

Inhalation Hazard of RTU Hydrogen Peroxide as a Room Disinfectant

Overview:

This document estimates the potential inhalation exposure danger under common use conditions for accelerated hydrogen peroxide as a Ready To Use hard surface disinfectant.

- It estimates the potential exposure to hydrogen peroxide vapor in a 12 ft(w) x 20 ft(l) x 10ft(h) room treated with between ½ and 10 gallons of 0.5% (RTU) accelerated hydrogen peroxide solution to thoroughly wet all floors, walls, ceilings and all animal housing units.
- It estimates that even under the most favorable conditions the exposure levels are well above the OSHA/NIOSH/ACGIH exposure limit of < 1 ppm average over 8 hrs and in most cases exceeds the IDLH (Immediately Dangerous to Life and Health) limit of 75 ppm.

Background:

The mass of hydrogen peroxide vapor in the air is assumed to be the mass of hydrogen peroxide applied as the Ready To Use (RTU) solution. It is calculated from the volume of the solution and the concentration of the solution assuming the specific gravity of the use-solution is 1.0 (which is reasonable at the low, 0.5% peroxide concentration). The mass of hydrogen peroxide is converted to volume of hydrogen peroxide vapor using the ideal gas law, and assuming 1 atmosphere total pressure and a temperature of 20°C.

The volume of air into which the peroxide is evaporated is assumed equal to the volume of the room plus the volume of the ventilation air that enters the room as the peroxide solution evaporates. This approach will slightly underestimate the peak peroxide concentration in the room.

The concentration of hydrogen peroxide in the air is calculated by dividing the volume of hydrogen peroxide vapor by the volume of air into which the peroxide is evaporated and converting to ppm by volume; which is the standard measure for low vapor phase concentrations.

Discussion:

The calculation is based on the evaporation of the applied hydrogen peroxide solution into the air, assuming that the distribution of peroxide throughout the room is uniform.

It was done over a range of applied solution volumes ranging from ½ gallon to 10 gallons, at two different room ventilation rates (10 or 16 air changeovers per hour), and at two different solution evaporation times (20 minutes and 40 minutes).

The concentration of the RTU solution was 0.5% by weight hydrogen peroxide.



Conclusions:

Table 1 (below) indicates the results of the calculations, and it shows that for most combinations of conditions the estimated hydrogen peroxide concentration in the air exceeds 75 vppm; the level considered by NIOSH to be immediately dangerous to life and health (<http://www.cdc.gov/niosh/idlh/intridl4.html>). For those few that do not exceed the IDLH level, the concentrations exceed the OSHA/NIOSH/ACGIH threshold limit value of 1 ppm by a minimum of 8x (<https://www.cdc.gov/niosh/npg/npgd0335.html>).

While this report estimates the vapor concentration of accelerated hydrogen peroxide as a hard surface disinfectant, the methodology could be applied to other volatile disinfectant actives such as alcohol, glutaraldehyde, or chlorine dioxide. It does not apply, however, to non-volatile active ingredients such as quaternary ammonium compounds.



Table 1. Estimated Vapor Phase Hydrogen Peroxide Concentration In Air

Room Volume, ft ³	Ventilation Rate, Air Changes Per HR	Volume of Use Solution, gal	Volume of H ₂ O ₂ Vapor at 20°C, liters	Evaporation Time, min	Estimated Concentration of H ₂ O ₂ In The Air, ppm by Volume	OSHA/NIOH/ACGIH Exposure Limit (TLV 8 Hour Weighted Average)	IDHL LIMIT Immediate Danger to Life & Health
2400	10	10	133.8	20	454	≤ 1 ppm	75 ppm
2400	10	8	107.1	20	363	≤ 1 ppm	75 ppm
2400	10	6	80.3	20	273	≤ 1 ppm	75 ppm
2400	10	4	53.5	20	182	≤ 1 ppm	75 ppm
2400	10	2	26.8	20	91	≤ 1 ppm	76 ppm
2400	10	1	13.4	20	45	≤ 1 ppm	77 ppm
2400	10	0.5	6.7	20	23	≤ 1 ppm	75 ppm
2400	10	10	133.8	40	257	≤ 1 ppm	75 ppm
2400	10	8	107.1	40	205	≤ 1 ppm	75 ppm
2400	10	6	80.3	40	154	≤ 1 ppm	75 ppm
2400	10	4	53.5	40	103	≤ 1 ppm	75 ppm
2400	10	2	26.8	41	50	≤ 1 ppm	76 ppm
2400	10	1	13.4	42	25	≤ 1 ppm	77 ppm
2400	10	0.5	6.7	40	13	≤ 1 ppm	75 ppm
2400	16	10	133.8	20	311	≤ 1 ppm	75 ppm
2400	16	8	107.1	20	249	≤ 1 ppm	75 ppm
2400	16	6	80.3	20	187	≤ 1 ppm	75 ppm
2400	16	4	53.5	20	124	≤ 1 ppm	75 ppm
2400	16	2	26.8	20	62	≤ 1 ppm	76 ppm
2400	16	1	13.4	20	31	≤ 1 ppm	77 ppm
2400	16	0.5	6.7	20	16	≤ 1 ppm	75 ppm
2400	16	10	133.8	40	169	≤ 1 ppm	75 ppm
2400	16	8	107.1	40	135	≤ 1 ppm	75 ppm
2400	16	6	80.3	40	101	≤ 1 ppm	75 ppm
2400	16	4	53.5	40	68	≤ 1 ppm	75 ppm
2400	16	2	26.8	40	34	≤ 1 ppm	76 ppm
2400	16	1	13.4	40	17	≤ 1 ppm	77 ppm
2400	16	0.5	6.7	40	8	≤ 1 ppm	75 ppm