

Oxygen-Enhanced Cement Production



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Russ Hewertson
Manager, Cement Applications

Help Increase Your Profitability with Air Products’ Oxygen Injection Technologies

Oxygen injection can increase cement production, lower fuel costs, and reduce emissions. And Air Products has the most experience in successfully applying oxygen enrichment on all types of kilns.



How Oxygen Enrichment Works

Oxygen is required for any combustion process. Although air is the most common source of oxygen, it is not the most effective, since it also contains about 79% nitrogen. Nitrogen in air takes up volume, absorbs heat, and lowers flame temperature. Adding pure oxygen (oxygen enrichment) improves the overall combustion process by increasing the flame temperature and the amount of available heat. In the kiln, oxygen enhances burning zone control and improves kiln stability. The result—more consistent kiln operation, better clinker quality, and increased production rates.

Increased Production Rates. Most cement plants that are fan-limited implement oxygen enrichment to increase clinker production. The added oxygen enables the combustion of additional fuel, allowing operators to increase feed rates. Enhanced kiln stability and quick recoveries from “pushes” also translate into increased production. We have helped customers increase clinker throughput by 5 to 30 percent.

Increased Use of Alternative Fuels. The flame temperature of alternative fuels is routinely below the primary fuel flame temperature. This “colder” flame necessitates a reduction in feed to maintain burning zone temperature and clinker quality.

Proven Technology

Oxygen enrichment is a flexible, efficient, and cost-effective technology that can help improve your profitability. With minimal capital investment, you can increase clinker production, lower your fuel costs, decrease emissions, and improve kiln operation.

The technology is applicable to all types of kilns (wet, long dry, preheater, and precalciner). For over 10 years, Air Products has been helping customers realize the many benefits of oxygen enrichment. Low installation costs of oxygen systems make them an attractive alternative to expensive capacity additions or debottlenecking measures. Today, the economics are more attractive than ever.

Benefits of Improved Combustion

Adding oxygen enhances combustion, no matter what type of fuel you burn. By installing an oxygen enrichment system, you have the potential to realize a wide variety of benefits:

- Increase clinker production by 5 to 30%
- Increase use of alternative fuels by 30 to 80%
- Reduce emissions
- Improve kiln stability
- Reduce specific fuel consumption
- Attain more consistent clinker quality

All of these add up to increased profits—in some cases as much as \$3 million per year.



Typical Production Gains Using Air Products' Oxygen Injection Technology

Company	Type	Base Production (tpd)	New Production (tpd)	% Increase
A	Precalciner	1,300	1,490	15
B	Precalciner	4,000	4,360	9
C	Wet	550	660	20
D	Wet	850	920	8
E	Precalciner	3,800	5,000	32
F	Precalciner	2,000	2,140	7



Additionally, variations in the composition of alternative fuels make it difficult to maintain stable operating conditions. To operate within regulated emission limits, plants must carefully monitor emissions and make necessary adjustments in fuel substitution and production rates. Using oxygen to improve alternative fuel combustion has been shown to reduce or eliminate emission concerns and increase flame temperature. The resulting improved burning zone control enables operators to maintain feed and burn at a more consistent rate.

Over time, improved kiln stability translates into more production, increased fuel substitution rates, and lower operating costs. The savings for our customers has been substantial, with a net benefit of \$3-4/ton being realized.

Count on Our Expertise

Since 1997, Air Products' proprietary technology has been installed and demonstrated at 15 plants (20 kilns). We have helped customers with all types of cement kilns improve their operation and maximize profitability.

We have installed oxygen injection systems in various pyroprocessing zones. Specific plant design and use of alternative fuels will often dictate the most appropriate site for oxygen injection. Our technology specialists will work closely with your process engineers and operators to select the best injection technique for your unique operating conditions.

To get your system up and running, we will work with you on-site. We also provide ongoing technical support after installation. In addition, you will benefit from our ongoing research into new methods for enhancing oxygen enrichment.



Buzzi Unicem USA: Where Oxygen Is Making a Difference

Buzzi Unicem USA has installed Air Products' oxygen injection systems at three of its eleven U.S. production plants to date. It began with their Signal Mountain plant in Tennessee to gain an increase in production.

Based on the success at the Tennessee plant, Buzzi Unicem decided to implement oxygen enrichment at its plants in Missouri and Indiana. Oxygen enrichment has brought the same benefits to both of these plants—increased production and better utilization of alternative fuels, which means big cost savings for Buzzi.

Tim Menke, Corporate Process Engineer for Buzzi, says, "Injecting oxygen using Air Products' proprietary technology not only increased output, but also dramatically improved combustion of liquid hazardous waste fuel being burned in the kiln to supplement our coal and pet coke primary fuel."

Menke adds, "We are very happy with the technical support we had on our start-ups as well as ongoing support. We chose Air Products because they had more experience in cement industry oxygen enrichment than other suppliers."

For Greg Ambrogi, Air Products technology specialist, it's all in a day's work. "We knew from our previous experience how to best implement oxygen enrichment at each of their plants. Their success has been our success and we highly value the strong customer relationship we have established with Tim and everyone at Buzzi."

Tim also appreciates the unique Air Products approach. "Air Products understands our business. They actually care about what we are doing and try to learn as much as they can about us. They've also suggested additional improvements. All of this is a big advantage over other suppliers."

Buzzi Unicem USA produces Portland cement, masonry cement, and ready-mixed concrete. It has approximately 10 percent of the U.S. market. The company owns 11 cement plants, including one grinding plant, with a capacity of more than nine million tons. Buzzi Unicem USA is a joint venture, owned by Italian parent company Buzzi Unicem and Dyckerhoff.



Greg Ambrogi (left, Air Products) and Tim Menke (Buzzi Unicem) worked together to enable Buzzi to fire more waste fuels and increase production.

Oxygen Increases Use of Waste-Derived Fuels

One of our customers had a significant issue with total hydrocarbons (THC) when trying to increase the firing of waste-derived fuels in their wet kiln. THC spikes were frequent and the resulting waste fuel cut-offs reduced the total benefit derived from employing alternative fuels.

Air Products specialists devised a solution employing oxygen injection technology. The positive results were immediate—complete combustion of the alternative fuels occurred and the plant was able to reduce their primary fuel (coal) rate. Also, clinker production increased, while carbon monoxide and hydrocarbon emissions dropped. This customer has been using oxygen effectively since 2000, often achieving net operating costs similar to a modern precalciner.

Results after Installing Air Products' Oxygen Injection Technology on a Wet Kiln*

*Normalized data	Base Operation	Operation with Oxygen	% Change
Clinker	1,000 tpd	1,080 tpd	+8
Waste-derived fuel	100 kg/min	148 kg/min	+48
Coal replacement	38.5%	58%	+51
Waste fuel cutoffs per day	3.4	1.8	-47

Your Success Is Our Success

We understand oxygen enrichment and know that it can make a difference for you, whether it is to increase production, maximize the use of alternative fuels, reduce emissions, or achieve other competitive advantages. We can help you do that.

Our unique approach to customer relationships is based on understanding your needs first so that we can offer the right gases, technologies, and services to help you be more successful. When you work with us, you deal with people whose understanding, integrity, and passion have been valued by our customers for years.

Our Emphasis on Safety

For us, nothing is more important than safety—not sales, not production, not profits. It is a commitment we all share and one that we share with our customers. We have earned more safety-related awards than any other industrial gas company and we stand among the top performers of the CMA's Responsible Care program. Our oxygen injection systems meet the highest safety standards.

About Air Products

Air Products serves customers in many markets worldwide with a unique portfolio of atmospheric gases, process and specialty gases, performance materials, and equipment and services. Founded in 1940, Air Products has built leading positions in key growth markets. The company has annual revenues of \$10 billion, operations in over 40 countries, and more than 22,000 employees around the globe.



Find Out More

If you are interested in learning more about oxygen injection technology, please contact us at a location near you.

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