

More Oxygen, Lower Emissions

Low Emission Combustion Technology
*A strategic commitment with our
environment*

 **PRAXAIR**[®]
Making our planet more productive[™]

Sustainable Development is an integral part of Praxair's business strategy. Environmental performance of our combustion equipment has always been a cornerstone of our design, as evidenced by our DOC technology. Whether for complete conversion to oxy-fuel firing or for auxiliary burner applications, Praxair is the industry leader in applying oxygen combustion technology to reduce NOx and particulate emissions from glass furnaces.

A key feature of Praxair's oxy-fuel combustion systems is its patented Dilute Oxygen Combustion (DOC) technology.

DOC Explained

DOC patented technology* is based on staged injection of fuel and oxygen through separate burner ports. Each jet is carefully controlled to produce very specific flow characteristics. The reactants are diluted by mixing with hot furnace gases before reacting with each other, preventing high peak flame temperatures and allowing for more uniform heat transfer. Flame characteristics are optimized by setting staging conditions to achieve desired shapes and lengths. The application of DOC technology results in two main environmental benefits: low NOx and low particulate emissions.

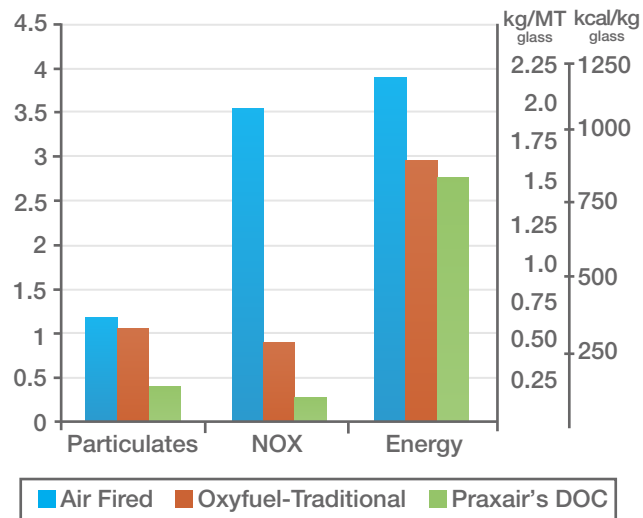
Ultra Low NOx

Air fired glass furnaces produce high NOx emissions due to the high nitrogen concentration in air (78% N₂) and the high flame temperature. The conversion of an air-fired furnace to full oxy-fuel firing typically reduces NOx emission by as much as 80-90% by eliminating most of nitrogen in combustion air. With the low flame temperature of DOC technology, NOx emission is further reduced to 1/5th of typical oxy-fuel flames. Auxiliary DOC burner applications can reduce NOx emissions even in air fired furnaces with high nitrogen concentration.

Low Particulates

The conversion of a furnace from air-fired to Praxair's DOC oxy-fuel system significantly reduces batch carryover and emissions due to reduced gas volumes. In addition, particulates emissions are also reduced due to significant reduction in alkali volatilization. Previous studies have shown that volatilization is the most important source of particulate emissions

lb / ton glass or MMBtu/ton glass



*Oxy-fuel traditional = 25% Cullet
 **Praxair's DOC = 60% Cullet

for gas fired glass furnaces. Volatilization of NaOH for soda lime silicate glasses is dramatically lowered with Praxair's DOC technology in two ways: reduced water vapor concentration at the glass-combustion interface, and lower impinging velocity of combustion gases on the glass interface.

Lowering Glass Carbon Foot-print

Praxair understands the need to make step changes in energy efficiency and to lower the carbon footprint as required by new standards and legislation. Efficient and economical ways of heat recovery from offgases are being actively investigated. These new developments will propel today's glass manufacturing process into the future, maximizing energy efficiency while dramatically reducing CO₂ emissions.

*(US Patents 5267850, 5411395, 5449286, 5601425, 5814125, 5823762, 5931654, 6096261, 6125133, 6139310, 6132204, 6142764, 6394790, 6171544)