Energy Savings for VOC Abatement

As a coating and laminate company in South Carolina discovered, older model regenerative thermal oxidizers can be real gas hogs. But at what point is it cost effective to replace an aging RTO?

By Jon Hommes, Lead Engineer, Dürr Systems Inc., EES

After operating two regenerative thermal oxidizers (RTOs) for the last 25 years, Soliant LLC, Lancaster, S.C., considered what repairs were needed to keep them operating reliably. The company manufactures precision coatings for durable films and laminates in support of the transportation, marine, heavy truck, recreation, consumer electronics and consumer packaging industries. They approached the original manufacturers of the RTOs, Dürr Systems Inc. EES, to assess and recommend repairs.

After inspecting the equipment, the manufacturer determined that the old oxidizers had been designed with low thermal efficiency to accommodate VOC loading significantly higher than their current levels. Under current operating conditions, the old oxidizers were gas hogs. In 2006, the oxidizers used 56,675 dekatherms (dth) at an average of $10.78/dth. This added up to over $50,913 per month.

RTO replacement project

In late 2007, the company installed a new rotary-valve RTO to replace the old oxidizers, which went online Dec. 17; the energy performance contract began Jan. 1, 2008. Through June of 2008, the new oxidizer had reduced the company's gas usage for VOC abatement by 85%. With their long-term gas supply contract ending in June 2008, the company began looking at a spot gas price for uninterruptible service of $15/dth and a contract price of $14/dth. At their current contract natural gas price, the RTO replacement project saves the company an average of $56,500 per month.

Energy performance contract

The RTO manufacturer financed the project under an energy-performance contract, which required no capital investment by the company. Jim Griffin, a regional sales manager for the RTO manufacturer, explains: "Soliant was interested in the oxidizer replacement project and the energy savings it would generate, but they had already budgeted their capital resources for expanding production to meet increasing demand. It's a story I hear frequently from customers and it's the primary reason [we] began financing energy projects."

"As a small company, we thought it was a good way to implement a greener solution without a large capital outlay," said Jeff Bailey, vice president of operations for Soliant. "The performance guarantee ensured both sides have a vested interest in improvement."

As part of the arrangement, Bailey's company agreed to pay the RTO manufacturer a fixed monthly fee from the natural gas savings generated by the RTO replacement. In return, the manufacturer guaranteed the RTO's measurable thermal efficiency for the full contract term. The contract also included bonuses for exceeding the guaranteed thermal efficiency and penalties for falling short of the guarantee. This means that if the RTO performance were to fall below the guaranteed level, the manufacturer would pay for the additional gas usage, and thus has a powerful incentive to address the issue immediately.

It is not uncommon that savings from energy projects begin to deteriorate long before the payback period is over. The contract tackled this issue by putting the risk of ongoing performance on the equipment supplier, while giving the end user and the supplier a vested interest in continuous monitoring and system tune-ups to maximize energy savings.

Overall, the company's net monthly operating expense has been reduced because of the performance contract, since the average natural gas savings has exceeded the monthly payment for the equipment. As an additional benefit, at the end of the contract term, the company will own the equipment outright and thus keep all the energy savings for themselves.

"Soliant was in a position where their production depended on the operation of two 25-year-old oxidizers that cost them $66,000 per month in gas alone. By using the EPC to fund the RTO replacement, at the end of the contract they will have a new RTO that costs them just $9,600 per month to run," said Griffin.

Service and maintenance
In assessing the situation, when asked to consult on the project, the RTO manufacturer estimated that the cost to repair the aging units would have been around $250,000. By making a decision not to invest in the old equipment, the company felt that they would achieve not only energy savings, but also a significant reduction in maintenance costs going forward. "There's really no comparison between the old and the new equipment," said Bailey. "The old system had 42 hydraulic valves for controlling air flow, which were a maintenance headache. The new ... unit has a single rotating valve which requires minimal service and is a much simpler design." Because the manufacturer's payment depends on the system's performance, it is critical from their perspective that they continuously monitor performance and regularly inspect and tune the system.

Room to grow
The company was pleased to discover they now had abatement capacity for a new production line, the exhaust from which could be routed to the old oxidizers. "While energy savings have been realized with the new equipment, what's of equal importance is the fact that we have more oxidizer capacity that will allow us to add new coating lines," said Bailey. The company's old oxidizers are still in place and ready to run. A new process could be connected to them with just minor ductwork changes.

Technical advantages
The new RTO system is about a quarter the size of the old two-oxidizer system as a result of significant developments in RTO design over the last 25 years. Whereas the old RTOs were arranged with seven horizontal flow ceramic media beds radiating outward around a central combustion chamber, the new RTO uses a vertical flow arrangement with the combustion chamber sitting atop 12 wedge-shaped ceramic media beds, all in a single can. The ceramic media bed area has also been substantially reduced by the use of structured honeycomb ceramic blocks, which accomplish the same heat exchange at 50% to 100% higher velocity than randomly packed ceramic saddles.

The RTO was delivered and installed from November through December 2007, while the company continued production. Only five days of shutdown, split between two weekends, were required to complete the ductwork tie-ins to the existing process duct and existing stack, and to wire interlocks to the

process. The RTO's skid, including the rotary valve, drive system, combustion chamber support steel, gas train and control room, was completely assembled, pre-wired and pre-piped in the manufacturer's shop.

By implementing this RTO replacement project under an energy-performance contract, the company was able, with no capital outlay, to expand its VOC capacity for future production lines, save more than $675,000 annually, replace aged equipment with a state-of-the-art machine, avoid $250,000 in repairs ,and get long-term supplier monitoring and service.

Figure 1: The replacement RTO system used much less fuel and energy, reducing the monthly gas bill by over $56,000 per month.

	Natural Gas Usage (dth/mo)	Operating Cost ($/month @ $14/dth)
Old RTOs (2006 Avg)	4,723 (56,675dth/yr)	$66,122/mo
New RL60 RTO		
January '08	734	$10,276
February '08	782	$10,948
March '08	650	$9,100
April '08	726	$10,164
May '08	609	$8,526
June '08	617	$8,638
Average Month	686	$9,604/mo
Gas Savings	4,037 dth/mo	$56,518/mo

Figure 2: The new system improved emissions and efficiency.

Technical Comparison	Old Oxidizers	New RTO
Number of Fans	4	1
Number of Valves/Actuators	42 (14 in, 14 out, 14 purge)	1 RL rotary valve
Number of Burners	2	1
Ambient Noise Level	Very high	Low
Control Panel	Inside plant, no HMI to display system information	Air-conditioned control room at the RTO + remote panel inside plant