Fogging and Misting Shower Performance in Reducing Operator Exposure to Pharmaceutical Active During Protective Clothing Removal

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Background and Objectives

A trend towards producing highly active pharmaceutical ingredients (API) means that exposures to very small quantities of API can result in adverse effects in workers. Workers in pharmaceutical and fine chemical industries typically wear protective clothing when working with these pharmacologically active powders. On leaving the work area where APIs are handled, there is a potential for exposure during disrobing. It is assumed that this exposure potential can be reduced by the use of a fogging/misting shower (Figure 1). On leaving the work area where highly active materials are handled, it is desirable to reduce the potential for both airborne exposure during disrobing and potential transport of these materials by surface contamination from controlled facility areas out into uncontrolled areas. Whilst fogging and misting showers are recommended for this purpose, there is little data in the public domain to support this recommendation. A study has been designed to assess the performance of a fogging/misting shower for both decontamination of protective clothing and suppression of airborne pharmaceutical powder during removal of two types of protective clothing.

There were two major objectives for the study:

Decontamination Evaluation: To evaluate surface decontamination achieved on surfaces of artificially contaminated protective clothing following use of shower when in fogging/misting mode for: (a) a disposable coverall with sewn in hood, (b) a washable coverall without hood, and (c) a PAPR hood worn in combination with (b).

Airborne Suppression Evaluation: To evaluate airborne concentrations of contaminant during de-gowning of the artificially contaminated garments listed in objective (1) above, following use of shower in both fogging/misting mode, and fogging mode.

Fig 1: Fogging/Misting Shower

Methodology

Two methodologies were developed, both methodologies relied on dosing the protective clothing using a brush, applying a powdered low toxicity API (naproxen sodium), at several defined locations on two types of protective clothing made from Tyvek and polyester respectively.

To assess suppression of airborne dust, measurements of airborne API were made during disrobing (Figure 2), with and without use of the showers. Samples were collected using an IOM sampling head.

To assess decontamination of the two types of protective clothing, surface concentrations at defined locations on the clothing (Figures 3 - 8) were measured with and without use of the showers. The effect of operator position relative to the shower was explored; direct and indirect showering techniques were compared.

Both methodologies were validated prior to the study by the SafeBridge Industrial Hygiene Analytical Laboratory.

Figure 3 Drawing Patch	Figure 4 Chest Patch	Figure 5 Forearm Patch
		
Figure 6 Knee Patch	**Figure 7 Back Patch**	**Figure 8 Armpit Patch**
		

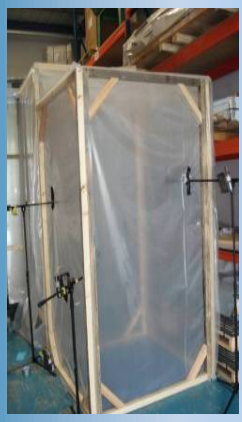

Fig 2: Disrobing Cubicle

Results

The effectiveness of airborne suppression was assessed for fogging/misting and fogging showers. Comparisons of the results for airborne concentrations during disrobing, with and without showering, demonstrated a significant reduction in airborne concentrations when using both types of shower. Results depended on the shower type used and protective clothing type worn.
The average airborne suppression factors found ranged from 440 to 800 times with the highest and lowest suppression values found being 1,135 and 160 times respectively.

The effectiveness of protective clothing decontamination was assessed for a combination fogging/misting shower. Decontamination effectiveness was found to vary depending on both the position of the operator in the shower and, to a lesser extent, on the type of clothing material being worn. The average patch decontamination factors achieved, using the fogging/misting shower and a direct showering technique were 104 times for Tyvek and 309 times for a polyester with overall patch decontamination factors ranging between 17 and 5,667 times.

The average patch decontamination factor achieved, using the fogging/misting shower and an indirect showering technique was an overall average for both fabric types was only five times.

Conclusions

The assessments conducted were limited and decontamination and airborne contaminants suppression levels achieved in this study may not be achieved with other materials, in other working environments and using different techniques. For the API used, the use of a fogging shower alone or a combination fogging/misting shower provided good suppression of airborne API during disrobing and therefore the potential for reduced risk of exposure via the inhalation pathway. With respect to decontamination, there were significant differences between patch decontamination achieved depending on the position of the operator when showering. The direct showering technique appeared to deliver the highest levels of decontamination under the circumstances of shower usage assessed.