3 Nozzle-Mixing Burners to Consider

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Nozzle-mix burners are not prone to flashback, have a wide range of possible air/fuel ratios and have a wide turndown capacity. Find out how these burners may improve your process.

Over the years, three groups of burners -- nozzle mix, premix and radiation -- have played an important role in process heating. Nozzle-mix burners have been around for quite a while, and during this time, many styles have been developed. Though there are many varieties of nozzle-mixing burners, this article will focus on a few types commonly used today: medium velocity, excess air burner; multiple-tunnel high heat release burner; and high momentum burner. Each of these offers distinct differences and specific benefits.

General Characteristics of Nozzle-Mixing Burners. A burner is considered to be nozzle mixing when the combustion air and fuel are separated up until they enter the combustion chamber and are ignited. These burners offer several features that distinguish them from premix and radiation burners:

- The flame cannot flashback upstream of the mixing nozzle. This eliminates the need for additional safety components in the fuel delivery system.
- A range of air/fuel ratios is possible. A premix burner must operate within the flammability limits of the fuel.
- Turndown ranges from 10 to 1 to as much as 40 to 1. Premix burners have, at most, a 5-to-1 turndown. During a long idle or no-load condition, burners with enough turndown will not cause the process temperature to creep up.

Today, nozzle-mixing burners tailored for specific applications are offered by a range of manufacturers. Why choose one of these burners for your application? A closer look at three types will show the performance they offer.

Medium Velocity, Excess Air

The medium velocity, excess air burner is a good all-purpose burner. The main feature of this burner is its wide operating range while firing without requiring additional volumes of air for fuel consumption. Burners in this classification typically have excess air ranges of 800 percent to 3,000 percent, or eight to 30 times additional volumes of air required for fuel consumption.

The main feature of a medium velocity, excess air burner is its wide operating range while firing on large amounts of excess air.

The ability to have large amounts of additional air introduced through the burner gives the oven or process designer several important benefits. The additional air may be used for product drying. It also may be used to temper or lower the flame temperature. This is necessary when the product being treated must not be exposed to a hot spot that would be created by a burner flame with low amounts of excess air. In addition, the medium velocity, excess air burner can be used on afterburner applications. In these applications, as much excess air as can be tolerated is fed through the burner. This additional air, when mixed with the volatile organic compounds (VOCs) in a process stream, enables oxidation of the mixture at temperatures above 1,450°F (788°C).

Multiple-Tunnel, High Heat Release

The multiple-tunnel burner serves the need when a large heat release must fire into a short or confined area. Typically, as nozzle-mixing burner capacities increase, the flame length increases proportionally. As an example, a single tunnel burner rated at 30 million BTU/hr has a flame that is approximately 20' long. This may be desirable for some applications; however, when a process needs a high heat release in a short combustion chamber, it may become a problem.

The multiple-tunnel burner was designed to fill this type of application. As a comparison, a multiple tunnel burner rated at 30 million BTU/hr will provide a 6 to 7' flame length. Given the proper design, the flame length does not increase appreciably as the burner capacity increases. This feature is accomplished by spreading the combustion process over the cross-section of the burner tile outlet.

Typical applications that require short-flame, high heat release burners are aggregate drying, calcining and limestone pelletizing. The short flame length in these processes is important because the material typically is introduced at the entrance of the drum or kiln. By releasing the heat in a space as short as possible, premature quenching of the flame and combustion process is avoided. This translates into saving fuel and low VOCs going out the stack.

High Momentum

Third and just as important is the high momentum burner. The key feature of this burner is the high discharge velocity of the products of combustion from the burner tile outlet. Typical discharge velocities range from 400 to 500 ft/sec. These burners may be known to some as a high velocity burner.

The main purpose of a high momentum burner is to move large amounts of the oven's atmosphere to provide a uniform environment for the product being processed, dried or cured.

The main purpose of the burner is to move or stir large amounts of the oven's or furnace's internal atmosphere. This movement or stirring action is desirable when the material being processed, dried or cured must be done so in a uniform environment. Another common feature is the ability to operate on large amounts of excess air. This characteristic offers the same benefits as previously discussed with the medium velocity, excess air burner. Because the high momentum burner has both a high rate of discharge and can operate with large amounts of excess air, it commonly is used for drying newly refractory-lined vessels and furnaces as well as in the curing of polymer-lined tanks, which require very low curing temperatures in the range of 180 to 220°F (82 to 104°C).

When applying this burner, care must be given as to where the flame will be directed. If the material load is too close, temperature hot spots, warping or erosion can occur, eventually ruining the product. Also, if the chamber wall directly opposite the burner is too close, erosion may occur, especially if a fiber insulation is used. These issues easily are addressed by discussing the application with your burner manufacturer.

When selecting a burner for your process, the most important question is "What style of burner is best suited for my process?"Of course, there will be many other questions to follow, but selecting the correct style of burner is an important first step. Often, several different styles of burners may be satisfactory for the application; it will depend on your process and budget needs as to which one you choose.