

# TURBINE SCR DESIGN FEATURES

The Turner EnviroLogic SCR has been designed based on 20+ years experience in building and operating air pollution control equipment. It combines over 60 years of engineering experience in such systems, including catalytic systems. Turner EnviroLogic began building catalytic systems in 1983, using the same metal monolith construction, as well as the same lining systems and block support system currently used in the SCR. Further, many of the design features of these systems have been field proven in thermal oxidizers, operating at temperatures of up to 2000° F, with systems operating for 15 or more years. These features have been proven in SCR operation over the years, since our first installation in 1998.

Turner EnviroLogic is committed to the design and supply of *AINNOVATIVE AIR SOLUTIONS*®. We have applied our expertise to regenerative thermal oxidizers, producing a simpler, more cost effective system, while increasing destruction efficiencies from 95% to greater than 99%. We have done this by departing from the industry norm, and building our own proprietary single valve rectangular butterfly switching system, among other things, instead of relying on multiple purchased valves like the bulk of our competitors. This same expertise has been translated to SCRs.

SCR=s are actually very simple devices compared to the oxidizer and scrubber systems the company builds. All that is required is to redistribute the high velocity swirling turbine exhaust gas into an evenly distributed flow, mix it uniformly with ammonia, and pass it across a catalyst. The areas of challenge are distribution of air, mixing of ammonia, pressure drop, and sound attenuation. Sound concerns include near field levels for OSHA compliance, and far field levels for community noise control.

In our design we have attempted to optimize all components into an effective total system. Our flow distribution is accomplished using vanes, designed using CFD for minimum pressure loss and maximum effectiveness. The silencer, consisting of vertical baffles, also helps in this regard, thus providing a secondary benefit, and putting its pressure loss to constructive use, something not achieved in a stack mounted design. Putting the silencer up front in the system also achieves the following:

1. Sound levels radiated through the SCR walls are lowered, since sound is reduced early in the system.
2. Structural and seismic loads are lowered, since the unit is now at grade level, and not elevated.
3. The silencer is readily accessible for inspection and any required maintenance.

The silencer is designed with solid velocity cones at the entry, and the fill is totally encapsulated to prevent fiber loss. There have been no failures or fiber loss to date.

Ammonia vaporization and mixing is another area of concern. The quantity of ammonia being added is small compared to the air flow from the turbine. Rather than using outside air and electric heaters to vaporize the ammonia, our design uses waste heat in the turbine exhaust. This provides the following benefits:

1. Total air flow to be treated by the catalyst is reduced, since no additional air is introduced.
2. No parasitic load is introduced, since there are no heaters.
3. No heaters, contactors, controllers or other devices are provided, requiring mounting, wiring, and maintenance.

This also eliminates the potential for failure of these systems

4. The vaporization air can be increased, since it is not necessary to minimize it. This allows for a fairly substantial flow, thus improving ammonia mixing, without penalty.
5. By using higher vaporization flows, a self balancing plenum distribution system can be used, eliminating the need for balancing valves on the ammonia distribution system. This reduces cost, complexity, and start-up and testing requirements, as the balancing is eliminated.

The catalyst system used has been designed to optimize its operation as well. The catalyst used is a metal monolith, instead of ceramic. This provides the following advantages:

1. The metal monolith has thinner cell walls, reducing cross sectional area, making the bed smaller. For a similar cross section with ceramic catalyst the bed must be made deeper, raising pressure drop.
2. The thinner wall creates less pressure drop than ceramic.
3. The metal blocks are more durable, and less prone to spalling and breakage, including during installation. Thus, they do not need to be combined into larger, heavier modules. Ceramic modules are normally 6' square or larger, making them excessively heavy. Smaller modules would increase size and cost due to the extra frames. The larger modules do not comply with the spec requirement that modules be less than 3' on any side.

4. Due to lighter weight, it is not necessary to top load. This eliminates the need for large doors, and for a crane to load and unload. Metal modules can be side loaded from a scissor lift with normal labor. In addition, the additional platforms and stairs associated with top loading can be eliminated.
5. Due to the lighter catalyst, and the elimination of the extra steelwork required, foundation loads are substantially reduced, including seismic considerations. Thus, foundation costs are lowered.

The unit is typically lined using a system proven for 10 years or more in oxidizers and high temperature stacks. The chamber walls are lined with mineral wool, with an overlay of ceramic fiber blanket. This is a dense fiber spun blanket, with no exposed cut fiber ends. A stainless steel mesh (304 has proven adequate at these temperatures) is used to retain the blanket and prevent movement. Rigidizer solution is applied to firmly lock the fibers in place. As a result of erosion and abrasion of fibers on the floor in earlier models, the floor is covered with a solid sheet. This system has been field proven to be effective, and has eliminated the buckling and peeling of sheets encountered in some SCR=s when sheets warp and edges are lifted by the air velocity.

These features result in an improved overall design. The system as designed is smaller, lighter, simpler, and more reliable. Parasitic loads have been reduced, and the need for time consuming and costly balancing eliminated. Multi-plant users operating this system have indicated it is an improvement over the other designs they have operated at other plants.