

Controlling hazardous conditions in ozone rooms

By Piyush Patel

Ozone hazards are not well known because it was rarely used in industry in the past. Now, however, it is increasingly replacing chlorine as a disinfectant in water treatment plants, due to the many advantages it offers.

Ozone was first used in water treatment in the late 1800s. It is a highly toxic, dangerously reactive, oxidizing gas with greater disinfection effectiveness than chlorine against bacteria and viruses. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends the following time-weighted average exposure limits for ozone: heavy work 0.05 ppm; moderate work 0.08 ppm; light work 0.1 ppm; for two hours or less exposure time, heavy/moderate/light work loads 0.2 ppm. Its carcinogenicity designation is A4 (not classifiable as a human carcinogen).

Ozone is not combustible, but pure ozone poses a serious fire and explosion risk by reacting with combustible materials. The ozone molecule is composed of three oxygen atoms; it is an unstable gas that decomposes slowly to oxygen, with a half-life of three days at 20°C and three months at -50°C. The rate of decomposition is increased by light, trace organics, nitrogen oxides, mercury vapour, peroxides, metals, and metal oxides.

It is a strong oxidizing agent, forming oxides with iron, manganese and sulphur in water to form insoluble metal oxides, which can be removed easily by post-filtration. Ozone is manufactured on demand using an on-site ozone generator.

Ventilation is one of the effective methods to control hazardous conditions involving ozone. The ozone generator and associated equipment should be housed in a separate room, preferably in separate buildings, and the ozone room/building should have a separate ventilation system.

Designing for ozone ventilation

The upgrade project at the Holmedale Water Treatment Plant in Brantford, Ontario, designed by R.V. Anderson Associates, includes an ozone facility for disinfection. The ozone room will be ventilated by a two-stage system, for nor-



Holmedale Water Treatment Plant.

mal and emergency ventilation.

Under normal conditions, the general system will provide at least three air changes per hour. In the event of an ozone leak, the emergency ventilation system will be automatically activated by a monitoring system when the gas concentration exceeds 0.05 ppm. The emergency system will provide at least 30 air changes per hour in the room.

Exhaust vents will discharge air well away from any air intakes, and will be installed vertically down to 150 mm from the finished floor level of the room to exhaust the ozone, which tends to settle at a low level. The exhaust fan will be an up-blast, roof-mounted unit which will throw the ozone-contaminated air high above the building to allow more time for decomposition. Supply air will be provided by a roof-top, indirect gas-fired air-handling unit.

The room will be ventilated with 100% outside air with no recirculation. The air-handling unit will consist of two supply fans: one for normal ventilation, the other for emergency ventilation. The system is designed to maintain a temperature of 18°C in winter for normal conditions, and 10°C in an emergency condition. The ozone room exit door will open into a vestibule (air lock), which will be continuously pressurized by a separate, small, make-up air unit in order

to avoid the spread of ozone to other areas of the building. The ozone generator will also be interlocked with a gas monitoring system to shut down in an emergency.

Good engineering practices must be applied to control hazardous conditions. Gaskets, piping, and sealing compounds must be made of compatible materials. Ozone piping should be kept as short as possible and properly supported. Piping should be protected from shock and vibration.

People working with ozone should be properly trained about its hazards and safe use. No welding, cutting, soldering, drilling, or any other work should be allowed without inspection and a permit. The complete system and piping should be purged to remove any traces of ozone before any kind of maintenance or project work is performed. It should be checked regularly for leaks.

Keep the ozone room clear of all kinds of combustible materials, and avoid electrical sparks and intense light flashes. Regular testing of the controls is required to make sure they are working properly.

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