Gas Assist Injection Molding

The Delivery of Gas Supply

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THE DELIVERY OF GAS SUPPLY

Gas assist requires a source of high-pressure nitrogen gas that can be controlled and delivered to your process. Nitrogen is used because it is an inexpensive and readily available inert gas. Nitrogen gas, if supplied at a purity of greater than 97 percent, will not corrode or harm gas assist equipment or react with the resins used for the process.

Some gas control systems are equipped with booster systems that will compress the gas taken from standard bottles. Other systems may require a supply of high-pressure nitrogen to be fed directly to the control unit. Several options exist for supplying gas in the gas assist process.

Nitrogen Generators

Although the initial cot of nitrogen generators is higher than that of bottled gas, long-term savings make a nitrogen generation system an option to explore. On average, a nitrogen generation system will pay for itself in nine to 14 months.

Nitrogen generators also reduce the floor space required in a plant because the generator usually resides in the compressor room, and is plumbed to drops next to as many machines as necessary. This also eliminates the safety issue of bottled nitrogen being moved from press to press.

- A low-pressure compressor to supply air to the generation system.
- A means of removing oxygen from the air
- A high-pressure compressor to increase pressure to meet the needs of the process

The nitrogen used for the gas assist process is taken directly from the atmosphere. Therefore, the nitrogen generation system must have a low-pressure air supply to flow through the oxygen-removal media. This air must be dry and free of contaminants or the generation system can fail. Adequate air filtration is critical t any nitrogen generation system.

In some systems, the low-pressure compressor is not used. In these systems, low-pressure air is supplied by the shop's air-compressor system. When using this type of system, be sure that the shop's air supply will handle the added load.

When oxygen is introduced to the gas assist process, it can burn the resin and cause a number of molding defects. Therefore, once you have a clean supply of air, the oxygen must be removed. This is done by flowing the prefiltered air through a membrane, or a PSA (pressure swing adsorption) system. The oxygen is removed from the air, leaving high-purity nitrogen gas.

A supply of nitrogen gas is now available, but it is at a relatively low pressure. The pressure must now be increased, or compressed to a usable level for the gas assist process. The compressor system should be capable of increasing the nitrogen pressure to a level above that which will be used for the process.

When choosing a nitrogen generator, the first consideration should be reliability, and there are very few reputable makers of nitrogen generators. The best producer of a nitrogen generator is a compressor manufacturer, because the company specialized in manufacturing compressors that can withstand the duty cycles of a gas assist molding operation. These systems incorporate their own on-board air compressor and high-pressure compressor. You need only supply a source of electrical power and some preventive maintenance.

Maintenance of a preventive nature is required on a nitrogen generator. As with any mechanical component, maintenance keeps the machine operating at optimum levels. Oil levels must be checked and valve wear must be recorded –the usual procedures considered normal for any type of compressor.

Bottled Gas

In the early days of gas assist, bottled nitrogen gas was the most predominant type of supply used, but many downfalls were associated with its use. These downfalls included:

Safety. Sometimes in the production shop safety issue are overlooked in favor of production requirements. The fact still remains that an individual bottle or tank of any high-pressure gas is a potential hazard. Because the supply of gas eventually depletes from use, bottles must be changed often. With the changing of bottles comes the risk of accidental tipping of the cylinder. Even though the bottle has little gas left in it, a valve breaking off the cylinder is still dangerous.

Now, just consider a new, fully charged bottle falling over. We have seen safety video tapes in which a fully pressurized broken bottle of gas penetrated through three cinderblock walls before stopping. Numerous molders do not anchor bottles of gas in their shops. The chance of tipping is always present in those situations.

Another, much safer, way to purchase high-pressure gas is to buy a multipack. Multipacks contain high-pressure cylinders plumbed together and mounted in a protective cage so that accidental valve breakage is nonexistent. These multipacks are referred to as six or twelve packs due to the number of cylinders contained in one cage.

NOTE: If you intend to use bottled gas rather than a nitrogen generation system, these multipacks are highly recommended.

Waste. Most fully charged gas bottles come with an internal pressure of around 2400 psi. As you use the gas from a cylinder, its pressure decreases. Since most processes require average pressures of about 1500 psi, if you directly plumb a bottle of gas to a gas controller, you will be required to interrupt your process at the time the gas pressure supply drops below 1500 psi.

Knowing this, many manufactures of gas assist equipment incorporate booster systems into their machines. These boosters are actually miniature gas compressors that allow you to intensify pressures, and then store them in high-pressure reservoirs or receivers. This means that as the bottled gas pressure decreases, the miniature booster compressor continues to operate and drive up the pressure. This allows you to use most of the gas volume of a bottle.

As the supply pressure of a bottle decreases, so does its volume, so the miniature gas booster has to work harder to accommodate the demands of the process. Once pressure is reduced to about 500 psi, the bottled gas has to be changed so that no premature wear is caused by the overcycling of the pump.

At this point you realize that you have paid for 2400 psi, but can only use a maximum of 1900 psi.

Although a multipack of gas lets production run at much longer intervals than single bottles, inevitably the process will be altered when the supply of gas depletes itself. Multiple bottles have to go back to the supplier with gas still in them that you paid for.

Additional waste occurs in the gas lines themselves. Often we see sites with long lengths of gas line going to the process from the controller. What's not understood is that all the gas in the line between the controller and the process is vented to atmosphere every machine cycle. The longer the line, the more gas is wasted.

Gas assist molders who use .25-inch line think that it will provide more flow or that the size of the gas line does not matter. The truth is, the larger the diameter of the gas line, the more gas used. In many cases where .25-inch lines are used, more gas volume is used in the gas lines than in the product being molded.

Downtime. Bottled gas must be delivered from the supplier and stored somewhere. Because of unforeseen problems such as leaks, predicting how much gas will be used when running multiple gas assist jobs is difficult. Also, if more than one job is running with gas assist, a bottle supply will be needed for each one. If for some reason you run low on gas, a process is affected. Running out of gas is always a possibility, with resulting machine downtime.

A customer's demand for immediate product can warrant the setup of an additional job, creating an urgent and unforeseen need for gas; scheduling may have overlooked having a spare supply available. At this point, additional supplies must be ordered of possibly another gas job must be shut down to allow for the use of its gas. This is just one of the many examples of how a limited gas supply can affect a plant.

Booster failure. Because the pneumatic boosters utilized in some gas assist controllers are not capable of heavy-duty cycling, costly breakdowns occur frequently. With breakdown comes an inability to control machine runtime, as well as the maintenance cost of the boosters. We know of molders who have spent as much as $10,000 annually on booster repairs for a single controller. This does not account for the cost associated with the downtime caused by the failure.

An air-driven booster will cycle harder as a gas supply is depleted. This causes premature wear of the cylinder walls and can cause leaks that may go undetected, consuming gas. When a leak occurs, the booster continuously cycles harder to try to achieve the set system pressure. During this heavy cycling, excessive heat is generated that will cause the high-pressure seals to fail prematurely.

Most boosters are air-driven, meaning they rely on a supply of shop air to cycle. Air-driven gas boosters require very high air flow, which can put an added burden on a shop's air-compression system.

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