Garment Dryers in Detail

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Find out about the differences between IR and hot-air dryers and discover which features might be most useful to your operation.

FIGURE 1
A lint drawer and filter cassettes help keep the dryer's internal parts free from obstruction, thereby maximizing the velocity of the hot air inside the unit.

Garment screen printers are used to two types of dryers on the production floor: infrared and hot air. Both dryers use a conveyor to transport garments through the curing chamber and use heat to set the inks on the garments (up to 330°F for plastisols). These are the only similarities between these two dryers. The dryers are otherwise very different in design, capacity, versatility, running cost, and level of investment. For starters, infrared dryers work with direct heat radiated from infrared panels to heat up the ink to a specific drying/curing temperature. Hot-air dryers use heated air blown over the garments to transfer the heat. Let's look into the factors that set these two dryer designs apart and discuss the advantages, versatility, and possible limitations of each.

The infrared dryer

The Infrared, or IR, dryer uses electrically heated infrared panels mounted above the conveyor belt in a heat-insulated cover. As the printed garment passes under the IR panels, the radiated heat is absorbed by the ink and heated up to curing temperature. The drying temperature is regulated by the electric power to the element and/or by adjusting the height of the IR panels above the conveyor. The conveyor speed is also adjustable to set the correct drying time. The IR dryer is, by its nature, compact and simple in its design with few moving parts and is consequently a relatively inexpensive investment.

Ink considerations Water-based inks typically do not work well in an IR dryer because the dryer lacks airflow needed to drive out the water from the ink for a proper cure. Some infrared dryers use special IR panels with a small air-circulation fan that creates a moderate airflow to assist in drying. The drying capacity is reduced because water-based inks have a 50-100% longer drying time. The water must be driven out of the garment first before the ink can be heated to the final curing temperature.

Variations in drying temperature Due to the direct heat radiation, the drying temperature can be difficult to control and, therefore, may vary depending of what type of garment is used and the thickness of the print. Always test various dryer settings for best results each time you use any new type of garment or ink for the first time. This will minimize the risk of scorching the garment or under/over curing the ink.

Size The electricity consumption of a 36-in. dryer with a 6-ft drying chamber is relatively modest and does not raise any concerns about operating cost. However, if you were to use an IR dryer with the same design for a 76-in.-wide dryer and 16-ft-long drying section, then the operating cost for the electrically heated infrared elements could be many times higher than what you'd pay for a gas-heated air-jet dryer. The increase in size of the IR dryer also

leads to increased difficulty in controlling the temperature throughout the dryer. The result is uneven temperature throughout the dryer, known as hot spots, which can jeopardize good and safe curing of the ink.

The hot-air jet dryer

The hot-air jet dryer blows forced hot air over printed garments. The air can be heated by electric heating elements (coils) or by a gas burner, depending on availability and the most economical power supply—electric or gas—in a given geographical area.

The airflow is generated by a large fan positioned at the base of the dryer, and air is blown through the heater and up into a drying hood above the conveyor. The hot air then pressurizes the heat chamber and is forced out onto the printed garment through a special system of high-speed nozzles. The air is then returned through the mesh conveyor belt to the circulation fan. Capturing the air in this way keeps it in constant recirculation over the heating elements or through the gas burner to ensure that the air temperature is kept constant within a few degrees of set value.

A separate exhaust fan removes fumes and vapors released during the curing process, which then are exhausted out of the dryer while the dryer is then replenished with fresh air from the printing room.

The hot-air jet dryer is often more complex in its design and function than the IR dryer, and it requires a certain degree of maintenance and a higher level of investment. However, it offers some very important advantages in return. For instance, all printed garments and inks, such as plastisols, water-based inks, discharge inks, and specialty inks can be cured in the same hot-air dryer. Other examples follow.

Constant temperature Air temperature is kept constant thanks to the recirculation of the forced hot air over the heater. Garments and inks are heated and dried very effectively without any risk for over heating or scorching. The garment does not influence the drying performance and ink thickness, which can be easily fine-tuned by adjusting the drying/retention time. The position of the temperature sensor may differ according to dryer design, and the air temperature where the sensor is placed may not be same as the air temperature at conveyor level. Run a temperature probe on the conveyor through the dryer and compensate for any discrepancy between the dryer's temperature setting and the actual reading from the probe.

Gas/electric consumption The recirculation of hot air enables even very large dryers to consume power modestly—and if gas is available, this often even more favorable.

Airflow/nozzle system The airflow and nozzle system is the most important factor for dependable drying performance. The more air that is recirculated and blown over the printed garment, the more effective the heat-transfer rate—that is, how fast the air can heat up the ink to its curing temperature. This is especially important for water-based inks, where greater air volume and higher air velocity are very influential for the dryer's ability to drive out the water in the shortest possible time and prepare for the second drying phase: heating up the ink to the point of cross linking.

Air supply A large, high-capacity, high-performance blower is a must to ensure the proper supply of air to the dryer hood. The dryer hood must be large enough to hold and pressurize the air for even distribution across and along the hood. The pressurized air is then ducted through specially formed, high-speed nozzles that accelerate and direct the hot air onto the garment. Each nozzle acts like a mini dryer, and each one is identical in its performance to guarantee even distribution of the air

FIGURE 2
Modular dryers allow for expansion through the addition of heating chambers.

FIGURE 3
The return-belt dryer can be located away from the printing room while enabling access to inlets and outlets. Shown here is a return-split-belt system in use with a direct-to-garment inkjet printer.

flow and temperature across the drying area without creating any hot spots or uncontrolled, turbulent areas.

Internal components Drying water-based inks causes the release of water vapor into the dryer. In time, this will result in corrosion and rust that will severely damage the dryer. To prevent such corrosion, the dryer interior must be fabricated of stainless steel or aluminized sheet metal. Check the specifications of any dryer before introducing water-based inks to it.

Capacity of air-heating system It is important to have enough heating power installed to keep the dryer temperature constant, especially as the load of garments through the dryer increases. When the dryer is idle, it takes relatively little heating power to keep the temperature constant, but when we start to load the dryer with printed garments, the garments extract heat from the dryer as they are heated up to 330°F. When the hot garments leave the dryer, they will carry heat out of the dryer as they exit. The installed heating elements or gas burner must therefore have enough capacity to compensate for this sudden heat loss without fluctuations in the drying temperature.

Insulation Heat insulation is important for the cost of operation and also for the operator's well being in the printing environment. Dryers that are poorly insulated lose a large amount of heat through their walls and into the printing room, which can cause the water-based inks in the nearby presses to dry into the screens. Therefore, 3- to 4-in.-thick insulation is recommended in addition to specially designed heat brakes—manufactured slots—that minimize the heat transfer from the hot-air duct inside the dryer to the outside of the dryer.

Exhaust hoods Although the exhaust fan removes fumes and vapors, which are then are ducted out of the dryer, it is recommended—especially for wide large dryers—to have separate exhaust hoods at the entrance and exit of the dryer to capture any fumes and vapors that can leak out through the relatively large inlets and outlets.

Access for cleaning With the time dust and lint from the garment will accumulate inside the dryer. It is important that the interior of the dryer can be accessed for routinely cleaning to avoid any fire hazard as well as maintain a clear opening of all the air nozzles to ensure high air velocity. It is an preferable that the dryer be designed with special lint filter drawers for easy maintenance ***(Figure 1)***.

Conveyor drive The conveyor drive system should be powerful and accurate enough to run at constant set speed whether the dryer is idle or operating under a full load of garments. The conveyor speed is directly proportional to the retention time, and any variation results in a change of this important drying parameter.

On-board diagnostics An automatic diagnostic warning system is recommended for larger dryers and for larger facilities where many dryers are in operation. It constantly monitors all of the important dryer parameters, such as airflow, temperature, and heaters, and it gives an alarm automatically when there are any significant changes in a dryer's operation and performance.

Modular design Modular dryer designs ***(Figure 2)*** allow the units to be upgraded by adding one or several more drying modules to meet any future demands for increased production capacity or changes in ink types.

Special dryers

The introduction of water-based inks created the need for two different sets of drying parameters, one retention time for plastisols and another for water-based inks. The retention times for water-based inks are often 50-100% longer. One wide dryer is often used to cure prints from two automatic garment presses, where one press is located on each side of the dryer's inlet. In such a case, one can only run one ink type in either press at the same time. With the introduction of the split-belt dryer, where the conveyor belt is separated into two belts side by side, each with its own conveyor drives, it is now possible to run simultaneous

production from two presses without any restriction as to which type ink is being used in either press.

The introduction of direct-to-garment digital printers with water-based inks called for longer drying times and longer dryers, 8-16 ft, which for many is a problem with floor space and handling. The digital printers are operated by only one person, and it can be time consuming to always have to go to the back of the dryer for sampling or collection. The return-belt dryer is designed with a second return-belt conveyor under the first conveyor. As the garment exits from the hot-air section on the top conveyor, it passes over a transfer section that moves the garment onto the lower return-belt conveyor that brings it back into the hot-air section and to the front of the dryer.

Digital garments printers often require controlled humidity and are therefore installed in air-conditioned rooms. Here, the return-belt dryer can be of great advantage and offer great savings because the dryer's heating chambers can be installed outside the air conditioned room, leaving only the top and bottom conveyor belts on the inlet protruding through an opening in the wall towards the printer ***(Figure 3)***. A the return-split-belt dryer can serve two digital printers each using inks with different drying times.

The IR and the hot-air dryer are today mature designs with their specific differences in technology and capacities. Choosing one over the depends on your needs for versatility, size, and capacity. Are there any future developments to expect for the dryers within the garment industry? Well, here have been talks about UV inks for garments for a long time.

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