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NEW PROCESS FOR ACHIEVING VERY LOW NO_x

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ABSTRACT

Over the last two and a half years, Covanta Energy, working with their technology partner, Martin GmbH of Germany, has developed and commercialized a new technology for reducing NO_x emissions from Energy from Waste (EfW) facilities. NO_x levels below 60 ppm (7% O₂) have been reliably achieved, which is a reduction of 70% below the current EPA standard and typical levels of today's EfW facilities in the United States. This technology represents a significant step forward in NO_x control for the EfW industry.

The technology, known as VLNTM, employs a unique combustion system design, which in addition to the conventional primary and secondary air streams, also features a new internal stream of "VLNTM-gas," which is drawn from the combustor and re-injected into the furnace. The gas flow distribution between the primary and secondary air, as well as the VLNTM-gas, is controlled to yield the optimal flue gas composition and furnace temperature profile to minimize NO_x formation and optimize combustion. The VLNTM process is combined with conventional, aqueous ammonia SNCR technology to achieve the superior NO_x performance. The SNCR control system is also integrated with the VLNTM combustion controls to maximize NO_x reduction and minimize ammonia slip.

A simplified version of the process, known as LNTM, was also developed and demonstrated for retrofit applications. In the LNTM process, air is used instead of the internal VLNTM gas. The total air flow requirement is higher than in the VLNTM process, but unchanged compared to conventional systems, minimizing the impact on the existing boiler performance and making it ideal for retrofit applications.

Covanta first demonstrated the new VLNTM and LNTM processes at their Bristol, Connecticut facility. One of Bristol's 325 TPD units was retrofitted in April of 2006 to enable commercial scale testing of both the VLNTM and LNTM processes. Since installing and starting up the new system, Bristol has operated in both VLNTM and LNTM modes for extended periods, totaling more than one year of operation at NO_x levels at or below 60 ppm (7% O₂). The system is still in place today and being evaluated for permanent operation.

Based on the success of the Bristol program, Covanta installed LNTM NO_x control systems in a number of other existing units in 2007 and 2008 (total MSW capacity of over 5000 TPD), and is planning more installations in 2009. All of these retrofits utilize the Covanta LNTM system to minimize any impacts on existing boiler performance by maintaining existing excess air levels. Going forward, Covanta is making the LNTM technology available to its existing client base and is working with interested facilities to complete the necessary engineering and design modifications for retrofit of this innovative technology.

For new grassroots facilities, Covanta is offering the VLNTM system with SNCR as its standard design for NO_x control. An additional feature, particular to VLNTM, is the reduced total combustion air requirement, which results in improved boiler efficiency. This translates into increased energy recovery per ton of waste processed.

In addition to introducing the VLNTM and LNTM processes, this paper will provide an overview of the Bristol development and demonstration project. NO_x and NH₃ slip data from Bristol will be presented, illustrating the extended operating experience that has been established on the system. Other operating advantages

of the new technology will also be discussed, along with lessons learned during the start-up and initial operating periods.

The VLNTM technology has been demonstrated to decrease NO_x emissions to levels well below any yet seen to date with SNCR alone and is comparable to SCR-catalytic systems. The result is a significant improvement in NO_x control for much less upfront capital cost and lower overall operating and maintenance costs. VLNTM also goes hand in hand with higher energy efficiency, whereas SCR systems lower energy efficiency due to an increased pressure drop and the need for flue gas reheat. The commercialization of the VLNTM and LNTM processes represents a significant step forward in the reduction of NO_x emissions from EfW facilities.

INTRODUCTION

Emissions from U.S. Energy from Waste (EfW) facilities have been significantly reduced over the past ten to fifteen years, making them one of the cleanest sources of electrical power in the nation. While very significant reductions have occurred for most of the pollutants, the available technology for reducing NO_x emissions, Selective NonCatalytic Reduction (SNCR), was not able to achieve reductions of the same scale. Mass-burn EfW units typically operate with uncontrolled NO_x emissions in the range of 300 ppm_{dv} corrected to 7% O₂. The Federal permit limit for NO_x emissions is currently 205 ppm for large mass-burn units constructed prior to 2005, and 150 ppm for newer units. In some states or regions, more stringent limits of 180 ppm are in place for older units. The limits being imposed on new units have been significantly lower than the current Federal limit. For example, the expansion unit at Lee County, FL, which began commercial operation in 2007, has an annual average NO_x limit of 110 ppm_{dv} @ 7% O₂, while the expansion unit currently under construction at Hillsborough County, FL has a permit limit of 90 ppm_{dv} @ 7% O₂. These limits are pushing the capabilities of conventional SNCR technologies.

Another option for NO_x control is Selective Catalytic Reduction (SCR). This approach significantly increases both the capital and operating costs for the facility, and reduces energy efficiency due to the need to reheat the flue gas to the temperature required for the reduction reactions after the acid gases and particulate have been removed in the air pollution control system. SCR systems are capable of reducing NO_x to approximately 50 ppm_{dv}, albeit at a significant cost.

Covanta Energy and Martin GmbH have jointly developed a new technology for reducing NO_x emissions from EfW facilities to a range very close to that achieved by SCR technology, but at a significantly lower cost. The process, known as Very Low NO_x, or VLNTM, operates by removing a stream of gas from the lower grate area, and reinjecting it into

the furnace at an elevation above the conventional overfire air nozzles. U.S. and foreign patents are pending on this process, and a simplified version known as LNTM in which air is used in the new injection nozzles.

Process Description

EfW systems typically employ a moving grate with two major sources of combustion air. Primary air (also called underfire air) is supplied through plenums located under the grate, and is forced through the grate to dry and combust the waste. The quantity of primary air is typically adjusted to minimize excess air during the combustion of the waste on the grate, while maximizing burnout of carbonaceous materials in the waste bed. Secondary air (also called overfire air) is injected through nozzles located in the furnace waterwalls immediately above the grate, and provides turbulent mixing to complete the combustion process. Secondary air provides the majority of the excess air to the combustion process.

With the VLNTM process, the secondary air stream is reduced, and a “VLNTM” gas stream is introduced through a new series of nozzles, installed at a higher elevation in the furnace, as shown in Figure 1. The VLNTM gas is taken from the roof of the lower furnace, above the last grate section. This location is beyond the fireline in normal operating conditions, and as a result, the gas is relatively cool, and has little corrosion potential.

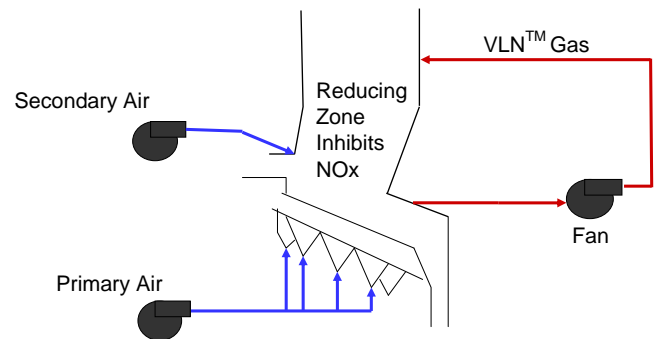


Figure 1
Process flow diagram of the VLNTM process

The relative amounts of primary and secondary air, and the VLNTM gas stream are controlled to yield the optimal gas composition and temperature to minimize NO_x, while simultaneously maintaining high burnout and low CO. The control takes into account the heating value of the waste and the fouling condition of the furnace. The combination of these combustion changes yields an increase in furnace efficiency (more steam per ton of MSW fired).