

Information Regarding the Respiratory Protection Equipment and the Volcanic Eruption in Hawaii, May 15, 2018

As of this date, Kīlauea Volcano on the Island of Hawai'i has been venting gases through erupting fissures along the Lower East Zone. This eruption, located within the Lower Puna community, has been accompanied by elevated concentrations of sulfur dioxide and sulfate aerosols reported in various parts of the island.

Gases

The Interagency VOG Dashboard¹, <https://vog.ivhhn.org/leilani-eruption>, has published information regarding the air quality hazards of this eruption including the hazards of sulfur dioxide.

Sulfur dioxide (SO₂) is a colorless gas with a strong characteristic odor like a burnt match, or fireworks, that can irritate the skin and the tissues and mucous membranes of the eyes, nose, and throat. People can smell sulfur dioxide at levels of 0.3 to 1.4 ppm.

Worker Exposures

The American Conference of Governmental Industrial Hygienists (ACGIH) sets the short term exposure limit threshold limit value (STEL-TLV) for workplace exposures as 0.25 parts per million (ppm)^{2,3}. This is the maximum average concentration to which it is recommended that workers be exposed to for a short period of time. At concentrations higher than this, it is suggested that engineering controls are implemented, workers leave the area, or they wear respiratory protection. The US Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) have different exposure limits. https://www.osha.gov/dts/chemicalsampling/data/CH_268500.html. ACGIH does not currently have a time weighted average value (TWA) for SO₂.

Public Exposures

The Hawaii Department of Health (HDOH) has recommended actions for SO₂ advisory levels for the general public which include suggested actions/activities at specific SO₂ concentrations. At levels below 0.1 ppm, the SO₂ levels are considered "good". Levels over 5 ppm are considered hazardous for all populations. <https://vog.ivhhn.org/current-air-quality>
<http://www.hiso2index.info/assets/FinalSO2Exposurelevels.pdf>

Ash

Exposure to volcanic ash can cause irritation to the eyes as well as the respiratory system. The gritty ash particles can scratch the cornea of the eye and could cause conjunctivitis, an inflammation that leads to redness, burning of the eyes, and photosensitivity. For people with existing respiratory conditions such as asthma, emphysema or other chronic lung disease, exposure to ash may pose serious health risks.

<https://www.cdc.gov/disasters/volcanoes/facts.html>

<https://vog.ivhhn.org/summit-ash-hazards>

Personal Respiratory Protection

The Hawaii Department of Health (HDOH) is not recommending respirators for the general public^{4,5} for exposures to volcanic gases as of May 13, 2018. Respirators are used by first responders and other professionals entering zones where exposures to gases may occur.

3M is receiving many questions regarding the ability of respirators to help reduce exposures to sulfur dioxide and other gases generated by the volcano. The intent of this document is to help answer questions and to provide some guidance to anyone who has obtained a respirator to help protect against the gases and particles resulting from the volcanic activity.

Gas concentrations during volcanic eruptions can vary greatly, and it is possible that concentrations will be higher than a respirator with cartridges and filters can handle. Respirators should be a last resort option. Individuals choosing to use a respirator should do everything possible to avoid gas and particles, including staying as far away as possible from the eruption and gas plume, and following the directions of local public health agencies.

Workers should follow the instructions of their employer.

Filtering facepiece particulate respirators, sometimes called “N95s,” are effective against particles, such as ash. The US CDC recommends N95s in the case of exposures to ash.

<https://www.cdc.gov/disasters/volcanoes/after.html>. Research by the International Volcanic Health Hazard Network (IVHHN) has determined that these respirators are very effective at capturing ash particles: www.ivhnn.org/ash-protection

3M has a technical data bulletin specific to ash exposures. <https://multimedia.3m.com/mws/media/5596290/ppe-for-volcanic-ash-exposures-technical-bulletin.pdf>

N95 masks are not effective for protection against sulfur dioxide and other gases, and thus will not sufficiently protect people close to erupting fissures.

Reusable respirators can help reduce exposures to gases and particles when they are used properly and create a tight seal to the face.

However, there is no guidance regarding the use of respirators by the general public to help reduce exposures to volcanic gases. The HDOH recommends that individuals follow guidance regarding avoiding areas where volcanic gases may be present and following evacuation orders.

In the US, respirators used by workers must be used in a formal US Occupational Safety and Health Administration (OSHA) respiratory protection program that includes medical evaluation, fit testing and training. OSHA requires workers to be in a formal program to help ensure that the respirators are selected and used properly for the differing contaminants and exposures that workers may encounter.

When using a respirator the *User Instructions* must be read and followed carefully. **Men must shave every day that they use any respirator that seals to their face.** Nothing must come between the edge of the respirator and the face including scarves, jewelry, hair and glasses.



Particulate filters and gas cartridges can be used in combination to reduce exposures to particle, gas and vapor hazards. Gas cartridges are color coded and must be selected based on what type of gas is present in the environment. In a volcanic environment such as Kilauea, protection from SO₂, other sulfur gases, and other acid gases is necessary. In addition, a cartridge that filters ‘organic vapors’ will help filter organic vapors generated by the volcano, burning vegetation and burning infrastructure. As sulfate aerosols and ash may also be present, it is recommended to also have a particulate filter with the cartridge. Cartridges that are appropriate for filtering volcanic gases and organic vapors include: “multi-gas/vapor” cartridges (olive label) and “organic vapor/acid gas” cartridges (yellow label). To filter acid gases alone, an “acid gas” cartridge (white label) is available. These cartridges should be equipped with a particulate filter (e.g. N95 or P100 filter). Certain gases, such as carbon dioxide, are not removed by industrial respirators.

Respirators that cover the entire face, ‘full facepiece respirators’, are more protective than those that cover only your nose and mouth and also protect the eyes. However, these cannot be worn with traditional glasses. For those people that wear glasses, a ‘half facepiece respirator’ that covers the nose and mouth, coupled with goggles, could be a workable solution.

When not in use, the respirator must be stored properly per the *User Instructions*. It is important to store the respirator and cartridges in a clean area, sealed in a plastic bag to protect it from the environment.

The Hawaii Department of Health (HDOH) is not recommending respirators for the general public^{4,5} as of this date.

¹The interagency VOG Dashboard is the result of a partnership between the International Volcanic Health Hazard Network (Durham University, UK), Hawaii State Department of Health, the USGS Hawaiian Volcano Observatory, Hawai'i County Civil Defense, the National Park Service, County of Hawai'i (Mayors Office), CSAV (University of Hawai'i) and the US Department of Agriculture Farm Service Agency.

²TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices." ACGIH. Cincinnati, Ohio. 2018.

³<http://www.nj.gov/health/eoh/rtkweb/documents/fs/1757.pdf>

⁴<https://vog.ivhnn.org/leilani-eruption>

⁵<https://vog.ivhnn.org/FAQ.pdf>

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