The use of ozone as a decontaminant and as an anti-microbial agent has expanded rapidly in recent years. Since Food and Drug Administration approval in 2001, ozone use has proliferated in many industries. Ozone deployment systems continue to replace chlorine and other decontamination systems as a safe and cost-effective alternative.

A New Kind of Check Valve

By Dan Kennefick

Unique check valve protects ozone generating equipment against upsets

Figure 1. Current Process Diagram with Check Valve

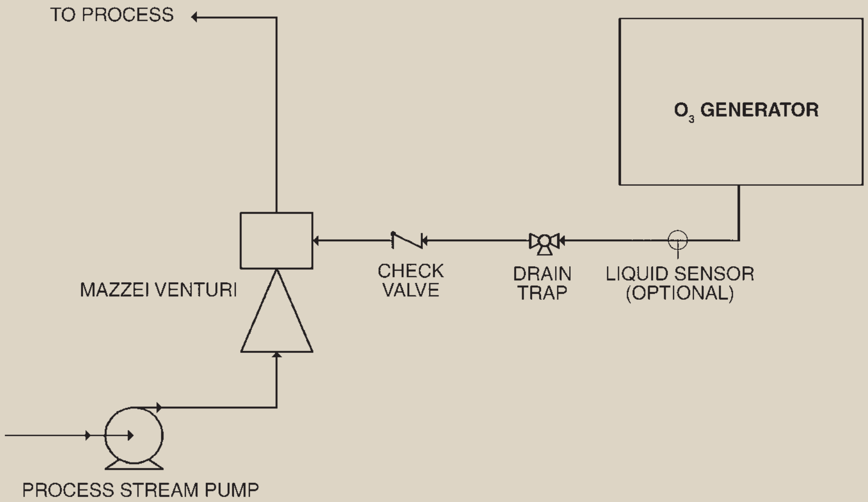
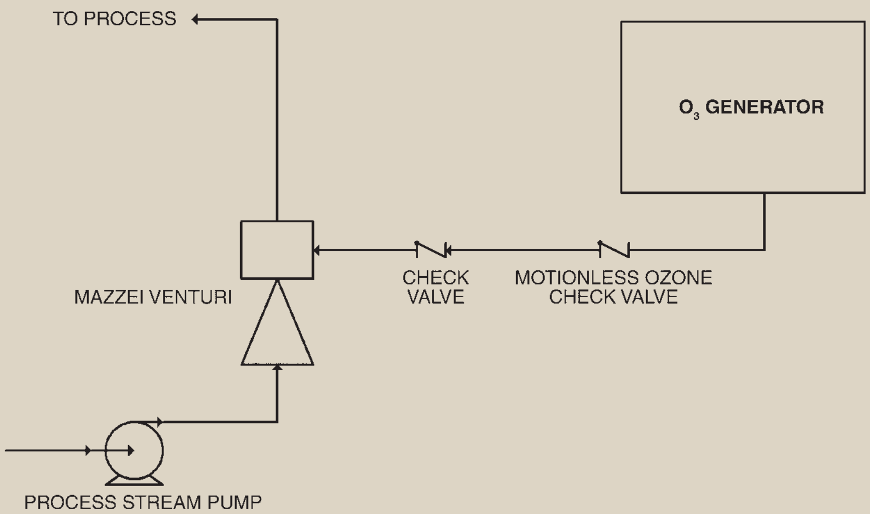


Figure 2. Process Diagram with Motionless Ozone Check Valve



Some of the key advantages of ozone compared with other decontaminating technologies include:

- One of the strongest single oxidizing agents available—150% stronger than chlorine over a broad pH range;
- Generated on site—no shipping, handling or storage required;
- Reacts swiftly and effectively on all strains of viruses;
- Rapidly decomposes to oxygen; and
- No formation of toxic halogenated compounds.

As rapidly as the use of ozone has expanded, the number of manufacturers of ozone generating equipment and systems has expanded. It is estimated that the ozone generator market is a $370-million global market with an expected compound annual growth rate of 6.7% (BRR Research). Global application areas for ozone include but are not limited to:

- Bottled water;
- Agri-Food;
- Beer and wine;
- Laundry;
- Wastewater treatment;
- Groundwater;
- Pools and spas;
- Aquaculture;
- Aquariums;
- Microelectronics;
- Pharma and Bio-Med; and
- Hospitals.

The primary method used for the generation of ozone is to ionize either air or oxygen in a high-voltage field across a dielectric material. Because of the use of these high-voltage fields, it is important to prevent water from entering ozone generators. Typical field installations can include any or all of the protective devices installed in ozone feed lines (see Figure 1):

- Mechanical check valve;
- Drain trap; and
- Liquid sensor (optional).

Impervious to Attack

Because ozone is a powerful oxidizer, thermoplastics, thermosets, rubber materials and some metals will degrade after prolonged exposure. Mechanical devices such as check valves and drain traps, which can contain rubber or plastic components, eventually fail or do not perform as designed in the prolonged presence of ozone. This ongoing issue has created an opportunity for a device such as the Markel Motionless ozone check valve.

The Motionless ozone check valve has no moving parts and is composed 100% of fluoropolymer materials. Fluoropolymers, as a family of plastics, are extremely resistant to ozone attack. The fluoropolymer materials chosen for the Motionless ozone check valve are impervious to ozone attack.

The Motionless ozone check valve consists of a number of porous PTFE hollow fiber lengths, which are "looped" or mounted "dead end" style in an all-fluoropolymer tube.

Ozone gas is fed into the fiber open ends and is allowed to pass freely through the porous wall of each fiber. If a process upset occurs and water enters the ozone feed line and contacts the looped fiber end of the Motionless ozone check valve, the porous PTFE fiber will prevent flow because of the water-rejecting properties (hydrophobic) of the porous PTFE. The Motionless ozone check valve can be

Figure 3. Flow vs. Pressure

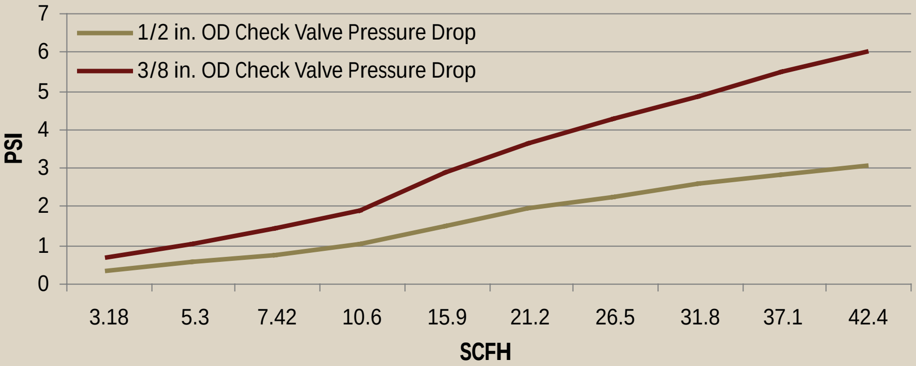
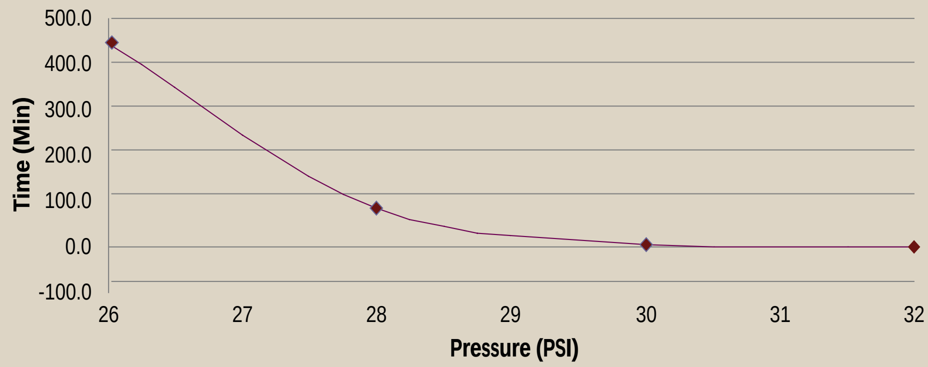


Figure 4. Water Breakthrough Test



easily inserted into ozone supply lines with the use of stainless steel or PVDF compression fittings.

Protect Against Upsets

This unique check valve is best designed to protect ozone generating equipment against low-pressure upsets. Mechanical check valves have a history of unreliable performance in low-pressure upset situations due to the degradation of plastic and rubber parts in the check valves themselves. The degradation of these parts can prevent mechanical check valves from seating properly or can affect the spring metal and affect their cracking pressure.

A suggested installation method calls for a mechanical check valve to be used to protect against high-pressure upsets and a Motionless ozone check valve to be placed closest to the ozone generator to protect against low-pressure upsets and check valve leakage. Figure 2 (Page 22) shows the recommended placement of both devices in a typical ozone supply system.

Work is underway to develop a Motionless ozone check valve that will block the flow of water in process upsets up to 60 psi, which would allow the user to replace the mechanical check valve in most installations.

Figure 2 shows the recommended placement of both devices in a typical ozone supply system.

Design Variables

Proper design and sizing of ozone generators takes into account a number of variables. One variable that needs to be considered is the flow-restricting characteristics of the devices placed in the ozone feed line. If a new device, such as the Motionless ozone check valve, causes too much pressure drop and restricts flow, the generator may not be large enough to deliver the desired quantity of ozone.

The Motionless ozone check valve creates minimal pressure drop and can easily be designed into any ozone delivery system. Figure 3 shows flow versus pressure drop curves for two Motionless ozone check valve sizes

The check valve can be easily inserted into ozone supply lines with the use of stainless steel or PVDF compression fittings.

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(½-in. OD and ⅜-in. OD). The ½-in. OD unit, for example, generates a flow versus pressure drop curve similar to a typical spring-loaded, mechanical check valve.

Water Breakthrough Performance

Another important variable to consider in the component design of an ozone delivery system is the water breakthrough characteristics of the check valves. Mechanical check valves typically specify a minimal pressure close. Because the Motionless ozone check valve has no moving parts, there is no need to consider a minimal pressure to operate. This check valve will operate at a very minimal pressure and totally block the flow of water.

Figure 4 shows the water breakthrough performance for the ½-in. O.D. version. Because of where it is placed in the ozone supply line, the Motionless ozone check valve will not see high pressure unless there is a total failure of the mechanical check valve. If total failure of the mechanical check valve occurs, water flow through the Motionless ozone check valve is still significantly restricted because of the elevated pressure drop that occurs across the porous PTFE hollow fiber membrane walls. This pressure drop and resultant reduced water flow allows time for the system operator to locate problems and shut systems down.

The Motionless ozone check valve is an exciting new development for the ozone industry. It provides an added level of safety and protection for ozone generator manufacturers and system designers and can be easily installed in most ozone generating processes. *wqp*

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