Hydrogen Peroxide/PAA
Respirator Cartridge Service Life
Technical Data Sheet

HYDROGEN PEROXIDE/PERACETIC ACID (PAA)
RESPIRATOR CARTRIDGE SERVICE LIFE

PURPOSE

Workers must wear respiratory protection when exposed to excessive concentrations of peracetic acid (PAA) and hydrogen peroxide (H_2O_2) vapors. While air-supplied respirators such as an airline or self-contained breathing apparatus are known to provide adequate protection in such circumstances, they can be cumbersome to wear and expensive to maintain.

Solvay Chemicals, Inc. and other companies under the auspices of CEFIC (European Chemical Industry Council) contracted a testing laboratory to evaluate the effectiveness of selected chemical cartridge respirators. This Technical Data Sheet contains the results of their testing and conclusions.

SUMMARY

A study was commissioned to evaluate the efficiency of standard organic vapor and acid gas respirator cartridges to remove hydrogen peroxide, acetic acid, and peracetic acid from a challenge air stream. The purpose of the study was to determine if the cartridges quantitatively remove these air contaminants from air under conditions simulating possible use in an occupational setting, so that employers can select air-purifying respirators under appropriate circumstances.

The results showed that these contaminants were quantitatively removed from the test air stream for at least 8 hours, at very high test concentrations of all three substances by all tested cartridges.

The test concentrations exceeded typical workplace exposure conditions that would be allowed under generally accepted good industrial hygiene practices. This information is intended to show that the cartridges are effective at removing the substances of interest as part of an employer's selection of the appropriate respirator. The efficiency of the cartridges under actual work conditions will vary depending on such factors as the presence of other contaminants, environmental conditions, and frequency, severity and duration of exposure.

STUDY DETAILS

Hydrogen peroxide (H_2O_2, HOOH, HP), Acetic Acid (AA), and peracetic acid (PAA, peroxyacetic acid) are hazardous when inhaled in high concentrations. The American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA) and National Institute of Occupational Safety and Health (NIOSH), as well as other bodies, have set limits to control occupational exposure to H_2O_2, AA, and PAA (See table).

At the present time, the limits are set as follows:

	Hydrogen Peroxide	Acetic Acid	Peracetic Acid
ACGIH® TLV® (2005)	1 ppm TWA 1.4 mg/m^3 TWA	10 ppm TWA 25 mg/m^3 TWS 15 ppm STEL/CEIL© 37 ppm/m^3 STEL/CEIL©	
OSHA PEL (29 CFR Table Z-1)	1ppm TWA 1.4 mg/m^3 TWA	10 ppm TWA 25 mg/m^3 TWA	
NIOSH REL	1 ppm TWA 1.4 mg/m^3 TWA	10 ppm TWA 25 mg/m^3 TWA 15 ppm STEL/CEIL © 37 mg/m^3 STEL/CEIL ©	
SAEL (1997)			0.15 ppm TWA 0.46 mg/m^3 TWA

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TWA – Time-weighted average TLV - Threshold limit value
REL - Recommended Exposure Limit PEL - Personal exposure Limit
SAEL - Solvay Acceptable Exposure Limit, Time-Weighted Average for 8-hour workdays.
No specific TLV-STEL (Short-Term Exposure Level) has been set for peracetic acid. ACGIH recommends that excursions in exposure level may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a workday and under no circumstances should they exceed 5 times the TLV-TWA, provided the TLV-TWA is not exceeded.

RESPIRATOR CARTRIDGE SERVICE LIFE FOR PAA AND H_2O_2

Without objective data to prove the effectiveness of air-purifying respirators, workers should wear an atmosphere supplying respirator (e.g. either a self-contained breathing apparatus (SCBA) or an airline respirator) when working in an environment where PAA, AA, or H_2O_2 vapor concentrations may exceed applicable exposure limits or when expected concentrations are unknown. For purposes of convenience and cost, an air-purifying cartridge respirator may be considered preferable but data must first be developed to show the efficiency of the cartridge in removing the offending chemicals from the incoming air stream containing either H_2O_2, PAA or AA vapors, singly or in combination.

The following respirator cartridges were tested to determine efficacy and service life when in an environment with PAA, AA or H_2O_2 vapor concentrations exceeding the recommended limits.

US Cartridges
- 3M organic vapor/acid gas (OV/AG),
- 3M organic vapor (OV)
- Mine Safety Appliance (MSA) multipurpose type (GME) (NIOSH approved for 10 gases and vapors).

European Cartridges
- Draeger multipurpose type (A2B2E2K1P2)
- 3M multipurpose type (ABEK2P3)

The laboratory conducting the study is considered to be one of the most authoritative and experienced laboratories in this field.
The cartridges were tested in the “as received condition” and received no special preconditioning.
Tests were conducted at 32 liters per minute. Humidity was 40 and 80 percent relative humidity and temperature was 25ºC.
Tests were run for at least 8 hours or until a breakthrough of 1 ppm (H_2O_2) or 0.15 ppm
Acetic Acid (AA) was observed. PAA concentration was expected to be considerably lower than the AA due to volatility differences. Duplicate samples were run at each experimental condition.
The peracetic acid challenge solution was an equilibrium mixture of peracetic acid (12%), acetic acid (20%) and hydrogen peroxide (18.5%)
The challenge conditions were 150 ppm peracetic acid, 300 ppm acetic acid and 600 ppm hydrogen peroxide.

TESTING AND DETECTION

A testing system was assembled and generated the conditions described above. The test mixture was passed through the selected cartridges. Organic vapor concentration was measured with a Beckman Model 400 Hydrocarbon Analyzer [a continuous flame ionization detector (FID)]. The analyzer was calibrated to detect a concentration of 0.1 ppm organic vapor (PAA/AA).

The breakthrough species was determined by infrared spectrometer scan to be acetic acid.

Hydrogen peroxide was analyzed by IR at 7.8 microns with a detection limit of 0.5 ppm. The presence of carbon monoxide was determined using an Interscan Electrochemical Analyzer.

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Calibration was conducted on each system component prior to testing. The air flow was checked against a dry gas meter that in turn had been compared to a five-cubic-foot spirometer. The humidity was checked using the saturated salt technique. The temperature probe was compared to a U.S. Bureau of Standards certified mercury in glass thermometer. The IR and FID analyzers were calibrated using the syringe-injected dynamically-produced concentrations.

RESULTS AND RECOMMENDATIONS

All the cartridges were effective in removing both the individual chemicals and the PAA mixture from the air stream quantitatively. Because these challenge concentrations were many times greater than what would be likely encountered in the workplace, the data show that these cartridges can be used as part of a complete respiratory protection program to provide protection as components of air-purifying respirators. As important as cartridge efficiency, the evaluation of suitability for use should include the potential for leakage arising from the face-to-face piece seal in a negative-pressure respirator.

At a challenge concentration of 100 ppm, hydrogen peroxide was removed quantitatively for at least 8 hours in all tests. Thus, the anticipated service life of the typical organic vapor cartridges against hydrogen peroxide is greater than 8 hours in most situations.

Likewise, the peracetic acid mixture was completely removed from the air stream for more than 8 hours at a total challenge concentration of 150 ppm peracetic acid. A slight increase in temperature was observed during the test. This was more noticeable at the higher humidity and was partially due to water vapor absorption. Thus, the anticipated service life of the typical organic vapor cartridges against the peracetic acid mixture is greater than 8 hours in most situations.

No carbon monoxide was detected in any of the tests.

These tests were performed under laboratory conditions and not under actual use conditions.

Solvay Chemicals, Inc. and the testing laboratory make no warranties concerning protection afforded by these devices and assume no liability for use of any equipment with the chemicals tested based on the results of these tests. The user must determine the applicability of the data in this report when assessing suitability of any device selected under actual anticipated exposure conditions.

CONCLUSION

Five types of commonly used air purifying organic vapor and acid gas respiratory cartridges were tested. All were found to remove the air contaminants of interest for at least eight hours or more when challenged with very high concentrations of hydrogen peroxide and/or peracetic acid (100 and 150 ppm respectively) as well as acetic acid in atmospheres with relative humidity as high as 80%.

The user must determine the applicability of the data in this report when assessing suitability of any device selected under actual anticipated exposure conditions.

Before using, read Safety Data Sheet (SDS) for this chemical.

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