



Selective Catalytic Reduction Technology

Redefining NO_x reduction through innovation



RENEWABLE | ENVIRONMENTAL | THERMAL

Babcock & Wilcox (B&W) is a leading designer and supplier of boilers and the full spectrum of air quality control systems. Our technical expertise with boiler and auxiliary equipment design and construction enhances our ability to properly integrate selective catalytic reduction (SCR) systems and their components.

We have completed or contracted to design and supply nearly 32,000 MW of SCR systems, including both new boiler installations and retrofit applications. In addition, our subsidiary, Babcock & Wilcox Construction Co., Inc., has erected SCR systems for more than 44,000 MW of capacity.



Innovative design solutions to improve overall performance

Temperature control

As an experienced designer of boilers and air quality control systems, we understand the importance of assessing each boiler and customizing a temperature control solution, if required, for optimal SCR performance.

High flue gas temperatures present challenges for both the SCR catalyst and the structure that must support it. On the other hand, even if temperatures are acceptable at full load, low inlet temperatures at partial load may limit the ability to keep the SCR system in service.

Economizer exit gas temperature reduction alternatives

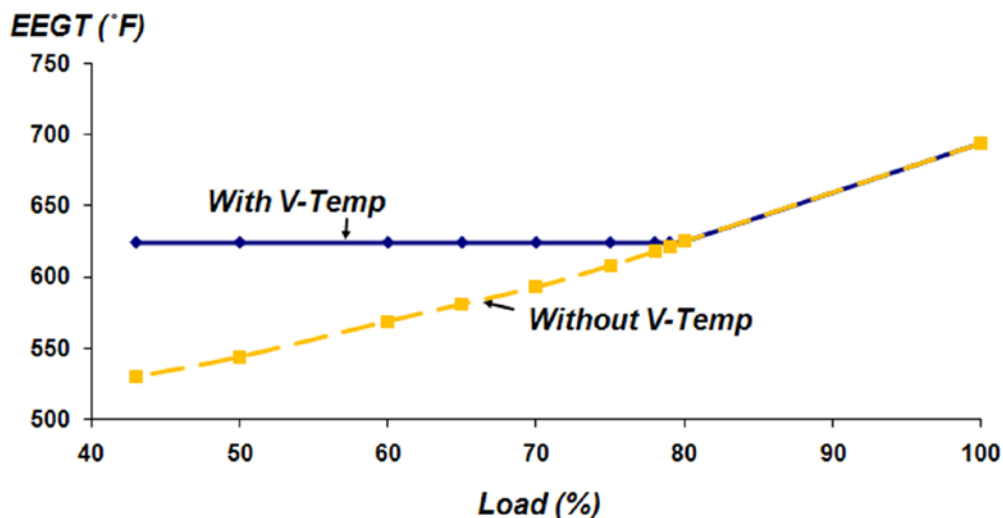
High economizer exit gas temperatures (EEGT) result from a variety of circumstances – most frequently excessive boiler fouling and fuel switching. Boiler-specific remedies include:

- ▶ Boiler modifications to add absorptive surface
- ▶ Retrofit of an external economizer or air heater in the flue gas path between the economizer outlet and the SCR reactor inlet
- ▶ Enhanced “smart” boiler cleaning with sootblowers or HydroJet® boiler cleaning systems

V-Temp™ economizer system for extended load operation

B&W's V-Temp economizer system is an improved, cost-effective method of controlling SCR flue gas inlet temperatures.

This patented system increases flexibility, enabling the SCR system to remain in operation at reduced loads by maintaining the required minimum flue gas temperature for ammonia injection. Our V-Temp system enables SCR operation at partial loads without deposition of ammonium bisulfate on the catalyst. As a result, owners and operators benefit from reduced operating and maintenance costs and the ability to operate over a wider load range.



Predicted economizer exit gas temperature with and without B&W's V-Temp economizer system.

Customized technical solutions for cost-effective, superior performance

We continue to improve our SCR technology to meet the evolving needs of our customers. Through technology diversification, we can deliver a customized design solution that addresses your unique challenges.

Ash management

Fly ash and large particle ash (LPA) must be managed to avoid ash accumulation in fluework and the SCR reactor where ash plugging can increase pressure drop and decrease catalyst performance. This can result in excessive unit downtime for cleaning and catalyst management. Through computational fluid dynamic modeling and physical modeling, we continue to develop innovative solutions for ash management.



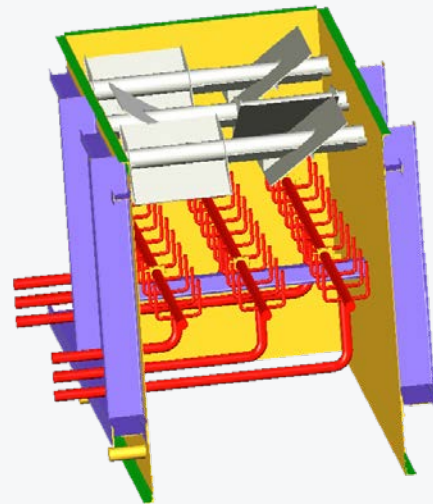
Design options to reduce ash build-up and plugging

Solution	Function	Typical Application
LPA screen with rappers	Capture large particle ash	Any unit (located in the economizer outlet or SCR inlet flue)
LPA baffle	Redirect large particle ash into economizer hoppers	Units with compatible economizer outlet configuration
Scalloped vane slots	Eliminate build-up of ash on trailing edges of turning vanes	Units firing greater than 20 percent Powder River Basin (PRB) coal or other high ash coals
Boxed catalyst support beams and closure plates	Prevent ash falling from beams located above a catalyst layer	Units firing greater than 20 percent PRB coal or other high ash coals
Catalysts with large pitch	Allow ash to flow freely through the catalyst bed	Units firing greater than 20 percent PRB coal or other high ash coals
Sootblowers and sonic horns, alone or in combination	Avoid ash piling and keep ash moving through the catalyst bed	All coal-fired applications (sonic horns); high ash applications (sootblowers or combined devices)

Ammonia injection and mixing equipment

High-performance SCR systems require thorough ammonia-NO_x blending. Our ammonia injection grid and mixing systems deliver the high performance required over the entire load range, simply and robustly, with minimal maintenance requirements. As well, customized mixing systems capitalize on the best efficiencies of both the injection and mixing functions. Results speak volumes – B&W injection and mixing equipment consistently enables our systems to meet challenging performance guarantees.

- ▶ Customized injection zones for optimal performance
- ▶ Straightforward initial tuning and infrequent need for future tuning, but with the flexibility to retune to accommodate changes in unit operation over time
- ▶ Mixer design and quantity that meet ammonia-NO_x distribution requirements while minimizing devices that collect ash in the fluework

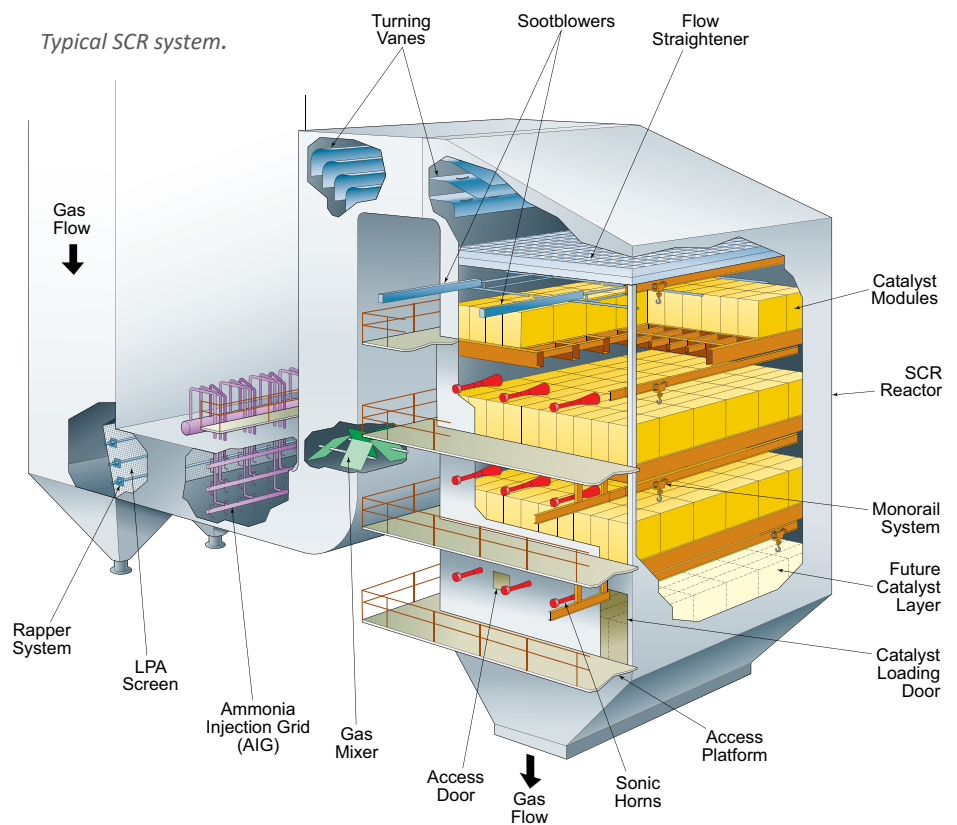


Our customized AIGs and mixers achieve a superior outcome with minimum draft loss.

SCR reactor

Our reactor and inlet designs optimize gas and ash distribution to the catalyst and limit opportunities for ash accumulation. To further minimize ash piling, we utilize modeling to finalize reactor hood geometry and internals. Because there is no single right answer, we deliver a cost-effective, customized solution that meets your project goals.

- ▶ Reactor designs accommodate catalysts from all major suppliers
- ▶ Customized catalyst cleaning systems based on ash profiles
- ▶ Reactor configurations to meet catalyst loading with:
 - Hoist system
 - Rolling hydraulic cart
 - Pallet trucks



Versatile designs to optimize constructability, and enhance safety and quality



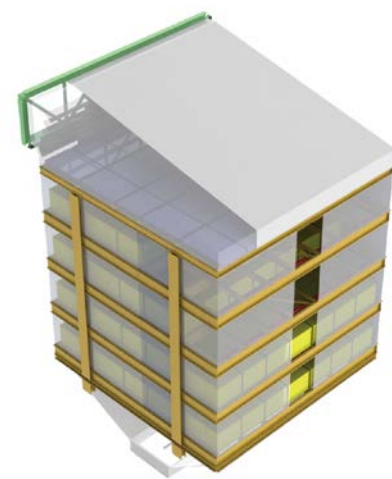
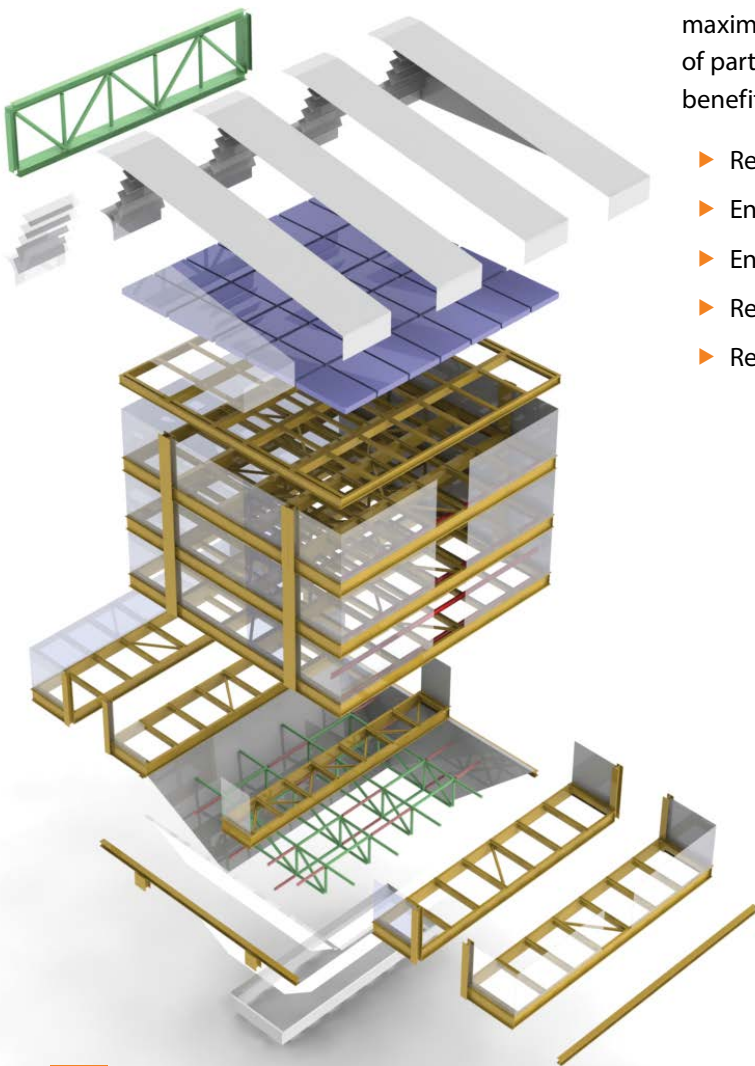
Modularization enhances quality and safety, and reduces schedule risk.

Through our array of SCR reactor and flue design options, we can match an overall system design to the available space on site, and meet technical challenges of the boiler system and plant location.

- ▶ Flat panel delivery for sites with restricted delivery access, and equipment arrangement and erection challenges.
- ▶ Truck-shippable modules for sites with adequate space for equipment laydown and crane placement. Flues and reactors are sub-assembled to meet roadway requirements.
- ▶ Very large barge-shipped modules for sites with water access, unloading and storage capability, and adequate open area for placement using large cranes.

We continue to improve our reactor designs with the goal of maximizing modularization and minimizing internals, a feature of particular importance in high ash situations. Modularization benefits include:

- ▶ Reduced cost
- ▶ Enhanced quality
- ▶ Enhanced safety
- ▶ Reduced schedule risk
- ▶ Reduced impact to plant operations



Our completely modularized truck-shippable design can be erected as delivered or ground-assembled into larger modules.

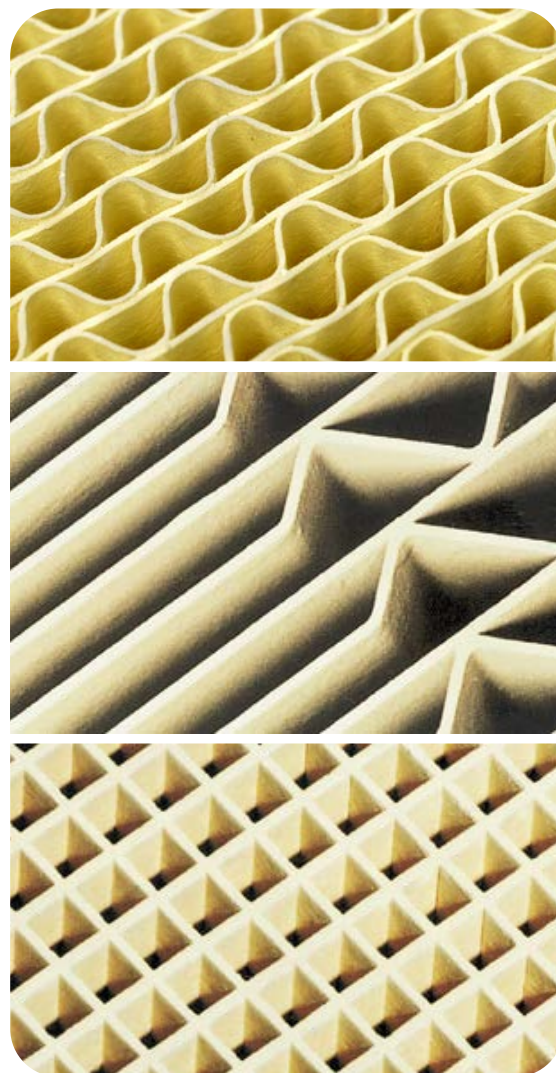
Combustion additive for enhanced catalyst performance

During combustion, substances in coal can create catalyst poisons or be released into the environment. Firing Western U.S. coals often results in the production of gas-phase phosphorus, a material that can lead to rapid catalyst deactivation in the first few months after exposure of a new catalyst bed to flue gas.

We have developed a proprietary process, which uses B&W's Mitagent™ additive to combat the effects of gas-phase phosphorus. This additive, when combined with the coal, reduces the impact of gas-phase phosphorus on the SCR catalyst.

- ▶ Patent-pending process with proven field-tested success
- ▶ Designed for new or regenerated catalysts
- ▶ Maintains catalyst life through poison mitigation
- ▶ Reduces catalyst management costs

Blending Mitagent additive with a mercury oxidation agent enables simultaneous mitigation of deactivation due to gas-phase phosphorus and oxidization of mercury for capture in flue gas desulfurization equipment. Thus, our additive blend performs a dual role of improving SCR catalyst life while cost-effectively achieving up to 90 percent mercury oxidation, reducing or eliminating the need to inject activated carbon for mercury emission compliance.



We put it all together

As a single-source supplier, B&W can provide a complete project, combining design, engineering, procurement, supply and construction into one seamless and integrated NO_x reduction package. For our customers, this means single-point accountability and overall project risk reduction.

Beyond NO_x control, we provide a wide variety of proven environmental technologies to control sulfur dioxide,

fine particulate, mercury, acid gases and other hazardous air emissions. Our complete package of environmental equipment upgrades, services and replacement parts provides many benefits, including improved system reliability, increased removal efficiencies, and reduced long-term maintenance and operating costs.

We blend our experience from nearly 32,000 MW of SCR system projects, our innovative technology, and our expertise as an integrator and constructor of boilers and environmental systems to address the unique challenges of our customers across the country and around the world.



The Babcock & Wilcox Company

1200 E Market Street, Suite 650
Akron, Ohio, U.S.A. 44305
Phone: +1 330.753.4511

www.babcock.com    

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