UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF
PREVENTION, PESTICIDES,
AND TOXIC SUBSTANCES

July 14, 2006

MEMORANDUM:

Subject: Revised Occupational/Bystander Inhalation Exposure and Risk Assessments of New Uses of Vaporox Hydrogen Peroxide Sterilant

To: Marshall Swindell, Product Manager
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Thru: Norm Cook, Branch Chief
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DP Barcode: 330842

Chemical No.: 000595

Chemical Name: Hydrogen Peroxide

CAS No.: 7722-84-1

EPA Reg. No: 58779-4

Action Requested:

Exposure and risk assessments in support of a proposed new use amendment for Vaporox Hydrogen Peroxide Sterilant have been requested. The exposure assessment has been revised to utilize actual half-life monitoring data submitted by STERIS Corporation.

Summary of Findings:

Based on the proposed new use pattern for STERIS Corporation's Vaporox Sterilant product, the Risk Assessment and Science Support Branch (RASSB) anticipates negligible occupational inhalation exposure potential to hydrogen peroxide for handlers involved in the application of the sterilant product. However, RASSB concludes that the bystander/applicator hydrogen peroxide inhalation exposure (8hr TWA = 0.013 ppm) when reentering a treated area exceeds the Agency's inhalation level of concern (0.007 ppm). This bystander/applicator level of exposure assumes that the aeration phase continues until the hydrogen peroxide gas is reduced to a level of 0.1 ppm (limit of detection of PAC3 instruments) prior to opening the room for general use. RASSB further recommends that the registrant develops a detailed fumigation plan in addition to the technical manual. Increased ventilation of the room could reduce the air concentrations over the 8-hr exposure period.

Background:

The Antimicrobials Division (AD), Regulatory Management Branch II, received an application from STERIS Corporation for a new use amendment for Vaporox Hydrogen Peroxide Sterilant (EPA Reg. No. 58779-4). Currently Vaporox contains 35% hydrogen peroxide and is registered as a microbial sterilant in small enclosures (e.g., glove boxes and isolators) at a maximum size of 40 cubic feet. The proposed new use of Vaprox utilizes the same formulation, however the use sites are non-residential, non-food applications for indoor areas up to 4,000 cubic feet which include clean rooms, medical device sterilization, laboratories, animal research facilities, patient rooms, hotel rooms, offices, cruise ships, recreational facilities, and emergency response vehicles.

Vaporox is to be applied only by STERIS trained and certified applicators using the VHP Generator Unit. STERIS will provide training on all aspects of the application process which includes proper handling of hydrogen peroxide, equipment operation, and preparation of areas to be treated (i.e., sealing, securing and placarding). The VHP Generator unit delivers the hydrogen peroxide as a dry vapor into the room being treated. The room being sterilized is thoroughly sealed and enclosed to ensure that the application occurs via a closed system. The VHP generating unit may be placed within the enclosure/sealed room and remotely controlled or adjacent to the enclosure where the hydrogen peroxide is piped into the sealed enclosure. The concentration of hydrogen peroxide in the sealed enclosure and adjacent areas will be monitored during the application and aeration phase. The sealed enclosure will not be released for general use until the hydrogen peroxide levels are at or below the proposed label

concentration of 1.0 ppm which is the current OSHA PEL.

Human Exposure Considerations:

Based on the toxicological review conducted by AD/RASSB (D324625), the physical chemical properties of hydrogen peroxide, and the application method of Vaporox, the inhalation route is the only potential route of human exposure. Furthermore, based on the application method and equipment technology, AD/RASSB believes that the greatest potential of human exposure via the inhalation route is for applicators or bystanders during reentry period immediately following the application process and aeration phase.

Although OSHA has set a PEL at 1.0 ppm for hydrogen peroxide, the inhalation risk-based level of concern used in this assessment is 0.007 ppm[1] based on the RASSB toxicological review (D324625). For a detailed discussion on this toxicological endpoint, the reader is referred to the following RASSB memo: *"Hydrogen Peroxide –Interim Inhalation Toxicological Endpoints for Risk Assessment for uses as a fumigant in sealed room enclosures and vehicles"* (D324625).

Since the registrant did not submit any hydrogen peroxide monitoring data, RASSB utilized the dilution and ventilation approach to estimate air concentrations in a room following the application and aeration phase of Vaprox. These air concentrations are the levels that bystanders and applicators will be exposed to during the reentry period. The initial air concentration, the air exchanges, and the ½ life of hydrogen peroxide in air were used to estimate the air concentration in the room every hour.

The dilution and ventilation approach was conducted using the initial concentration of hydrogen peroxide at 1.0 ppm based on the OSHA PEL and 0.1 ppm based on the limit of detection of the PAC3 instruments.

The dilution ventilation equation is as follows:

$t = V_r/Q \ln [C_i/C]$

Where: t = time in hours
C = concentration at time t
C_i = initial concentration
V_r = volume of area/room in ft^3
Q = air flow into room, in ft^3/hr

Note: $ACH = V_r/Q$
ACH = number of air exchanges per hour
V_r = volume of area/room in ft^3
Q = air flow into room, in ft^3/hr

[1] 0.007 ppm = (0.01 mg/m^3 x 24.45) ÷ MW, where 0.01 mg/m^3 = 3 mg/m^3 (LOAEL) ÷ 300 (UF) and MW = 34

The above equation does not incorporate the hydrogen peroxide half life in air. To account for the ½ life of hydrogen peroxide ($t^{0.50}$), the assumption of first order decay ($ln2/t^{0.5}$), and the air exchange parameter (ACH) the following equation was used to estimate C:

$$C = C_i \times e^{(-t \times (ACH + (ln2/t^{0.5}))}$$

Based on data submitted by STERIS Corporation, the maximum half-life observed in the study (0.5 hrs) was used in this assessment[2]. For non-residential buildings, the average number of air exchanges per hour is 1.24[3].

Table 1 summarizes the air concentrations for hydrogen peroxide every hour starting at an initial concentration of 1.0 ppm (OSHA PEL) and 0.1 ppm (LOD of PAC3 instruments). The results for both analyses indicate that the 8hr time-weighted averages (TWA) of 0.13 ppm (initial conc. = OSHA PEL) and 0.013 ppm (initial conc. = LOD of PAC3) which bystanders and/or applicators reentering a treated room could be exposed would exceed the Agency's level of concern of 0.007 ppm.

Table 1 Hydrogen Peroxide Air Concentrations with an Initial Concentration of 1.0 ppm (OSHA PEL) and 0.1 ppm (LOD of PAC3)

Time (hours)	Hydrogen Peroxide Air Conc. (ppm) (OSHA PEL)	Hydrogen Peroxide Air Conc. (ppm) (LOD)
0.0	1.0	0.1
1.0	0.072	0.0072
2.0	0.0052	5.2×10^{-4}
3.0	3.8×10^{-4}	3.8×10^{-5}
4.0	2.7×10^{-5}	2.7×10^{-6}
5.0	2.0×10^{-6}	2.0×10^{-7}
6.0	1.4×10^{-7}	1.4×10^{-8}
7.0	1.0×10^{-8}	1.0×10^{-9}
8hr TWA	0.13	0.013

[2] "Half-Life of Vaporized Hydrogen Peroxide (VHP) During Remediation of the U.S. Department of State SA-32 Diplomatic Pouch and Mail Facility," STERIS Corporation - June 22, 2006.
[3] "A Guide to Selected Algorithms, Distributions, and Databases Used In Exposure Models Developed by the Office of Air Quality Planning and Standards" EPA ORD Grant No. CR827033, May 22, 2002.