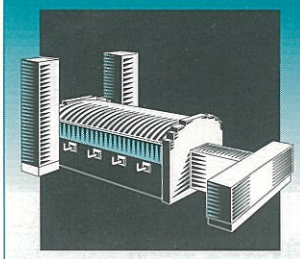


Oxy-Fuel Firing of Glass Furnaces Using Vacuum Pressure Swing Adsorption

A GLASS INDUSTRY VISION:

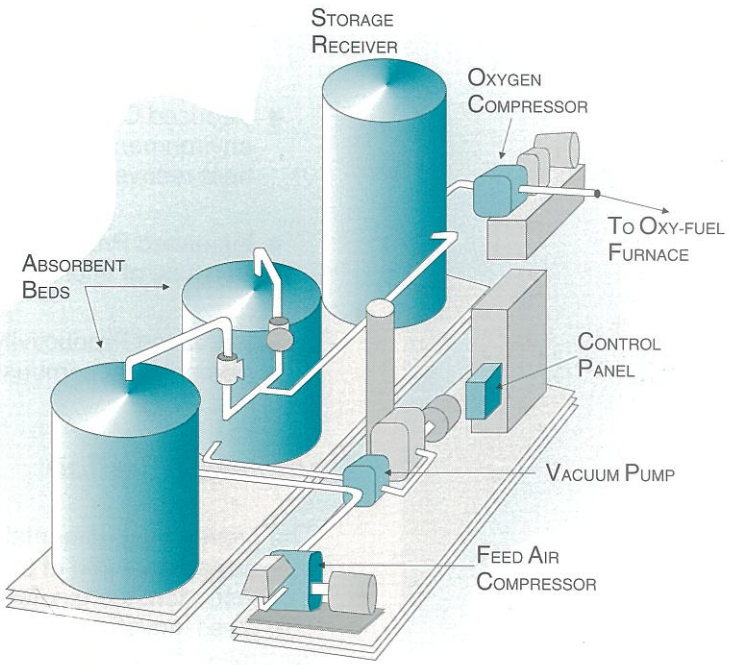
COMMERCIALIZATION SUCCESS

Opportunity for Industry

Oxy-fuel firing of glass furnaces offers industry substantial economic, environmental, and energy-saving benefits. Presently, most of the 500 high-temperature glass-melting furnaces in the U.S. use ambient air for the combustion of fossil fuels, which lowers fuel efficiency when nitrogen carries away energy in the hot combustion exhaust gas. Developed by Praxair, Incorporated, and demonstrated with support from the Department of Energy's Office of Industrial Technologies (OIT), oxy-fuel firing overcomes this problem by replacing ambient air with oxygen.

Utilizing oxygen instead of air to fire glass furnaces has already yielded significant benefits for its users, including:

- Reduced NO_x and particulate emissions
- Energy savings
- Fuel savings
- Reduced costs
- Reduced exhaust gas volume
- Increased product quality
- Increased melter control



Oxy-Fuel Combustion:
The system uses an advanced oxygen supply and significantly reduces melting energy requirements.

Project Partners

Office of Industrial Technologies
U.S. Department of Energy
Washington, D.C.

Praxair, Incorporated
Tarrytown, New York

Corning, Incorporated
Corning, New York

Gallo Glass Company
Modesto, California

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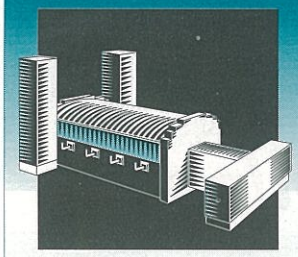

Project Contact

Praxair, Incorporated
Phone: 1-800-Praxair

Project Description

Praxair's oxy-fuel process uses a technology called vacuum pressure swing adsorption to supply the oxygen for combustion. This technology features an air separation system using two zeolite beds to separate oxygen from ambient air. As the air passes into the first bed, nitrogen is adsorbed and oxygen passes through. While the first bed separates oxygen, the second regenerates by purging the adsorbed nitrogen. After a specified period, the pressure swings and the beds reverse functions.

To demonstrate the process in an actual on-line melter, Praxair teamed with Corning, Incorporated and Gallo. Corning supplied the burner and the combustion technology, while Gallo, a producer of flint and green glass for wine bottle manufacturing, provided the demonstration site. Gallo has converted all four fossil fuel-fired furnaces to oxy-fuel and is now the world's largest oxy-fuel glass facility.

Benefits

Based on the success of this demonstration, users of oxy-fuel firing have achieved:

- Reduced Emissions — NO_x emissions were reduced by 90 percent, from over 5 lbs. per ton of glass to less than 1 lb. per ton. Particulate emissions were reduced by about 30 percent.
- Reduced Energy — On small furnaces savings have reached 45 percent and on large furnaces savings have reached 15 percent.
- Fuel Savings — Fuel savings is attributed to the absence of nitrogen carrying heat out of the furnace and reduced radiation losses.
- Reduced Costs — The need for costly new equipment to meet environmental requirements is eliminated. Also eliminated is the need for a heat recovery system because of the large reduction in exhaust gas volume.
- Increased Product Quality — Oxy-fuel firing reduces defects in the glass because of improved melter control.
- Increased Productivity — Furnace production rate can increase by 15 percent over combustion with ambient air.

Commercialization

The proven environmental and economic benefits of oxy-fuel firing have led to the widespread adoption of this technology. In the three years following the Gallo demonstration, the oxy-fuel process has proven so effective that 15 percent of the U.S. glass industry has already contracted to convert to oxy-fuel firing. In 1995, the project received a Technology Commercialization Award from OIT.

Project Span: 1985 - 1994

U.S. Department of Energy
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