Biosolids Facility Realizes Savings of $78,000 per Year from RTO Retrofit Using MLM® Media (VOC Control)

Projected Savings top $1,000,000 over life time of installation.

introduction

A major east coast city owns a biosolids drying facility. This facility accepts solid wastes from the various wastewater treatment facilities owned by the city. This material is dried prior to final disposal. As biosolids are by definition organic material, the drying process of the sludge produces volatile organic compounds (VOC) that if released into the atmosphere support smog formation [1]. A number of compounds that are the source of offensive odors are also formed when biosolids degrade [2]. These malodorous species can possibly be organic and inorganic sulfur compounds, ammonia, amines and organic fatty acids.

The air pollution control technology used to prevent the release of these various species into the atmosphere at this facility is a regenerative thermal oxidizer (RTO) or afterburner. In this unit air that contains the organic pollutants produced by the drying process is passed through a high temperature (1500 °F) chamber. There is sufficient residence time in the chamber to assure that >99% of the VOCs present in the air are burned to CO_2 and H_2O. The RTO is shown in Figure 1.

Figure 1: The RTO that is the subject of this discussion

the problem

The city has privatized the management of this facility. The private company in charge of day to day operations of the RTO realized that the cost of operating the RTO was extremely high. And the management contract granted by the city encourages cost savings as any savings are shared between the city and the private firm.

As discussed elsewhere [3, 4] RTO units recover heat by passing the air being treated through beds of heat recovery media. Note in Figure 1 that this RTO has two canisters containing heat recovery media. The recovery of heat is vital to minimizing the fuel (natural gas or some other fuel source) needed to maintain the high combustion temperature noted above.

Typical of RTO units of this design, the original heat recovery media used was 2" ceramic Typacks®. This media operates in a similar fashion to saddles described elsewhere [4]. As a result the pressure drop observed for this RTO was very high, 10-30 inches WC. The value of 10 inches WC represents the pressure drop of clean Typacks® and the value of 30 inches WC was the pressure drop observed after collection of particulate matter within the heat recovery beds. On average a monthly maintenance shutdown was required to wash and restore the pressure drop across the RTO.
This pressure drop represented two problems:

1. Operating expenses were high as the result of the large power consumption required to overcome this pressure drop.
2. The monthly maintenance events just noted also represented a large, continuing expense.

the solution

Introduced to the RTO industry by Lantec Products in 1996, MLM® (Multi-Layer Media) is reducing the cost of both building and operating RTOs around the world. In this instance, a retrofit of the heat recovery media to MLM® made great economic sense as it offered to solve both problems just noted.

Note in Figure 2 that MLM® is a structured media with a self supporting, free floating plate design. The free floating plate design of MLM® offers both greatly reduced pressure drop as well as far superior resistance to deposition of solids vs. traditional RTO heat recovery media such as saddles or in this instance, Typacks®.

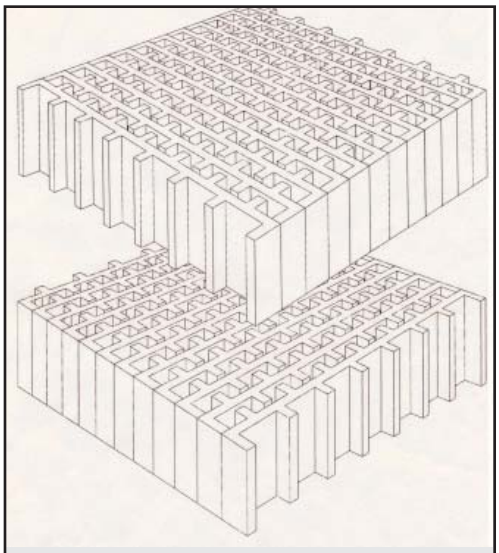

Figure 2. MLM® structured RTO heat recovery media from Lantec Products. Note that by rotating the plates of successive layers 90° that each successive layer is supported by the lower layer of media.

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the results

Plant management accepted Lantec Products' recommendation to exchange the Typacks® in the RTO canisters for MLM®. This decision was based upon the growing acceptance of MLM® for both new and retrofitted RTO units around the world. The results of this project are summarized on the right.

Obviously, a large power savings has been realized as the result of the retrofit to MLM®. Using data published by the Electric Research Institute [5], management estimates that it will realize a reduction of electric power of approximately $28,000 per year. Additionally, as a projected capacity increase to 20,000 cfm for the RTO is planned, the power savings per year will grow to approximately $68,000 vs. the operating expense if the Typacks® had not been replaced.

Actual thermal efficiency within an RTO can be difficult to measure. Thermocouples may have 'lag' times, other thermal losses may be taking place, etc. However, a reduction in therm consumption, as reported here, is an absolute measure of improved thermal efficiency – as less fuel is being purchased, at a $50,000 annual savings, to operate the RTO.

These savings are in contrast to previously held beliefs in industry that RTOs are expensive to operate [2].

	2" Typacks®	MLM®
Bed Depth of Heat Recovery Media:	8 ft	5 ft
Air Flow:	12,000 cfm	12,000 cfm
ΔP, average:	20-30 in WC	4-5 in WC
Fan Load:	40 Hz	30 Hz
Thermal Efficiency:	~91%	~95%
VOC Destruction Efficiency:	>99%	>99%
Gas consumption (therm/dry ton):	11.7	6.2
Fuel Gas Savings (per year):		$50,000
Electric power savings (per year):		$28,000 [6]
Current annual savings:		**$78,000**
Savings after capacity increase:		$118,000

At project cost of $80,000, investing in MLM® led to full project payback in one year! 12 Year Savings = $1,000,000+

environmental benefits

Each kWh of electric power generated in the United States [6] is estimated to result in 1.34 pounds of CO2 emissions. As a result of the power reduction reported here, a greenhouse gas emission reduction [7] of over 300,000 pounds per year has been realized. If the RTO capacity increase takes place as planned the carbon emissions will be over 760,000 pounds per year less than what would have been the case had the old heat recovery media not been replaced.

project update

Historically, the media in this RTO was baked once per month. The purpose of a 'bake out' is to drive off any volatile material that may have accumulated within the heat recovery bed. The normal schedule of bake outs is once a month. During the first 6 months of operations after the MLM® retrofit, the RTO held constant pressure drop.

Recall that with Typacks® in the RTO the pressure drop would start at 10 in WC and climb to 30 in WC over the course of a typical month's operation.

After 6 months, the pressure drop was observed to climb slowly until it had reached 20 in WC. This value was reached in early October, 2003. This type of behavior of the RTO has been observed elsewhere in the bio-solids handling industry [3, 4]. At that time a wash of the heat recovery media was performed. The pressure drop across the MLM® has been restored to 4 ~ 5 in WC as a result.

This experience points out the need to monitor pressure drop across the media in a RTO on a daily or weekly basis. Lantec Products has recommended that a twice per year wash of the media with no baking events is the most effective use of resources. This is based upon the following analysis of the cost of the wash event:

Total hours required = 24
Crew Size = 4
Total Man Hours x $40/hr = $3840
Total Conservative Cost, Single Maintenance Event = $5000

An increase of pressure drop of 3 in WC represents an additional electric power expense of $5000 per year [5]. Therefore it is seen that the maintenance events should be scheduled on a 6 month basis or if the pressure drop is observed to rise by this amount from the clean media value of 4 ~ 5 in WC.

References

[1] "Global Issues: Biogenic Volatile Organic Compounds", Rainer Steinbrecher, http://www.gnest.org/Global_Issues/Biogenic.htm

[2] "Biosolids and Residuals Management Fact Sheet - Odor Control in Biosolids Management", US EPA document 832-F-00-067, September, 2000

[3] "Biosolids Incinerator Operator Retrofits RTO to Improve Air Flow", Ann Hasbach, Pollution Engineering, Nov. 1999, pp. 55-56, www.lantecp.com/mlm/MLMPollEng.htm

[4] "MLM® Upgrades Municipal Sludge Multiple Hearth Incinerator RTO", http://www.lantecp.com/casestudy/cs36.pdf

[5] Electric Power Research Institute, EPRI, 3412 Hillview Ave., Palo Alto, CA 94304, USA, data assumes 80% efficient motors, 10% annual downtime, www.epri.com

[6] United States Department of Energy and Environmental Protection Agency, "Carbon Dioxide Emissions from the Generation of Electric Power in the United States", July 2000

[7] "Q-PAC® Scrubbing and MLM® Heat Recovery Medias Help Industries Fight Global Warming by Reducing Greenhouse Gas Emissions, Slowing Climate Change, Reduces Fossil Fuel Consumption and Saves over $200,000 in Reduced Annual Power Costs", http://www.lantecp.com/casestudy/cs41.pdf