Air pollution control drives hot water supply

*A producer of aluminium bottles recently integrated a system that recovers waste heat from the stack of its pollution control equipment to generate hot water, says Jason Schueler**

One Fortune 500 company that produces resealable aluminium bottles is setting the standard by combining pollution control systems with process heating equipment.

Historically, companies would use independent systems for generating hot wash water, but the combination of environmental control systems and process water heating allowed this customer to achieve environmental compliance, generate heat for its processes and reduce greenhouse gas emissions.

During coating and curing, volatile organic compounds (VOCs) are created in the ovens as the coatings dry. As is the case with many industrial air pollution control applications, such emissions are often destroyed by thermal or catalytic oxidation. Time, temperature and turbulence are used to break apart organic compounds into carbon dioxide and water vapour. When process emissions are oxidised, heat is also generated from the exothermic process. This heat is used within the pollution control device to minimise auxiliary fuel consumption during operation.

Hot water generation occurs by transferring heat from the abatement system stack over a series of finned coils where water within the coils is countercurrent to the airflow direction. For this particular size of oxidiser, these coils can generate up to 3 million BTU/hr of energy transfer which can be used to heat 100 gallons per minute of water to the required 200 deg F temperature in the washing stage. Pumps deliver the water through the coils based on the heating demand of the washing stage. As more hot water is requested, the pumps can deliver the water at a higher rate of flow based on the variable speed of the pumps. Water temperature is controlled by adjusting the amount of hot gases that are passed over the coils, with dampers directing the gases either across the coils or bypassing them based on specific temperature requirements.

Though air-to-water heat exchangers are common, another popular thermal fluid to use for heat recovery is oil, such as Therminol 66. Operating in much the same way as the air-to-water exchangers, the air-to-oil heat recovery coils capture waste heat from the oxidiser. This allows an operator to also utilise the hot oil within the ovens or other process equipment. Another benefit to a hot oil system is that they allow for temperatures up to 550 deg F without needing to deal with the extreme pressures that come hand in hand with high temperature steam. The hot oil systems can also be decoupled from the owner's process with a second heat exchanger, such as an oil-to-water or oil-to-air, providing more flexibility in how the waste heat from the oxidiser is utilised.

The aluminium bottle facility also used cutting-edge abatement technology to minimise the overall carbon footprint.

By using a regenerative thermal oxidiser (RTO), this facility was already limiting its environmental impact. What differentiates RTOs from the catalytic, recuperative and direct-fired oxidiser technologies is their ability to recover and reuse the thermal energy generated during operation. Even under low emission input, destruction is often achieved with little-to-no auxiliary fuel once the RTO is brought up to temperature.

Even though all process emissions from the aluminium coating operation could have been effectively removed using just an RTO, this customer was very progressive in looking for other ways to reduce natural gas consumption. It also incorporated an emission concentrator system for its low temperature emission sources. The concentrator technology is an energy and cost saving add-on to thermal and catalytic oxidisers that can reduce the amount of treated airflow by 95 percent. It takes the high volume of low concentration process exhaust from the internal bottle coating, and passes these emissions across a zeolite adsorbent where the VOCs are captured onto a zeolite material. The emissions are desorbed into a much smaller and concentrated air stream which is then sent to the RTO for VOC destruction. Excess heat from the RTO is used for desorption so that no supplemental fuel is needed for the concentrator.

The addition of a concentrator resulted in a smaller exhaust volume being sent to the RTO, reducing the capital cost of the control device. It also delivers a higher VOC concentration to the RTO which ensures the system is more fuel efficient. In this case, the higher VOC concentration correlates to a higher RTO stack temperature, enabling even higher flow rates of hot water to be used within the process.

Results driven initiative

Using the water coils for process heating needs as opposed to stand-alone water heaters saved this company 3m BTU/hr of auxiliary energy consumption. This is the equivalent to about 1,500 tons per year of carbon emissions that were eliminated for a continually running process.

The RTO was able to provide 99 percent destruction of the VOC emissions while often operating without supplemental natural gas. This technology choice was able to reduce auxiliary fuel consumption up to 5.5m BTU/hr over older technologies, saving up to 2,800 tons per year of carbon dioxide emissions. The concentrator further enhanced the system efficiency and reduced auxiliary fuel consumption by an additional 5m BTU/hr, saving another 2,500 tons a year of carbon dioxide emissions.

The aluminium bottle manufacturer is now considering additional heat recovery projects at this facility. Applications such as hot oil generation, supplementing oven heat and ambient air heating are all potential green initiatives.

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