Autothermal RTO Retrofit with Structured MLM® Heat Recovery Media Yields $100,000+ Savings Per Year

MLM® and Ceramic Balls Succeed Where Random Heat Recovery Media Failed

Introduction

A suburban Chicago producer of coal tar distillates and specialty chemicals uses a regenerative thermal oxidizer (RTO) to destroy volatile organic chemicals (VOCs) emitted by various plant processes. Converting those emissions to benign carbon dioxide and water vapor helps prevent air pollution, since VOCs contribute to smog formation.

Chicago Plant RTO

The Problem

Random-dumped ceramic heat recovery media such as saddles have been widely used in RTOs over the past thirty years. Limitations of this type of media are high pressure drop and poor thermal efficiency, both of which translate into high operational expenses. High pressure drop requires a more powerful fan to move air through the RTO, which results in excessive power costs. Poor thermal efficiency requires that additional fuel gas be used to maintain high temperature in the RTO combustion chamber to ensure complete oxidation of VOCs. At today's natural gas prices, that's a major operating expense.

The Chicago plant had an additional problem. Due to the high VOC content of the air being treated, the RTO had been designed to operate in autothermal or self-sustaining combustion mode, so the heat recovery canisters in this RTO are shallow. The desired thermal efficiency was 80%, so the RTO was designed to operate with 2.5 ft of 1" ceramic saddles in each of the three heat-recovery canisters. It proved impossible to recover this much heat because the random-dumped ceramic media tended to become airborne during operation of the RTO at high gas velocities. In addition to 1" and 1.5" saddles, 2" ceramic 'dogbones' and 2" ceramic 'Christmas ornament' media had been tried in this RTO, but all of these media experienced fluidization during normal operation. Plant engineers had to resort to 3" ceramic saddles to stabilize the top of the media bed. Unfortunately, using large saddles caused the thermal efficiency to fall to 70%, resulting in an unexpected need to burn auxiliary fuel during normal operation. The resulting fuel costs were $50,000+ per year -- in an RTO that had been designed to run in autothermal mode without added fuel.


History of random media preserved in insulation.

Solution - Retrofit with MLM® and Ceramic Balls

Lantec Products recommended that 2.33 ft of MLM-160® be installed in each of the three canisters of the RTO. Since MLM® is supplied as standard sized units 1 ft by 1 ft by 4 inches tall, 19-mm ceramic balls were used to back fill between the MLM® and the insulation along the inside walls of the RTO canisters.

Since an uneven air inlet/support grate was in place in this RTO, 25-mm ceramic balls were installed over the grate. This layer of balls supports the MLM® bed and helps improve air distribution in the RTO.

Result - Major Fuel Gas and Electric Power Savings Achieved

1. Thermal efficiency of 84% achieved with RTO operating in autothermal mode.
2. RTO ΔP ~ 10 in WC (vs. 20+ in WC using 1.5" and 3" saddles).

Installation of New Heat Recovery Media MLM-160® and Ceramic Balls

25-mm ceramic balls installed according to wall markings indicating proper level of balls and MLM®

Installation of MLM® on 25-mm ceramic ball support

Closeup of MLM® on 25-mm ceramic ball support

Retrofitted Canister Configuration

Number of Canisters:	Three
Canister Cross Section:	11.25 ft x 15.25 ft
Base Layer:	1.0 ft of 25-mm balls
Main Layer:	2.3 ft of MLM-160
Peripheral Filler:	19-mm balls

RTO Operating Conditions

Air Flow:	61,936 scfm
Superficial Gas Velocity:	375 scfm/ft²
Inlet Air Temperature:	170°F
Combustion Temperature:	1,600°F
Valve Switch Time:	90 sec
Thermal Efficiency:	84%
Pressure Drop:	10 in.WC

Power Savings+Fuel Gas Savings > $100,000/yr

Final result

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