RTO Innovation

Now that the commercially available RTO system is 30 years old, some might say this seasoned technology has nothing new to offer.

By **RICHARD GRECO,** president of Cycle Therm Inc.

Regenerative Thermal Oxidizers (RTOs), have become a common name in the air pollution control industry, and with good reason. This technology has provided general industry with a consistent and reliable solution to plant emissions for over 30 years.

Since RTOs were first introduced in the 1970s, the technology has evolved and many improvements have been made that provide improved reliability, greater flexibility, heat recovery options and a reduction of the overall life cycle cost of the RTO.

History

The RTO, from its humble beginnings destroying odors in the 1970s, has evolved into an industrial equipment staple, destroying a large variety of VOCs.

Prior to formation of the EPA in 1970, back when fuel costs hovered around $1.50 per million Btu, demand for RTO technology for industrial air pollution control was so miniscule that only one company in the U.S. manufactured the device. With the

1973 Arab fuel embargo and EPA emission control limits, a new air pollution control industry was born.

Compared with other available technology of its day, such as a 62-percent thermally efficient recuperative unit, the 1970s RTO at 85-percent thermal efficiency, cut fuel usage 50 percent. The savings in operating costs were significant.

This era saw the debut of ceramic heat recovery media in lieu of the standard steel heat exchanger. More durable at high temperatures, the ceramic media greatly extended the life of thermal oxidizers. Furthermore, if the heat recovery media failed it could be field replaced quite easily, whereas recuperative oxidizers required factory refurbishment.

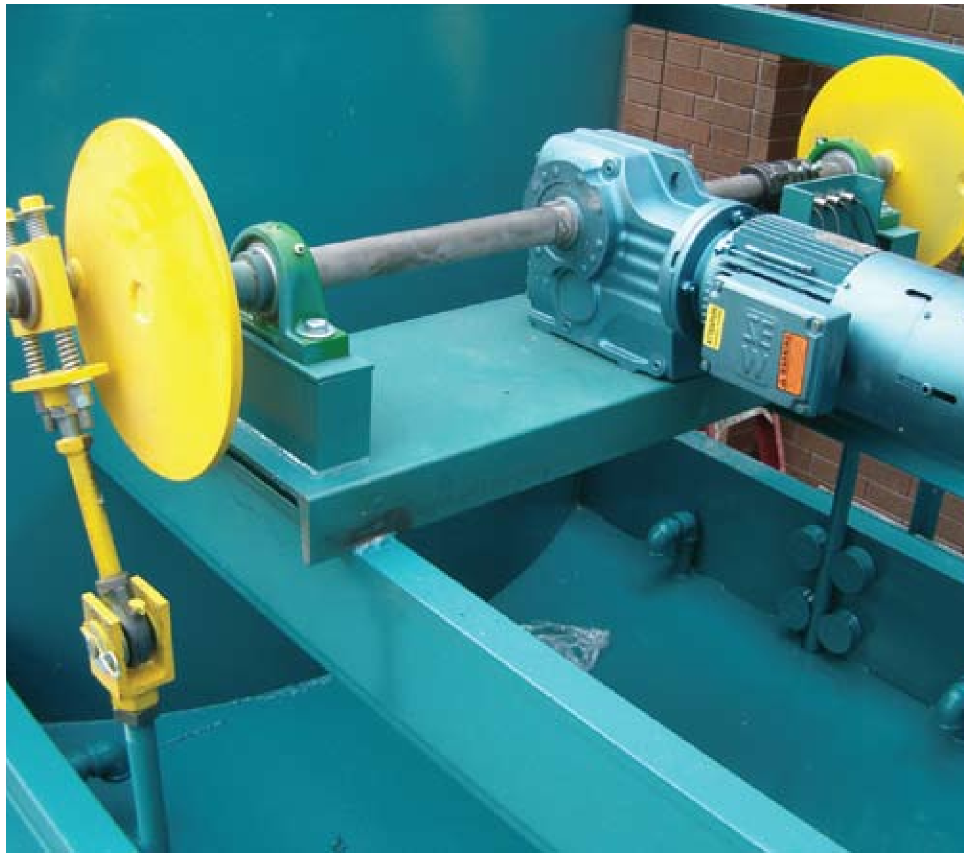
The 1970s design featured state of the art hydraulics. Unfortunately, this system was problematic as the viscosity of the hydraulic fluid changed drastically with the outside air temperatures. For example, for proper operation of a seven-chamber RTO containing 21 valves (7 inlet, 7 outlet and 7 purge valves), the valves must sequentially rotate 90 degrees in seven seconds. Depending on whether it were day or night, winter or summer, sunlight or shade, the valves all moved at different speeds. Constant readjustment was necessary to stop the valves from slamming in the afternoon sunlight and sticking during the coolness of the night. This phenomenon was even more pronounced in northern climates during the cold winter months.

Maintaining hydraulic cylinder seal life was another concern for early RTOs. Each cylinder was expected to make 350,000 rotations per year. Even on a small three-chamber system, it only took one of the nine cylinders out of operation to disable the entire RTO.

In the early 1980s the vertical flow RTO was commercially introduced. The design was simple in that gravity held the heat recovery media in place. A vertical media support wall was no longer required as gravity kept the ceramic media in place.

New companies were born to manufacture the vertical flow RTO, which proved to be 30 percent less costly to manufacture than the 1970s horizontal design.

Multi-chamber vertical flow units with heavy butterfly valves operated by hydraulic operators gave way to the two-chamber vertical flow RTO with poppet valves driven by pneumatic operators. These units were less expensive to manufacture and the high speed poppets driven by pneumatics made them viable for destroying volatile organic compounds.



Above is an example of an electrically controlled valve system. Maintenance time and expense is greatly reduced.

> **"Manufacturers are constantly pushing the thermal efficiency and power usage envelope by developing and using heat recovery media designed specifically for RTO systems."**

What's available today

Today's typical RTO uses the 1985 vertical flow configuration. There is no set rule on how much flow a two-chamber RTO can handle. Some companies feel comfortable building to 70,000 scfm using a multiple valve system, while others limit themselves to 40,000 scfm using a single set of valves. The design of a RTO, and ultimately, the amount of air it can handle comes down to vendor configuration and over-the-road shipping constraints.

Today's RTO is equipped with quick-changing poppet valve systems. The valves change the air flow from tower to tower every few minutes in order to desorb the maximum amount of heat stored in the heat recovery media. Valve discs, weighing as much as 200 lbs, are moved from seat to seat using a pneumatic valve operator. In order for the poppet valve to be effective, it must minimize unprocessed flow leakage from bypassing the RTO to the environment. The valve disc must move from position to position in a short period of time and stop at the end of travel without crashing into the valve closure seat, while making a tight seal under changing flows, temperatures and pressures for up

Electrically controlled valve movements are more reliable across more environmental conditions than hydraulically or pneumatically controlled valves.

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to 200,000 cycles per year.

Over the years the pneumatic operator and poppet valves, along with their respective valve seats, have suffered from wear and tear. Pneumatic valve operators are susceptible to moisture and dirt in air lines and have a tendency to wear out due to the high number of valve cycles required per year. The pneumatic operator can often crash the respective valve disk into the valve seat each cycle, causing a shorter seal life. Good valve sealing is critical to achieving higher contaminant removal efficiencies.

Recent innovations

Valve drives. In recent years, two-chamber direct mechanical drive valve systems using electric motors have become available. The electric valve transfer system has eliminated the problems of poor air quality and the destructive problem of valves crashing into the valve seats. This design consistently stops the valve motion gently when it contacts the valve seat. The electric drive also is not altered by ambient conditions.

Modularity. Larger RTOs today can often be entirely assembled, wired and tested in the fabrication facility. A modular, pre-packaged system eliminates the need for additional site contractors, allows comprehensive factory testing and single-source responsibility.

Heat recovery media. The highest pressure drop component of an RTO is the heat recovery media. Many types, shapes and sizes are available on the market today. There are segments of the marketplace that are convinced that structured or extruded monolith is the only heat recovery media to use when designing an RTO system. Essentially, different applications have different requirements and as such each application should be evaluated for the maximum heat exchange efficiency with the lowest corresponding pressure drop. This translates directly into the lowest utility usage for electricity and supplemental fuel.

Manufacturers are constantly pushing the thermal efficiency and power usage envelope by developing and using heat recovery media designed specifically for RTO systems. Such media tolerate thermal abuse while offering the lowest pressure drop and highest thermal efficiency on the market today. Today, using low-pressure drop media can cut fan horsepower by approximately a third without thermal efficiency loss.

Back to the future

It is likely that escalating fuel and operating costs will continue to spur improvement in thermally-efficient heat recovery media.

Just as going from yesteryear's 65-percent recuperative unit to the 85-percent RTO of the 1970s cut fuel usage in half, and just as today's typical 93-percent regenerative system cut its predecessor's fuel usage by another 50 percent, the new target of a true 96-percent thermally efficient RTO will soon be reached, again cutting fuel usage in half. ***PE***

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