Respiratory Protection:

Are your organic vapour cartridge respirators really protecting workers?

Until recently there was no sure way to answer that question. But, as health and safety consultant Sheri Suckling explains, recent research is changing that.

Work involving organic solvent vapours requires appropriate respiratory protection—usually in the form of a respirator mask fitted with an organic vapour cartridge.

Such cartridges are designed to protect workers from exposure to solvents by absorbing vapours onto a carbon filter fitted into a respirator mask.

These cartridges are effective when new. They are tested according to a standard method that measures resistance to a single solvent, using challenges of short duration and high concentration.

But how do you know when the cartridge has become overloaded and useless at preventing exposure to harmful vapours? How effective is the cartridge in handling exposure to multiple organic solvents? Does intermittent solvent exposure change the service you can expect from a filter cartridge? And do these tests accurately represent actual working conditions?

Well, until recently the answers to these questions were a volatile and even dangerous mix of speculation and assumption.

One reason is that most industrial workers are exposed to two or more solvent vapours at the same time. Solvent exposure is not constant or necessarily concentrated. Test methods don’t take this into consideration. There is currently no easy way to determine exactly when ‘breakthrough’ occurs – i.e., the cartridge becomes saturated and is no longer effective in protecting the wearer from solvent exposure.

The Institute of Occupational Medicine and the Health & Safety Laboratory in the UK conducted experiments to examine the performance of organic vapour filter cartridges subjected to a variety of use patterns (Reported by Health & Safety Executive — Research Report 322*). This study aimed to accurately mirror the use of industrial solvents so we know what protection we can expect from our respirators in the real world.
Some results were heartening. Research Report 322 indicated that intermittent or discontinuous use of organic vapour filters does not significantly affect their service life compared to continuous use where a single organic vapour is present.

But some results were frightening too. This study also found that exposure to multiple vapours — either sequentially or simultaneously — leads to more rapid breakthrough and shorter effective cartridge life than when used in a single vapour system.

In fact, when used in a dual (or multiple) vapour system, the breakthrough concentration of the first compound (i.e., saturation of the filter by one of the vapours) could exceed the challenge concentration, indicating the potential for an even higher level of exposure than workplace ambient conditions might suggest.

As a result, use-life conditions and expectations for organic vapour cartridges must be adjusted when workers are exposed to more than one vapour system. Sequential exposure to a number of different vapours is not recommended — or at least employers should take this into account and provide for the reduction of cartridge service life where employees are exposed to multiple organic vapours.

To maximise effective working life, organic vapour cartridges must be sealed against non-working exposure and kept dry. It is not yet clear whether cartridge life is adversely affected by water vapour absorption, but sealed storage between uses will at least prevent non-working exposure to any ambient vapours, thus maximising the useful service life of the cartridge.

The study also included investigation into the behaviour of larger A2 filters, to determine how they would behave in the presence of single or dual solvent systems compared with A1 filters. The study concluded that A2 filters provided greater protection against solvent exposure for either single or dual vapour systems, but it stopped short of predicting useful service life for any of the cartridges where more than one organic vapour was present.

To maximise protection against exposure to organic solvent vapours:

1. Assess workplace solvent conditions determine employee exposure risk parameters and establish respiratory protection requirements. Part of this is identifying which solvents are present and their likely workplace concentrations.
2. Purchase appropriate filters. A2 filters have been shown to provide superior protection against organic solvent vapours compared to A1 filters, due to their larger filter capacity.
3. Design and implement an appropriate system to manage respiratory protection equipment. Include a method to track equipment issue and determine when replacements should be provided. This will ensure a margin of safety against solvent exposure where multiple solvents are used.
4. Ensure respiratory protection equipment is always fitted and worn correctly.
5. Always store respiratory equipment in a sealed container and dry conditions. This prevents (or minimises) non-working absorption of ambient organic vapours or moisture that shorten the effective use-life of the filter cartridge.
6. Where multiple vapours are present in the workplace, replace organic vapour filter cartridges earlier than indicated by manufacturer recommendations to ensure breakthrough has not occurred and that workers are not exposed to unhealthy levels of solvent vapours.

7. Where possible, avoid sequential exposure to multiple solvents—use separate filters for each type of solvent. Where this is not practical, adjust use-life calculations accordingly and replace filters more frequently.

*To read the full research report, refer to
http://www.hse.gov.uk/research/rrhtm/rr322.htm

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