Respirator Selection for Diisocyanates

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Introduction

The Occupational Safety and Health Administration (OSHA) respiratory protection regulation 29 CFR 1910.134 requires employers who use gas or vapor air-purifying respirators to develop cartridge change schedules based on objective information or data. This provision applies whether or not the contaminant has adequate warning properties. OSHA says this very clearly in its compliance directive for 1910.134, which states, “Where an effective change schedule is implemented, air-purifying gas and vapor respirators may be used for hazardous chemicals, including those with few or no warning properties.”

While no chemicals are exempt from the regulation or the compliance directive, some users are still uncertain whether air-purifying respirators can be used for the common diisocyanates such as toluene-2,4-diisocyanate (TDI), hexamethylene-1,6-diisocyanate (HDI) and methylene bisphenyl isocyanate (MDI). OSHA has clarified its position on this issue in a letter dated July 18, 2000 that indicates air-purifying respirators may be used if all requirements of 1910.134 are met and other potential hazards are addressed. The letter is available at http://www.osha.gov.
Discussion
Prior to the revised OSHA Respiratory Protection Standard effective April 8, 1998 supplied-air respirators were used to help reduce exposures to the common diisocyanates. This was appropriate, since OSHA’s original respiratory protection regulation used a decision logic that only allowed air-purifying respirators to be used for gases or vapors with adequate warning properties. A contaminant is said to have adequate warning properties if it has persistent odor or irritation effects at concentrations at or below the exposure limit. Reported odor thresholds for the diisocyanates range from two to more than ten times their exposure limits. Therefore, the diisocyanates have poor warning properties and supplied-air respirators were required. Now air-purifying respirators may be used for compounds with poor warning properties if a cartridge change schedule is set up. If the respiratory protection regulation requires cartridge change schedules to be used instead of reliance on warning properties, why have some been concerned about the suitability of air-purifying respirators for the diisocyanates? It seems that their concerns are based on one or more of four misconceptions:

Misconception #1

Air-purifying respirators should not be used because diisocyanates have poor warning properties.

Although OSHA specifically permits change schedules in lieu of sensory warning properties, some argue this is not a safe practice. They believe diisocyanates could enter a facepiece through a spent cartridge or defect (e.g., a torn exhalation valve) and the user would be unaware, risking prolonged exposure. In reality, this potential exists for any gas or vapor with poor warning properties and for all particulate contaminants. In addition, the fact that a contaminant has adequate warning properties does not ensure that all respirator users will be able to detect it at or below the exposure limit. Because odor thresholds are median values for a population, more than half of individuals will not detect the odor until the level is above the reported odor threshold. A sound respiratory protection program minimizes the risk of undetected exposure by assuring that respirators are properly fitted, maintained and worn, and that cartridges are changed at appropriate intervals.
Misconception #2

*Air-purifying respirators cannot remove diisocyanates.*

In fact, it has been known for many years that diisocyanates are adsorbed by activated carbon and retained extremely well.\(^6,7\) Cartridge breakthrough equations predict very long service lives for the diisocyanates under plausible use conditions. If a diisocyanate is the only air contaminant present, a cartridge change schedule will most likely be based on general hygiene and maintenance considerations rather than breakthrough concerns. If other organic vapors are present in the same atmosphere as a diisocyanate, those vapors invariably break through first. Cartridge change schedules will be established using predicted breakthrough of the other contaminant(s).

It must be recognized that diisocyanates may form condensation aerosols when they are airborne. For this reason, it is generally necessary to use a particulate filter in combination with an organic vapor cartridge.

Misconception #3

*Air-purifying respirators are not approved for gases and vapors with poor warning properties.*

The National Institute for Occupational Safety and Health (NIOSH) supports OSHA’s requirement for change schedules and recommends against reliance on warning properties.\(^8\) In addition, NIOSH directed respirator manufacturers to change the cautionary language previously used on cartridge and canister approval labels and user instructions to be consistent with 1910.134. Specifically, the statement “Do not wear for protection against organic vapors with poor warning properties or those which generate high heats of reaction with sorbent” was changed to “Follow established cartridge and canister change schedules or observe ESLI to ensure that cartridges and canisters are replaced before breakthrough occurs.”\(^9\) This cautionary language must appear on labels for all gas and vapor respirators sold after July 1, 2001.
Misconception #4

Air-purifying respirators should not be used because diisocyanates are sensitizers or are “too hazardous.”

There is no doubt the effects of diisocyanate overexposure can be serious, particularly in individuals who become sensitized. However, this reasoning is contrary to accepted respirator decision logic. By definition, no respirator is required when exposure to an air contaminant is below the exposure limit. The purpose of a respirator is to reduce an exposure that is above an exposure limit to an exposure that is below that limit. The diisocyanates have exposure limits. Any respirator that reduces a diisocyanate overexposure to a concentration below its exposure limit is acceptable. NIOSH changed its long-standing policy of recommending only the “most protective respirators” (e.g., SCBA) for use with carcinogens to reflect this logic. NIOSH now acknowledges that the entire range of respirators can be considered for protection against carcinogens with exposure limits. The same respirator decision logic is applicable to all air contaminants, including the diisocyanates.

Summary

When properly selected and used, air-purifying respirators can be used safely and effectively to reduce exposures to the common diisocyanates. Appropriate cartridge change schedules can be developed to ensure cartridges are changed before breakthrough occurs. OSHA is correct in allowing employers to choose air-purifying respirators for diisocyanates if they are appropriate for their workplaces. As is the case with any other air contaminant, a complete respiratory protection program per 29 CFR 1910.134 is necessary to ensure that respirators are selected properly and provide appropriate protection.

References


