-Smith hood was then performed, indicating the cause of the SO_2 leakage during normal operations was a local positive pressure region at the top of the hood gate. Modelling of other non-standard operating conditions demonstrated that the existing hoods were fundamentally incapable of containing all emissions.

A number of solutions to the problem were proposed: reducing the gap at the top of the hood gate, increasing the hood draught, strategic positioning of blowers around the converter to blow fume back into the hood, and incorporation of a secondary hooding system to capture fugitive emissions from the primary hoods. Further CFD modelling suggested that substantially increased SO_2 capture could be attained with most of the above initiatives, while secondary hoods could capture all emissions. Further investigations are currently underway, with implementation of a final solution expected shortly.

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