Batch Oven Q&A

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Choosing a batch oven does not have to be difficult if you know what questions to ask about the equipment and your process.

Process oven manufacturers understand that their businesses are not just about selling ovens -- their job is to help match the correct oven design with a customer's application. But, paying careful attention to your product and process is only part of the job. This article can help ease the process of choosing a batch oven by providing a list of questions to help focus the search.

Q: What are my Temperature Requirements?

Not all airflow patterns are created equal. Different part geometry and processes require different airflow patterns. Choices include horizontal/vertical (combined), vertical and full horizontal patterns.

Horizontal/Vertical Airflow. This type of airflow pattern is suitable applications with large parts, and where there is a need for air circulation to be supplied from both sides and then returned to the top of the oven.

Vertical Airflow. Vertical airflow is best suited for processes where parts are hung from racks or hooks, with the air supplied from the top down or bottom up.

Full Horizontal Airflow. This pattern is used when product is loaded onto shelves or a shelf cart for processing. With the supply on one side and the return duct on the other, the product becomes encircled with air.

Q: How Essential Is Temperature Uniformity?

Oven temperature uniformity helps ensure uniform heating of the product. This is not to be mistaken for control sensitivity.

- ***Uniformity***. This is defined as the greatest deviation, in degrees, between the highest and lowest temperature points within the work area. For example, it is important to note that ±5°F represents an actual difference of 10°F (5.5°C).
- ***Control Sensitivity***. Control sensitivity relates to the ability of a control instrument to measure and react to temperature fluctuations at a given setpoint.

Many factors influence uniformity. Controller calibration, sensor calibration, sensor placement within the work area, oven operating temperature (higher temperature/greater variables), air circulation (the greater the air circulation, the better the uniformity), placement of the product within the work area, product geometry, airflow pattern, heat losses through walls, and metal-to-metal conduction all can influence temperature uniformity.

It is important to take all of these variables into consideration and to utilize a 10-point thermocouple test to ensure that the specified uniformity is obtained for the application. Although this 10-point test is not always included with the oven purchase, it is recommended and usually available for an additional cost.

Some applications such as paint or resin curing require a temperature uniformity of ±10°F (±5.5°C). Many drying or preheating processes only require a uniformity of ±20°F (11°C). Some technical processes need a uniformity of ±5°F (2.7°C). Knowing your temperature uniformity requirements helps with oven selection.

Q: How Can the Proper Oven Chamber Size Be Determined?

Among the factors to consider when determining the proper oven chamber size are:

- The maximum dimensions of your products.
- The required spacing between multiple parts, and between the parts and any ductwork. Usually this dimension is 3 to 6".
- The quantity of units to be processed in a single batch, and the space they will require after considering the required clearances.
- The method of material handling. Be sure you have enough room to move the product in and out of the oven safely.

After these factors have been determined, you will have arrived at an approximate work area dimension. Remember, if the work area is too small, there may be an inadequate amount of space between parts, which will result in less than optimal oven performance due to poor airflow. Similarly, when the work area is too large, there is an excess of space to heat and circulate air through, which wastes energy, space and -- most importantly -- time.

Q: What Role Do Volatiles Play?

The National Fire Protection Association (NFPA) has stipulated multiple classes of ovens that determine what can be processed within them. Class A can be used with volatiles while Class B cannot be used with volatiles. Moreover, the heating method determines the controls and instrumentation that must be implemented on them.

- Class A electrically heated ovens may process volatiles. Required controls include airflow switches, manual reset excess temperature control, backup contractors, powered exhaust, and a purge timer.
- Class A gas-fired ovens also may process volatiles. Required controls include airflow switches, manual reset excess temperature controls, powered exhaust (sized per NFPA requirements), designed relief area, high/low gas pressure switches, purge timer, flame-sensing unit and controlled spark ignition.
- Class B electrically heated ovens may not process any volatiles. Required controls include airflow switch, manual reset excess temperature control and backup contractors.

It is important to note that the rating of Class A is determined by examining the volatile gallons per hour at a given operating temperature. Volatile ratings are never to be exceeded. Physical injury or death may occur if the volatile ratings are not strictly followed.

To properly size the rate of exhaust, you must know the amount and type of volatiles you will be processing. If you have any concerns as to whether your process utilizes volatiles, please consult your oven manufacturer.

Q: Should the Unit Be Gas, Electric or Steam?

If you have equal access to gas, electricity or steam as potential power sources, knowing which to use may not be obvious.

Depending on your energy rates, gas-fired units may be more cost effective to operate than electric heated ovens. However, direct gas-fired units cannot be used in some processes because the products of combustion will affect the product. As an alternative, an indirect gas-fired oven can be used. Keep in mind, though, that the initial cost of this option is much higher, and it often is not available in small ovens or high temperature units.

Electrically heated ovens are clean, non-polluting and can be used in applications where direct gas-fired units are not suitable. However, large loads or costly electrical power may make this option a poor choice.

Steam-heated units provide an efficient means of power when operating in the lower temperature ranges. Steam heated ovens are often advantageous when a facility already has a boiler in place and has extra steam available to use.

Q: How Do the Materials of Construction Impact Productivity?

In conjunction with the correct materials, proper oven construction will help prevent heat loss, increase efficiency and facilitate cleaning and service. Two materials typically are used for oven interiors: aluminized steel and stainless steel. Aluminized steel resists corrosion from simple moisture, heat and other sources. However, when the work area will be exposed to corrosive materials or must be cleaned with caustic solutions, stainless steel is recommended.

For exterior surfaces, three materials are used. Often an oven manufacturer's standard finish, a cold-rolled steel surface is primed and painted to provide durability and service. Aluminized steel, which resists oxidation that is caused by moisture, is offered as an option on most units. Likewise, stainless steel is an option on most units. It resists oxidization and withstands corrosion from chemical exposure.

Related to the materials of construction is the decision to insulate the oven's floor. In walk-in designs, insulated oven floors provide numerous benefits at operating temperature. For instance, insulated floors offer increased operating efficiency, lower operating costs and improved temperature uniformity within the work area as compared to units without floors. A normal concrete floor is not made to withstand the stress placed

on it by heat. Even units that operate below 250°F (121°C) will cause damage. Over time, this will result in the floor cracking or "powdering," which will result in product contamination and ruin the floor.

In conclusion, matching a customer's needs with the proper piece of equipment is just one of the many important considerations involved in choosing the proper oven for your company's application. Work with a reputable oven supplier to find a system that addresses all of your plant's specific considerations effectively.

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