ClimateBright™ Decarbonization Technologies

For more than 150 years, Babcock & Wilcox (B&W) has been a global leader in the supply of innovative technologies, such as steam generation, emissions control, and other energy solutions for a wide range of industries.

Research and development of new technologies have played key roles in our continuing ability to service major industries. As the world moves toward a lower-carbon future, we understand that clean energy is driving the demands of today's energy marketplace, and we are poised to respond with our innovative ClimateBright™ suite of decarbonization solutions. Since the early 2000s, we have been a leader in the development of carbon dioxide (CO_2) capture technologies.

We continue to build on our more than 150 years of innovation history to develop the technologies that will protect, fuel and energize our world in the future.

continued ▶

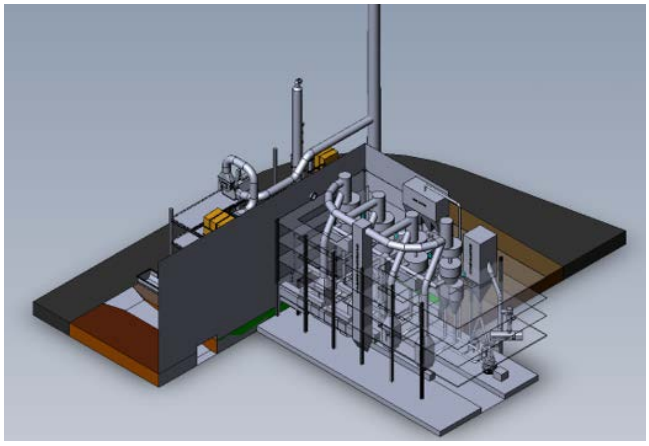
BrightLoop™ Chemical Looping

For more than a decade, B&W and our university partner have collaborated to develop a fuel direct chemical looping (FDCL) process for steam/power and hydrogen generation with CO_2 capture.

The team considers chemical looping a platform technology to convert a wide range of fuels, e.g., coal, petroleum coke (petcoke), methane, biomass, and other industrial process off-gases and materials, into multiple products including hydrogen, synthesis gas (syngas), and steam for power, process, and heating while inherently isolating a concentrated CO_2 stream. The chemical looping platform is also highly scalable, and its benefits can be applied to a wide array of industrial processes.

Process

In the FDCL process, the fuel reacts with the oxygen-carrier particles in a reducer reactor, forming combustion byproducts, predominantly CO_2 and H_2O, while reducing the iron oxide from Fe_2O_3 to FeO. The reduced oxygen carrier particles (FeO) then move to a partial oxidizer reactor where they react with steam to partially oxidize the particles to Fe_3O_4 and generate a stream of hydrogen. The oxygen carrier particles are then transported to a combustor reactor where they are regenerated with air to Fe_2O_3. The exothermic oxidation reaction of the oxygen carrier particles with air releases heat that both reheats the particles for their return to the reducer reactor and heats the air which can be used to heat water and produce steam for power generation or as a heat source for various other processes. The process can be optimized to produce hydrogen, steam or both products by adjusting the conversion in the partial oxidizer reactor.



10 MW chemical looping plant layout

Technology Status

Under a DOE-sponsored project, B&W built a 250 kW_t coal-based FDCL pilot facility to demonstrate the reducer and combustor operation for application to steam and power generation. On another project, our university partner demonstrated continuous hydrogen generation from the partial oxidizer at their 250 kW_t pilot unit constructed and tested at the National Carbon Capture Center.

B&W concluded that given the success of the 250 kW_t pilot units for application to hydrogen and steam for power generation, we are ready to demonstrate the technology at a larger scale. B&W is proposing a project to demonstrate steam and hydrogen production and to be rated at a thermal input of between 2.5 and 25 MW_t while utilizing the most applicable fuel feedstock.

250 kW_t fuel direct chemical looping test unit

SolveBright™ Post-Combustion CO_2 Scrubbing

B&W began initial research of a post-combustion carbon capture process in 2005. This led to the development of our SolveBright regenerable solvent absorption technology (RSAT) scrubbing process using an advanced amine solvent with demonstrated superior performance to that of competing solvents at the National Carbon Capture Center.

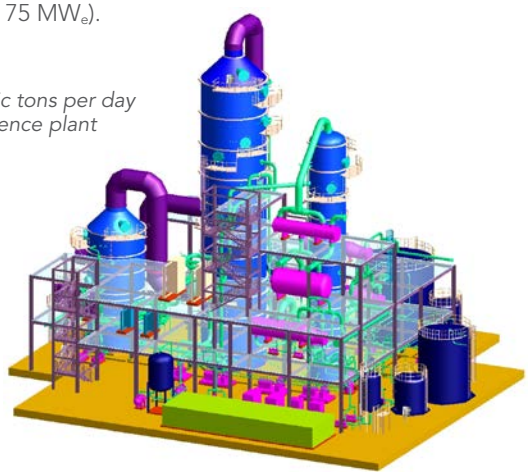
Process

B&W's RSAT system is a post-combustion carbon capture technology, works by absorbing CO_2 directly from flue gas in an absorber using a regenerable solvent. The CO_2-laden solvent is sent to a solvent regenerator where it is heated, and the CO_2 is released as a concentrated stream for compression and transport to a CO_2 storage facility. The solvent is then recycled to the absorber for additional CO_2 capture.

Technology Status

Having completed pilot scale testing, B&W is looking for opportunities to demonstrate the technology at commercial scale (25 to 75 MW_e).

1500 metric tons per day RSAT reference plant



BrightGen™ Hydrogen Combustion

B&W's BrightGen™ hydrogen combustion technology produces no CO_2 and is commercially ready and currently in operation worldwide. In fact, we have more than 60 industrial water-tube package boilers firing hydrogen and hydrogen-blended fuels. BrightGen technology can be retrofit onto existing equipment or provided with new installations to fire hydrogen efficiently and safely.

OxyBright™ Oxy-Fuel Combustion

Oxy-fuel combustion for use with coal to produce CO_2 in an enhanced oil recovery application was evaluated by B&W initially in 1979 at the request of a major oil company. Beginning in 2001 and with the support of the U.S. Department of Energy (DOE) and others, B&W has worked to develop this advanced carbon capture technology for steam generation. The steam can be supplied at various temperatures and pressures for use in processes or for use in a steam turbine if electrical generation is desired. This oxy-fuel combustion process can be applicable to coal, natural gas, biomass, or oil-fired units.

Process

In the oxy-fuel process, boiler combustion air is replaced with nearly pure oxygen from an air separation unit (ASU). Nitrogen that would normally be conveyed with the air through conventional air-fuel firing is excluded. Instead, a portion of the CO_2-rich flue gas is recirculated to a conventional pulverizer/burner/fluidized-bed system, substituting CO_2 for the nitrogen in the furnace. Oxy-combustion creates a flue gas that is primarily CO_2, rather than nitrogen, and includes typical products of combustion. The non-recirculated flue gas leaving the boiler is cleaned using conventional particulate and sulfur removal systems and sent to the compression purification unit (CPU) where a high-purity CO_2 stream is produced suitable for transportation or other uses.

Technology status

B&W provided oxy-fuel technology for use with coal on the DOE Future Gen 2.0 demonstration project in Meredosia, Illinois, which was a retrofit of a 167 MW_e coal-fired power plant. Although construction began in 2014, the project was canceled in 2016 due to redirection of DOE funding support.

B&W has continued to develop oxy-fuel technology and it is ready for full-scale commercialization and deployment.

Industrial water-tube boiler

Oxy-fuel combustion burner

CO_2llaborate 2 Decarbonize

Decarbonization for a net zero future

Babcock & Wilcox has been on the clean energy "trend" for many decades. We make big things happen through our B&W ClimateBright™ technological advancements that generate needed power, while lowering greenhouse gases and other emissions. And it all happens through B&W Research innovation.

Visit babcock.com/decarbonization for more details or to contact us.

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

www.babcock.com

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