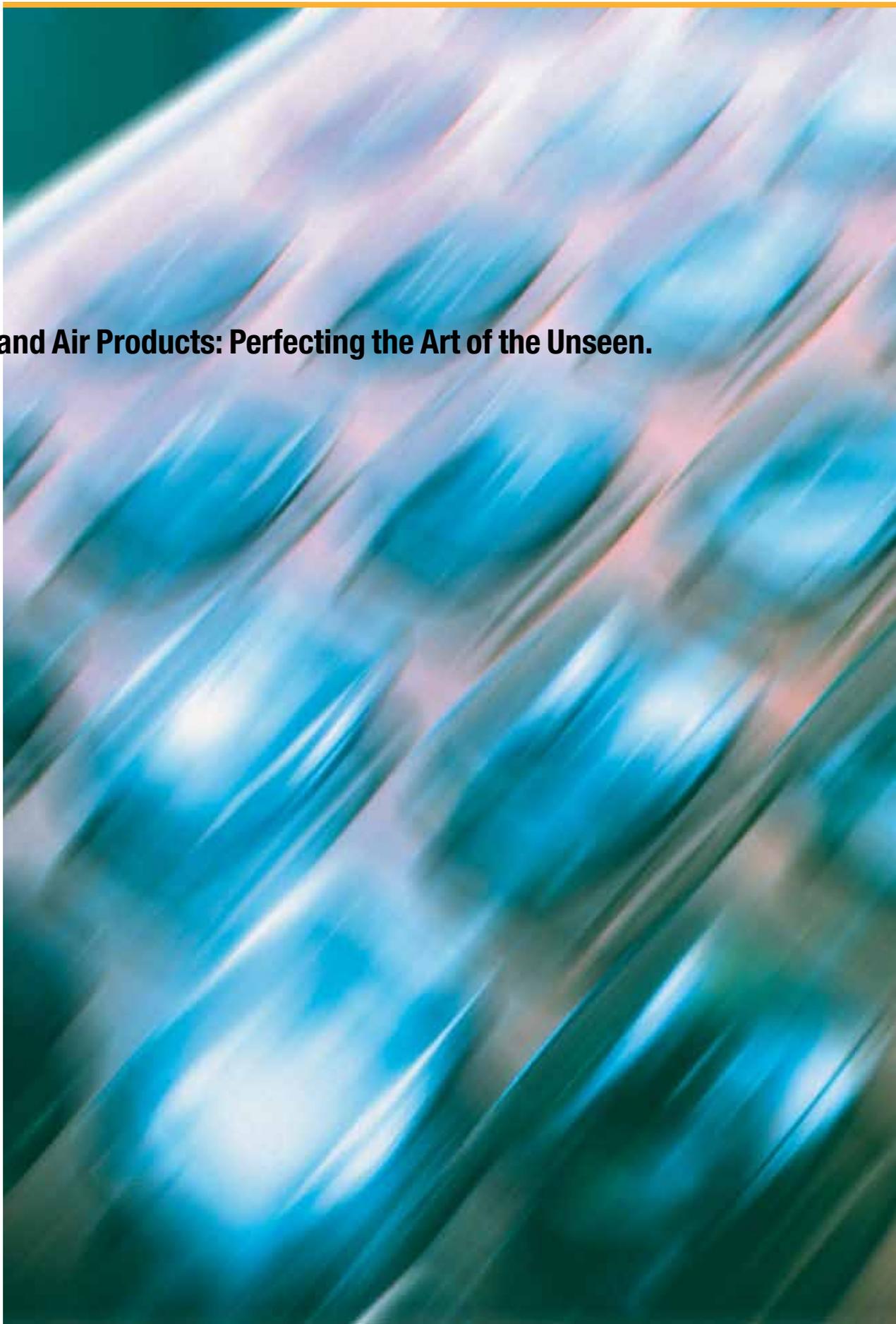




Techneglas and Air Products: Perfecting the Art of the Unseen.



When it comes to television glass, what we don't see matters most.



Snap the remote control and instantly the ball games, the sitcoms, and the nightly newscasts appear as if by magic, projected between a glass face panel and a funnel at the rear of the set. Every day, the people at Techneglas produce the finest quality television glass to make certain we never even notice the company's products. And that's precisely the point.

Techneglas has been at the forefront of TV glass-making technology for more than 50 years. Today, the company employs the most advanced production system in the industry. Headquartered in Columbus, Ohio, with two funnel glass furnaces there and three panel glass facilities in Pittston, Pennsylvania, Techneglas is a wholly owned subsidiary of Nippon Electric Glass, Japan (NEG). Combined, the two manufacture the largest supply of faceplates and funnels for CRTs in the world.

There is much that is unseen in a finished precision glass product—the hours of research, the testing, the trials, the technical expertise, and the special relationships that advance the state of the art.

For many years, Air Products and Techneglas have enjoyed a unique kind of relationship, where customer, supplier, and the industry benefit. Working with Air Products, Techneglas has increased productivity, advanced product quality, and secured a reputation for environmental leadership.



With Air Products' help, Techneglas has transitioned from regenerative technology to oxy-gas firing at four of its five glass furnaces. As a result, the company has increased productivity, advanced product quality, reduced pollutants, and secured a reputation for environmental leadership.

A History of Cooperation—From Faceplate to Furnace.

1980

Air Products began its relationship with Techneglas in 1980 as a supplier of liquid oxygen for faceplate polishing operations. Then in 1985, to meet the demand for large-screen TVs, Techneglas needed an innovative means to increase capacity at its panel glass furnace B in Pittston, Pennsylvania.

According to Bill Horan, manager of furnace design engineering at Techneglas, the only way to increase the capacity of the existing air-fired furnace was to create a shorter, hotter flame. To accomplish this, Air Products helped Techneglas devise and install a system for enriching the air-fired flame with oxygen. “Boosting the flame with oxygen allowed us to get the same glass quality at higher pulls than the furnace was actually designed for,” says Horan.

The Foray into Oxy-gas Firing

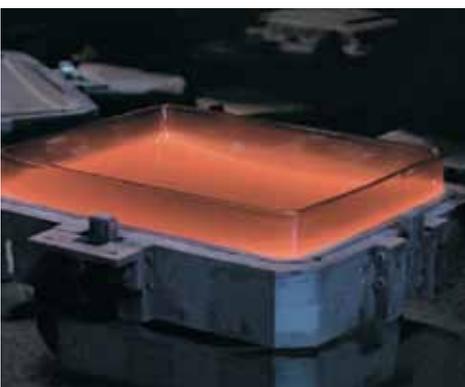
By the end of the decade, technical advances were making possible the conversion of entire furnaces from air-gas to 100% oxy-gas firing. Air Products helped lead this emerging technology, teaming up with an equipment manufacturer to develop the CLEANFIRE® oxy-fuel burner.

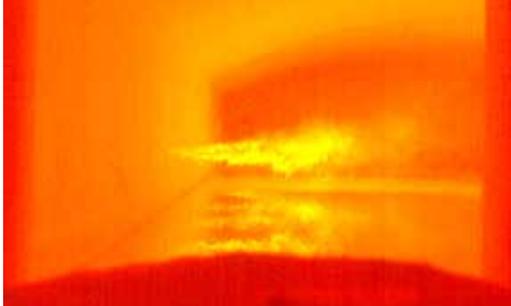
“Air Products took the approach that they didn’t just want to be the oxygen supplier. They wanted to be proactive in developing all aspects of the oxygen firing equipment.”
Bill Horan

Inspired by the benefits of oxygen enrichment in Pittston, Techneglas was ready—with Air Products’ help—to explore the use of oxy-fuel firing at one of its funnel glass furnaces in Columbus, Ohio.

In 1992, the Columbus F furnace was partially converted to oxy-fuel by installing a pair of CLEANFIRE burners at the charge end. The supplemental burner system was installed on the fly—without interruption to normal furnace operations—for use during peak pulls. This not only helped squeeze additional capacity out of the aging melter, it also allowed Techneglas to evaluate the burners and to gain experience in their operation and maintenance.

1992





Air Products' CLEANFIRE HR on TV glass.

The Decision to Convert in Columbus

Success with the CLEANFIRE burners persuaded Techneglas to initiate plans for a total conversion of the Columbus F furnace—the first complete conversion to oxy-gas firing in the TV glass industry.

A number of issues drove the decision. Problems with the checkers, which are required for heat recovery in an air-fuel furnace, topped the list.

To attenuate radiation in finished CRT funnels, lead is included in the glass. A portion of this lead vaporizes in the melter. Lead condensation gradually builds up in the checkers, creating hazardous waste when the contaminated refractory must be broken down and replaced. Oxy-gas firing eliminates the need for checkers, and therefore, the costs and disposal concerns associated with their upkeep.

In addition, the use of 100% oxygen improves fuel efficiency and dramatically reduces nitrogen oxide (NOx) and particulate emissions by eliminating nitrogen in the furnace. Always working pro-actively to address environmental concerns, Techneglas was anxious to capitalize on all these important benefits.

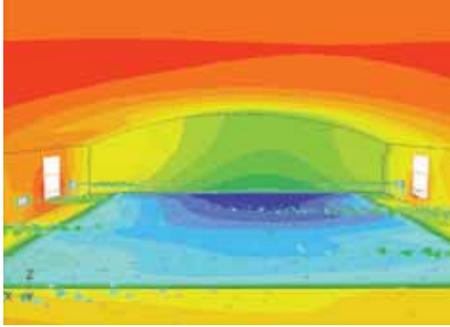
Understanding Oxygen Combustion

Conversion of this high-volume funnel glass furnace represented a big step for Techneglas. Air Products wanted to be certain the company had all the information it needed to comfortably adopt the new technology.

Air Products introduced Techneglas to another glass manufacturer—an Air Products customer who was using oxy-fuel firing for a noncompetitive application. After several trips to the customer's plant, the people at Techneglas were convinced that the technology was simpler, more effective, and better for the environment than the air-fuel system they were using.

Without this vital information sharing, insists Bill Augsburger, who recently retired as the company's technical director, "It would have been much more difficult to convince our management and to gain the confidence to do what we did."

**"Air Products really helped Techneglas understand oxygen combustion."
Bill Augsburger, Techneglas**



CFD Modeling: A Tool for Change

Another way Air Products helped Techneglas prepare for the conversion was through the use of computational fluid dynamic (CFD) modeling. Air Products used CFD combustion space modeling to recommend firing rates and the number and location of burners. The modeling work helped Techneglas duplicate melting conditions in the new furnace and also helped predict a minimum 20% decrease in the use of natural gas. The projected fuel reduction, along with the many savings associated with elimination of the checkers, proved essential in helping Techneglas justify the financial investment in oxy-fuel.

Achieving Record Results

The Columbus F furnace was fully converted to Air Products' oxy-gas technology in 1993 with outstanding results. Seed levels ran well below the standard spec of 20 seeds/oz., and an estimated 30% reduction in fuel costs exceeded expectations. The checkers were gone, and pollutants were cut by more than half: particulates plummeted from 19.7 to 8.1 lbs/ton and NO_x levels dropped from 16.3 to 8.8 lbs/ton. Fugitive lead emissions from the furnace were also reduced, thereby improving worker health and safety programs.

Almost immediately, Techneglas decided to convert the remaining furnace in Columbus, following the same procedure. The supplemental boosting system used in furnace F was transferred to the C melter, and one year later the conversion was complete.

Addressing the Unexpected

Invariably, new technology offers new challenges. Before long, Techneglas began to notice accelerated refractory corrosion in the crown area of the Columbus furnaces.

“When you’re first in the industry, you end up discovering problems you didn’t anticipate. Air Products was instrumental in assisting us to solve them.”
Bill Augsburg, Techneglas

Working as a team, Techneglas, its leading refractory supplier, and Air Products discovered the root of the problem. The absence of nitrogen in the furnace was permitting alkali vapors from the glass to increase in concentration and deteriorate the brick more rapidly. Together, the three companies tested and ultimately identified refractory materials better suited to the environment.



1994

The Road to Pittston

By 1994, capacity was again an issue in the Pittston B furnace, but strict Pennsylvania emissions standards made a production increase using air-gas firing an undesirable solution. The Pittston furnaces produce TV face panels—an optical quality glass. Improving quality in the B furnace was also an additional objective.

The people at Techneglas understood well the environmental benefits of oxy-gas firing. With operating experience in Columbus and alternate crown refractory materials selected, they felt sure they could make the switch to oxy-fuel succeed in Pittston.

A Breakthrough in Burner Development

Techneglas approached the Pittston B conversion as it had at both Columbus furnaces, installing CLEANFIRE burners in an oxy-boost configuration first and using them as needed to increase pulls. But soon, the market was flush with new burner designs, and Techneglas was anxious to explore the options before finalizing conversion plans.

Air Products independently developed a high radiation, flat-flame burner—the CLEANFIRE HR burner system—and Techneglas wanted to compare it with competitive flat-flame technology. Techneglas invited Air Products and four other burner manufacturers to compete in a 24-hour round-robin test in the Columbus C furnace. The Air Products CLEANFIRE HR burner won hands down.

“The main reason we selected the HR burner for Pittston was the impact it had on overall furnace temperature and glass surface quality,” says Horan. “We saw a dramatic change in the test: foam and batch lines pulled back toward the charge end, and scum formation was reduced.”

A Commitment to Technology

Results of the round-robin test were crucial, but Air Products’ investment in the technology also influenced Techneglas’ decision to become the first to purchase the CLEANFIRE HR burner.

Prior to the competition, the people at Techneglas toured Air Products’ world-class combustion laboratories in Allentown, Pennsylvania, where they observed the company’s comprehensive procedures for burner evaluation and flame diagnostics. Air Products demonstrated its CFD modeling capabilities and showed Techneglas how it uses modeling to validate burner designs.

“The effort, dedication, and commitment Air Products showed for the development of burner technology was definitely a selling point. When we looked at the whole package, Air Products was superior to everyone else.” Bill Horan, Techneglas

1995

Troubleshooting Teamwork

The Pittston conversion in 1995 was not without surprises. Before the furnace went into production, Techneglas uncovered a maintenance issue. In some positions in the furnace where burners were being fired at a lower rate, carbon was forming on the burner tips.

In record time, Air Products machined a variety of tip modifications and incorporated each new tip into the burner for Techneglas to test. After experimenting with several versions, Techneglas found the modification it needed. Air Products made the winning tip a permanent part of the CLEANFIRE HR burner design.

Once production was under way, Techneglas began to experience glass problems. The refractory was suspected as the chief contributor. Again, Techneglas, its refractory supplier, and Air Products joined forces to target the source of the defects.

Air Products used its new, advanced CFD coupled modeling to help Techneglas recreate the furnace environment and the glass melt itself. The refractory problem was confirmed, and Techneglas adjusted the temperature in the melter to correct it. "Initially," says Horan, "we made changes and got results, then used modeling to help us understand why they worked. After that, we were able to pinpoint the things in the furnace that were key to good quality and optimize them by using the modeling."

"Air Products has been very active in computer modeling, which has been very important in our conversion to oxygen. Without it, it would have been much harder to get where we are today in terms of furnace operation."

Bill Augsburg, Techneglas

As part of this extensive modeling project, Air Products also worked with Techneglas to significantly reformat the way the computer data was presented. This complicated change made the information more useful and easier to evaluate. Now Air Products provides modeling reports in this manner for all its customers.





A Boon to the Environment— And to Business

After the initial furnace adjustments, a significant improvement in glass quality and throughput followed the conversion of Pittston B. Maximum pull rate increased by a whopping 46%. Even more noteworthy was the effect on the environment and on Techneglas' relationship with it.

As in Columbus, the conversion in Pittston drastically reduced NOx emissions. The decrease in NOx and related particulates, along with the reduction in solid waste that accompanies elimination of the checkers, helped Techneglas earn three prestigious environmental awards in Pennsylvania, including the Governor's Waste Minimization Award.

According to Jeff Lowry, manager of environmental control and laboratory for Techneglas, lowering pollutants also allowed the company to obtain an environmental permit with a plant-wide applicability limit (PAL). "The PAL permit gives us greater flexibility," Lowry explains. "We can modify the size of a furnace or the process flow itself, without applying for a new permit each time. And we don't have to buy NOx credits to add a furnace or increase capacity like we would with an air-gas furnace."

"Because of the work we've done with Air Products, we've been able to reduce NOx emissions by about 50% overall. In Pittston, this allowed us to generate a new type of [environmental] permit that makes conducting our business much easier." Jeff Lowry, Techneglas

Another Burner, Another Success

In 1995, Air Products offered one CLEANFIRE HR burner design with a firing range of 3 to 8 MM Btu/hr. When the engineers at Techneglas needed to reduce fuel flow in Pittston B, Air Products worked with them to adapt the existing burner model. Subsequently, with the help of feedback from Techneglas and other glass manufacturers, Air Products introduced two additional CLEANFIRE HR burners—a small burner made expressly for the low firing range (.75 – 4 MM Btu) and a larger burner for the upper range (8 – 20 MM Btu).

In 1997, the Pittston A furnace was converted to oxygen using the smaller burners in the charge and throat areas, where lower gas flow is essential to good product quality. Today, the Techneglas Pittston A furnace manufactures the best quality panel glass in the NEG network worldwide.

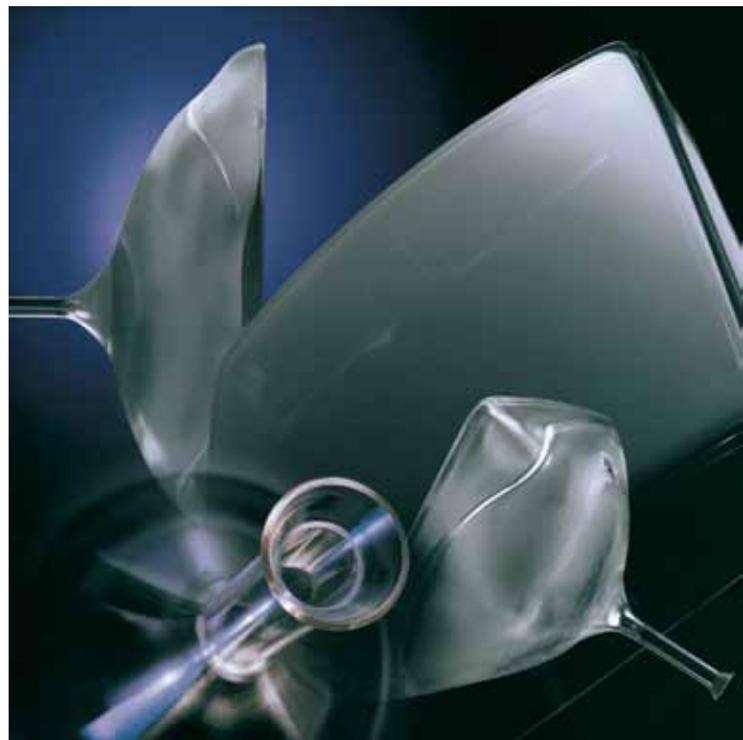
The Momentum Continues—From the Furnace To the Future.

Since the Pittston A conversion, both Columbus furnaces, which were installed with original CLEANFIRE burner technology, have been retrofitted with CLEANFIRE HR burners. Techneglas has also hired Air Products to conduct several CFD modeling projects in Columbus and Pittston in a continuing effort to optimize furnace operations and improve glass quality.

Currently, the two companies are collaborating on important industry initiatives. Air Products and Techneglas are helping fund a Department of Energy research project to develop improved oxy-fuel refractories. The DOE has also awarded Air Products its own research grant to design an intelligent control system that will respond automatically to changes in the glass furnace environment. Air Products' goal is create a system

that can improve glass quality, extend furnace life, and lower energy consumption. Techneglas will assist Air Products in developing the system and has agreed to act as a beta test site for the new technology.

Ask Bill Horan about his company's relationship with Air Products over the years and this is how he sums it up: "The people at Air Products have always gone the extra step to help us with anything that might come up. They didn't just say, 'We'll sell you oxygen and that's it.' They were willing to invest in all the technology. Air Products is in it for the long haul."





“The people at Air Products have always gone the extra step to help us be as good as we can or to help us with anything that might come up. They didn’t just say, ‘We’ll sell you oxygen and that’s it.’ They were willing to invest in all the technology. Air Products is in it for the long haul.”
Bill Horan, Techneglas

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