

MITIGATION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL HAZARD MITIGATION

Heatless Vaporization Of Liquid Decontaminants

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Vaporous decontaminants are useful for decontaminating sensitive equipment, which cannot withstand liquids, and indoor spaces with hard-to-reach areas. Vapor form offer efficient coverage, ensuring the decontaminant to get into contact with all the surfaces of the item or space to be decontaminated, minimizing the need for time consuming and laborious manual work.

We have developed a novel method to generate vaporous decontaminants from a liquid without applying heat. The result is an energy efficient vapor generator, which minimizes the risk of heat-induced decomposition of reactive decontaminants, such as hydrogen peroxide. The heatless approach also minimizes the risk of decontaminant condensing onto the surfaces, as the generated vapor is lower temperature than the environment.

The heatless evaporation method can produce vapor from any decontaminant solution, given that the vapor pressure of the decontaminant is suitably high. We have mostly explored the use of hydrogen peroxide because it is suitable for decontaminating both chemical and biological threats, and it decomposes into water and oxygen without leaving harmful residue. In vapor form, it is also non-corrosive and safe to use with most materials, or even sensitive electronics, unlike the liquid hydrogen peroxide solution. This highlights the importance of preventing condensation.

The generator works by generating a fine mist of decontaminant droplets. The simplest way to produce such mist is by a pneumatic collision atomizer. The atomizer removes and recycles the large droplets by impacting them against a baffle and returning the liquid back into the reservoir. Due to the sharp curvature of the remaining fine droplets, they evaporate spontaneously without the need for added heat. This mechanism is called the Kelvin-effect, and it allows for droplet evaporation even in saturated conditions.

We constructed a prototype based on the heatless technique and compared it against a commercial hydrogen peroxide vapor generator. The prototype surpassed the commercial unit, both in production rate and production efficiency. The design is simple: besides the control electronics and environmental probes, the most high-tech component is the air compressor.

Because our technology is simple, robust and energy efficient, it is particularly suitable for lightweight, mobile, battery powered vapor generators. With these generators, the vapor decontamination capabilities can be moved where needed, and the equipment exposed to chemical or biological threats can be decontaminated on-site. We see substantial potential for this type of generators, both for military and civil applications.