

# Cleaning Metal Parts and Tooling

*Are your powder/paint hangers reducing transfer efficiency, resulting in excessive overspray and poor product coating? Cleaning choices include pyrolytic heat cleaning and vacuum ovens, molten salt baths and fluidized beds.*

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Running a production facility is no easy task — there are endless concerns ranging from operational efficiency to product quality. Because every process step in a production line is interdependent on another, if any aspect is performed poorly, it can send shock waves through the entire manufacturing process. One critical but often overlooked link in this chain is the need to clean parts and tooling. Though there are many ways to approach this problem, thermal cleaning is perhaps the most common.

In conjunction with thermal cleaning, industry has used chemical compounds as a primary source of cleaning for many years. However, with changing business strategies and environmental restrictions, chemical cleaning has struggled to evolve with modern demands. It is becoming harder to justify the cost of using large chemical quantities to remove small amounts of resins. During the cleaning process, the chemicals act to transfer the contaminants (resins) to the solvents, creating a hazardous waste byproduct whose disposal is now a complex, expensive and closely regulated process.

Thermal cleaning is facing new challenges as well. In a heated environment, resins will pyrolysis into gas and vapor that often are viewed as environmental pollutants. Fortunately, manufacturers of burn-off ovens, salt baths, fluidized beds and vacuum ovens have found methods of reducing emissions that suit each type of thermal cleaning.

## Burn-Off Ovens

The operating performance of an industrial burn-off oven is similar to the same self-cleaning oven you may have in your home, but instead of eliminating food spills, the manufacturer is trying to clean tooling used in a manufacturing production line. The result of this batch-cleaning process can best be defined as removing organic matter from metal parts or production rejects. Most resins contain large amounts of organic material and limited quantities of inorganic substances. A burn-off oven removes the organic elements, leaving behind inorganic materials in the form of a light ash. In nearly all cases, the ash can be removed with a high pressure water wash.

The concept of a burn-off oven is relatively simple, but the reality of its design is much more complex. Early versions were primarily batch ovens; however, some continuous flow ovens were

available at higher costs.

Modern burn-off ovens contain two burners. The primary burner heats the chamber to a preset temperature, in the range of 700 to 900°F (371 to 482°C), and an afterburner operates at a minimum of 1,500°F (816°C) and consumes (burns) any smoke created by the process. Traditional design calls for the primary burner to be placed along the bottom of the back wall. Because both heat and smoke will rise, the afterburner usually is placed at the top of the back wall, where it consumes smokes to create acceptable emissions.

Powered almost exclusively by natural gas, a modern burn-off oven has an average cleaning cycle lasting approximately 4 hr. This technology has proven particularly attractive to smaller facilities that clean parts by hand or use brushes and blow torches, but larger ovens — exceeding 1,000 ft<sup>3</sup> — also are available. Burn-off ovens require minimum operator supervision, reducing the risk employee injury, which can occur with chemical, manual cleaning or molten salt baths.

## Molten Salt Baths

Considered the granddaddy of modern heat cleaning, salt baths are one of the oldest thermal-cleaning methods. Efficient and fast, salt baths utilize the conduction thermal method.

Salt baths consist of little more than a large container holding an inorganic mixture of salts and liquids, which remain in a liquid state when heated. Parts are placed in a wire basket and, via a monorail system, are immersed into the molten salt, where resins immediately vaporize in large quantities. After resin removal, the parts are dipped in water or other anti-corrosive mixture to prevent rusting. Afterburners are not used with salt baths — the gases pass through a stack and into a stack scrubber. Using chemicals, the noxious gas is removed and collected as hazardous waste for later disposal. Production facilities usually clean their stacks twice annually.

One drawback is that salt baths are extremely messy to operate. When a part is immersed in the mixture, violent spattering can occur, and if large amounts of polymer are placed in a salt bath, a mild explosion is possible. Because of the risk, many companies isolate their salt baths in a special room or enclose them with tall partitions.

A potential customer must also consider the

## OVENS

potential for thermal shock of the parts. Lowering a part that is at room temperature into a mixture at 800°F (427°C) can warp it or alter its design tolerances.

Salt baths are the fastest method of cleaning available with cycles as short as 25 min. But they must run constantly, usually powered by a 440 Hz electric generator. Moreover, their volatile nature and environmental incompatibility are leading some prospective buyers to look elsewhere.

### Fluidized Beds

Fluidized beds operate under the same conductive heating premise as molten salt baths but use a different heating medium. The bed itself resembles a small cauldron in design, and the material inside usually is aluminum oxide that is fluidized by a stream of air or nitrogen. When fluidized properly, the aluminum oxide will take on the characteristics of a liquid, maximizing heat transfer.

Wire baskets are most commonly used to suspend parts within a fluidized bed. Because the aluminum oxide is an inert substance, there is no melting or boiling point. The fluidized bed also is a relatively fast process although not as fast as a

molten salt bath, and there is very even heat distribution. However, because the parts to be cleaned go from ambient temperature immediately into the fluidized bed at 800°F, thermal shock can be a problem with some parts.

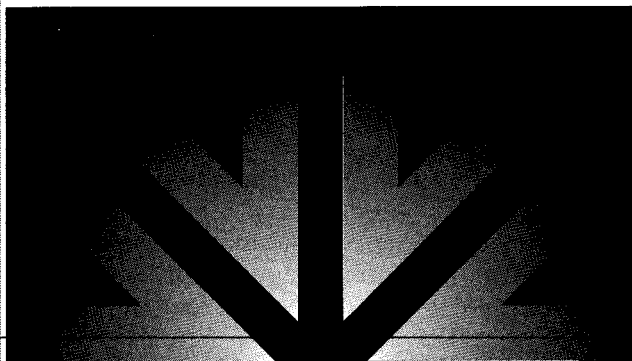
There are drawbacks to fluidized beds. For example, the inorganic residue of the coating being removed can intermix with the aluminum oxide. As quantities of ash build up, it may become necessary to dispose of the mixture and replace it. Also, the speed of coating decomposition can create problems, and the bed's afterburner must be oversized to handle large bursts of fumes. Overall, a fluidized bed offers an efficient and timely parts-cleaning process, particularly of small parts.

### Vacuum Ovens

Theoretically, a vacuum oven represents the safest approach to thermal cleaning. Parts are placed within a sealed chamber that purges the system of its atmosphere, therefore creating a vacuum. Consequently, the opportunity for resin combustion is significantly reduced. In situations where polymers flow or melt, the plastic drains into an unheated compartment, which captures the major-

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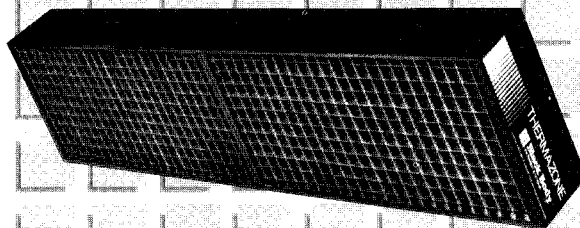


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## OVENS



ity of the mass. Pyrolysis gases are cooled through a water mist in a secondary chamber, where they condense and the fumes are eliminated. However, like a salt bath, the condensate can represent a hazardous waste disposal problem.

The vacuum oven chamber is relatively small — diameters vary between 9 and 54" with lengths up to 84". Special units may reach 160", but a vacuum oven is most effective and cost efficient in smaller sizes.

### A prospective buyer must consider operational costs, utility costs and cycle time.


Small, high temperature electric ovens also are manufactured with stainless steel interiors. Intended for smaller uses such as laboratory testing, these ovens often are supplied without an after-burner because of the minuscule amounts of smoke produced.

#### Expectations of Thermal Cleaning

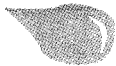
Because effective thermal cleaning only removes organic compounds, all inorganic elements remain. Paint pigment's titanium oxide probably is the most common example. Because it is transformed into a fine ash, a slight tapping usually removes it. Depending on the required level of cleanliness, a light wash may be necessary to complete the job.

In the plastics industry, a sonic cleaner can be used to dislodge ash particles from filters, spinnerets or other parts that have small orifices. In the automotive industry, which concentrates on the removal of oil and grease from engine blocks and heads, a shotblaster is sometimes used as a secondary cleaning method to remove any remaining residue. The food processing industry primarily uses thermal cleaning to remove food materials from metal pans and racks. Because food is organic, no secondary cleaning is needed.

In the purchase and long-term operation of any cleaning equipment, a prospective buyer must consider various aspects such as operational costs, utility costs and cycle time. Salt baths are electrically powered and usually run continuously. Fluidized beds also run on electricity, and although they do not need to operate continuously, many owners forgo the heat-up time to run them continuously. Vacuum ovens operate on electricity and have 2 to 4 hr cycles. Burn-off ovens operate on natural gas, and their cycle times average 4 hr.

Analyze the complexity of the technology you are considering. The simpler the design, the better: Streamlined products usually cost less to repair and result in diminished downtime when maintenance is a must. 

*Gary Davis handles industrial sales development and Keith Brown is national sales manager at Pollution Control Products, Dallas. For more information about Pollution Control Products' burn-off ovens, circle 403 on the Reader Service Card at the back of the magazine.*



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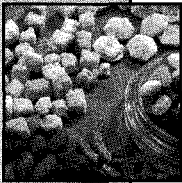
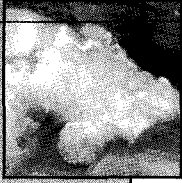
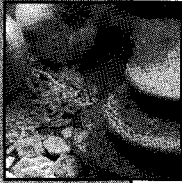
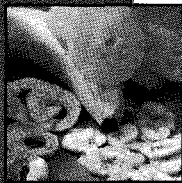
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# Reliable Cure Depends on More than the Oven

*Modulation equipment is an essential part of temperature control for paint curing ovens.*

Due to exacting finish requirements, Trek Bicycle Corp. needed stringent temperature control on the ovens used to cure liquid spray and powder paint. At Trek's plants in Whitewater and Waterloo, WI, finishing systems apply three layers of paint to bicycle frames — base coat, color coat and clear topcoat. Closely controlled oven temperatures are essential to optimize curing of the finish on the high tech, top-end recreational products.

To achieve its objectives, Trek turned to Therma-Tron-X Inc., Sturgeon Bay, WI, which designs, manufactures and installs industrial paint systems. With 25 years experience developing finishing systems that clean and dry parts prior to painting and apply and cure coatings, Therma-Tron-X created a system capable of handling the specific attributes of Trek's manufacturing operation.

As usual, oven design began with product coating requirements. Trek and its coatings supplier determined the optimal paint formulation to meet the demands of the application. Then, Therma-Tron-X engineered the ovens based on the curing requirements of the coating, part configuration and customer throughput requirements. While each oven is, in its own way, unique, several features were incorporated in Trek's ovens to provide effective heat transfer for an exacting heat processing operation.

"Most of our curing ovens are elevated, or even roof-mounted, to maximize use of floor space," Doug Hudon, project engineer for Therma-Tron-X, explained. "A bottom entry, overhead design helps minimize heat loss, increase efficiency and cut fuel costs."

Other features include air knives at entry and exit openings that effectively seal the oven atmosphere from ambient plant air. According to Hudon, this allows quick ramp up of part temperature and increases the effective curing area without enlarging the oven. Fans circulate direct-fired burner exhaust to overhead port nozzle ducts along the entire length of the cure stage to ensure even heat distribution. Oven panels have aluminized steel interiors, coated steel exteriors and semi-rigid, nonsettling mineral wood insulation.

"Most Therma-Tron-X curing ovens employ gas heating systems because natural gas is, first and foremost, an extremely clean fuel," Hudon continued. "Direct firing burners may be used without contaminating the paint coating, and gas is much less expensive than electricity, an important consideration in ovens of this size."

Central to oven efficiency and accurate temperature management is control of the gas train — it is not sufficient to simply pump natural gas into the burner and light it off. Modern, computerized con-

**Therma-Tron-X's elevated paint ovens are designed to provide the optimal curing environment for high tech coatings.**

