

Controlling NO_x Emissions in Combustion of Natural Gas in Steam Generators by Controlling Oxygen in the Windbox

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Abstract

The Bakersfield area of Central California contains one of the densest oil production fields in North America. Tertiary recovery of these mature heavy oil formations depends heavily upon steam flood injection. The steam is produced by burning natural gas in steam generators with heat inputs from 20 mmbtu/hr to 62.5 mmbtu/hr. In order to insure that EPA clean air standards are met while operating steam generators, the San Joaquin Valley Air Pollution Control District (SJVAPCD) implements and enforces rules of operation to limit the production Oxides of Nitrogen (NO_x) emissions resulting from the combustion process. The current rules limit NO_x emissions on oil field steam generators to 30 ppm. Starting in 1988 a method of controlling NO_x emissions from steam generators which has gaining increasing acceptance by oil producers has been the use of Flue Gas Recalculation (FGR). The use of FGR on most gas burner has proven to be an effective method of reducing NO_x emissions. A method of controlling the rate of FGR used by a large number of the steam generators relies on the measurement of Oxygen (O₂) in the burner wind box by using an O₂ analyzer. The wind box Oxygen is controlled to a specific value by adjusting the amount of flue gas which is mixed with combustion air to achieve an O₂ value. This optimizes burner stability while minimizing NO_x formation throughout the firing rate and under varying environmental conditions. This method has been accepted by SJVAPCD as a means for controlling and validating the operation of FGR systems for the reduction of NO_x in oil field steam generators.