

## POTENTIAL FOR HARMFUL LEVELS OF HYDROGEN PEROXIDE VAPOUR FOLLOWING DECONTAMINATION DUE TO PROLONGED OUTGASSING FROM PLASTICS

### Introduction

Decontamination / disinfection by Vapour Phase Hydrogen Peroxide (VPHP) is becoming widely used in a variety of applications from healthcare to industry. Whilst the hazards associated with VPHP whilst in use are widely recognised there is less discussion about potentially harmful levels of hydrogen peroxide vapour being released by materials and furnishings following decontamination. This article intends to look at the available literature to determine if further research is needed into this area.

### Background

VPHP Decontamination has its beginnings as an alternative to ethylene oxide (EtO) sterilisation widely used for medical instruments etc. It has since been used for clean rooms, safety cabinets etc. and has recently been taken up as an infection control system within hospitals and care homes. There are also a number of private companies offering a VPHP service to private customers. VPHP Decontamination is typically carried out using one of two methods loosely defined as “wet” or “dry”(1) which relates to the humidity level at time of operation and as to whether condensation is formed during operation. Due to the nature of the process, both methods produce sufficient concentrations of hydrogen peroxide to promote outgassing in certain materials.

There have been a number of cases of healthcare workers suffering ill health following use of VPHP (2) as well as an increased risk of long-term health conditions (3), (4) associated with use of hydrogen peroxide. Whilst VPHP machines are used in unoccupied areas and most use monitoring equipment to ensure vapour levels are below hazardous concentrations before re-entry, there appears to be little consideration of residual levels following use.

Real Sphere Eco World Ltd

68 Argyle Street | Birkenhead | Merseyside | CH41 6AF

t. +44 (0) 151 347 0295 e. [info@rsecoworld.com](mailto:info@rsecoworld.com) w. [www.rsecoworld.com](http://www.rsecoworld.com)



## Discussion

Hydrogen peroxide is aggressive to many materials causing degradation or discolouration. Less widely known is its ability to be absorbed. This occurs during the conditioning and decontamination phases of VPHP treatment. The final (aeration) phase of treatment is meant to allow for the outgassing of absorbed vapour but does not take into account the prolonged release of vapour from some materials.

Outgassing has been observed and studied in clean room materials (5) using a variety of plastics and different absorption/desorption rates have been measured. These findings concur with other studies measuring migration of hydrogen peroxide in sterilised I.V. pouches (6) and outgassing from different articles (7) (8).

Results show that some common plastics (PVC, PMMA(Perspex®), amongst others) have a tendency to slowly release hydrogen peroxide vapour in excess of safe exposure levels (9) over prolonged periods of time measured from days to weeks (7) (8) and that temperature has an effect on the rate of outgassing.

In one study, a plastic stapler was subjected to VPHP and outgassing of hydrogen peroxide was observed for 24 days before levels reduced to 1ppm – the recognised safe exposure level. Some of the manufacturers appear to be aware of the potential for prolonged outgassing (10) but there currently appears to be little appreciation of the potential for health effects by both manufacturer and end user alike.

## Conclusion

VPHP Decontamination will bring about prolonged outgassing from common materials. That the levels of hydrogen peroxide vapour emitted can exceed safe exposure levels for weeks is a matter of concern. There is potential for a localised build up of vapour in confined spaces and thereby an exposure risk to people. Further research should be conducted to determine the likelihood of an overexposure event in general settings following VPHP decontamination.

**Real Sphere Eco World Ltd**

68 Argyle Street | Birkenhead | Merseyside | CH41 6AF

t. +44 (0) 151 347 0295 e. [info@rsecoworld.com](mailto:info@rsecoworld.com) w. [www.rsecoworld.com](http://www.rsecoworld.com)



## References

- (1) Petr Kačer, Jiří Švrček, Kamila Syslová, Jiří Václavík, Dušan Pavlík, Jaroslav Červený and Marek Kuzma(2012). Vapor Phase Hydrogen Peroxide – Method for Decontamination of Surfaces and Working Areas from Organic Pollutants, Organic Pollutants Ten Years After the Stockholm Convention - Environmental and Analytical Update, Dr. Tomasz Puzyn (Ed.), ISBN: 978-953-307-917-2, InTech
- (2) Camilla Turner, 'NHS staff at risk of inhaling toxic fumes from cleaning investigation finds' (27 July 2019 The Telegraph)
- (3) Occupational exposure to disinfectants and asthma control in US nurses  
Orianne Dumas, Aleta S. Wiley, Catherine Quinot, Raphaëlle Varraso, Jan-Paul Zock, Paul K. Henneberger, Frank E. Speizer, Nicole Le Moual, Carlos A. Camargo Jr European Respiratory Journal 2017 50: 1700237; DOI: 10.1183/13993003.00237-2017
- (4) European Lung Foundation. (2017, September 10). Nurses' regular use of disinfectants is associated with developing COPD ScienceDaily. ScienceDaily, 10 September 2017
- (5) Radl, Stefan, Silvia Larisegger, Daniele Suzzi, and Johannes Khinast. "Quantifying Absorption Effects during Hydrogen Peroxide Decontamination." Journal of Pharmaceutical Innovation 6.4 (2011): 202-216.
- (6) MÜLLER, HANS-JÖRG & SOMMERMEYER, KLAUS & CECH, FRANZ. (2003). Permeation of gaseous hydrogen peroxide and peracetic acid into IV bags during their surface sterilization. Hospital Pharm. 10.
- (7) P.A. Baron, C.F. Estill, J.K. Beard, M.J. Hein and L. Larsen. Bacterial endospore inactivation caused by outgassing of vapourous hydrogen peroxide from polymethylmethacrylate (Plexiglas®) The Society for Applied Microbiology, Letters in Applied Microbiology 45(2007) 485–490
- (8) Rika Yoshida, Hiroyoshi Kobayashi. Problems on Hydrogen Peroxide Sterilisation-New Proposal for Safety and Effective Use Annual WFHSS and JSMI Conference 2012 13th World Sterilization Congress
- (9) HSE EH40/2005 Workplace Exposure Limits.
- (10) Bioquell: Hydrogen Peroxide Vapour Material Compatibility: Issues and facts. BDS-3-MATCOMP-V1.0

Real Sphere Eco World Ltd

68 Argyle Street | Birkenhead | Merseyside | CH41 6AF

t. +44 (0) 151 347 0295 e. info@rsecoworld.com w. www.rsecoworld.com