

INDUSTRIAL HYGIENE REPORT

THE DOW CHEMICAL COMPANY

LABORATORY REPORT CODE

HEH2.12-3-5(27)

DATE ISSUED

July 31, 1986

DEPARTMENT

H&ES Analytical & Environmental Chemistry Lab

ACCOUNT NO.

PROBLEM NUMBER

178-1524021

TITLE

EFFECTIVENESS OF SEVERAL RESPIRATOR CARTRIDGES IN REMOVING
MONOETHANOLAMINE AND DIETHYLENETRIAMINE FROM BREATHING
ATMOSPHERES

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DESCRIPTIVE SUMMARY WITH CONCLUSIONS

American Optical R51A (organic vapor), AO-R54A (ammonia), 3M-8712 (organic vapor), 3M-8727 (ammonia), and Scott 282-0AAM-L (organic vapor, acid gas, ammonia combination) respirator cartridges were challenged with 70-108 ppm monoethanolamine (MEA) vapor at 20% relative humidity and 46-70 ppm MEA vapor at 61% relative humidity. MEA vapor concentration levels in the challenge and exhaust air streams were monitored using a Foxboro Corp. MIRAN IB portable infrared ambient air analyzer. No breakthrough of any of the test cartridges at either relative humidity was observed during the 40 hour duration of the test (detection limit = 3 ppm MEA).

American Optical R51A and R54A respirator cartridges were challenged with 12-26 ppm diethylenetriamine (DETA) vapor at 47% relative humidity. DETA vapor concentration levels in the challenge and exhaust air streams was monitored using solid sorbent trapping and a fluorescence measurement technique. No breakthrough of either of the test cartridges at 47% relative humidity was observed during the 42 hour duration of the test (detection limit = 0.8 ppm DETA).

All cartridges tested would be expected to provide adequate respiratory protection under actual conditions of field use.

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INTRODUCTION

Alkanolamines and alkylpolyamines are handled widely by Dow customers. This study is part of Dow's ongoing product stewardship program to insure that these substances are handled safely and with minimum risk to health.

Alkanolamines are used in emulsifiers, acid gas scrubbers, and adhesives. Alkyl polyamines find use as epoxy resin hardeners and chelating agents. Low ACGIH TLV values for these amines necessitate the use of respirators in dealing with them in cases of inadequate ventilation or spills. The purpose of this study is to evaluate the effectiveness of several respirator cartridges for use with these amines. Monoethanolamine (MEA) and diethylenetriamine (DETA) were chosen as test compounds representative of each class of amine.

Physical Properties

Monoethanolamine	$\text{HO}-\text{CH}_2-\text{CH}_2-\text{NH}_2$
Molecular weight	61.08
Boiling point	171°C
Vapor pressure	0.4 mm Hg @ 20°C
Saturated air concentration	526 ppm @ 20°C
Density ^{2,5}	1.0117
Odor	Slightly ammoniacal @ 3-4 ppm
Physical State	Viscous, colorless liquid
Diethylenetriamine	$\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{NH}-\text{CH}_2-\text{CH}_2-\text{NH}_2$
Molecular weight	103.17
Boiling point	207.1°C
Vapor pressure	0.2mm Hg @ 20°C
Saturated air concentration	263 ppm @ 20°C
Density ^{2,5}	0.955
Odor	Amine
Physical state	Viscous, colorless to yellow liquid

Potential Health Effects

The most significant potential health effects of both test compounds are similar (1):

Eye - may cause severe irritations with corneal injury.
Skin - a short single exposure may cause skin burns.
ACGIH TWA-TLV - 3 ppm (MEA); 1 ppm-skin (DETA)

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Test Substance

The test compounds were obtained from the following sources:

MEA -- Gretchen LeBlanc, Plaquemine -- 99.81% pure
Lots 851018, P860107-55

DETA -- Rick Black, Freeport -- 99.36% pure
Lots TA860120-B, TA850802-BNA

Test Cartridges

The following cartridges were chosen to represent the variety of types which might commonly be used by Dow customers:

<u>Type</u>	<u>Style</u>	<u>Manufacturer</u>	<u>Model</u>
Organic vapor	one piece disposable	3M	8712
Organic vapor	dual cartridge	American Optical	R51A
Ammonia	one piece disposable	3M	8727
Ammonia	dual cartridge	American Optical	R54A

In addition, a chin-style organic vapor, acid gas, ammonia combination canister used for escape purposes in the Plaquemine Alkanolamines Plant (Scott 282-OAAM-L) was evaluated.

Test Procedure

The testing matrix is shown in Table I. The organic vapor, ammonia, and combination cartridges were challenged for 40 hours at 64 liters/minute and the concentration ranges and relative humidities indicated. In the case of MEA, duplicate tests were conducted. For DETA, a single test was run because of the time-consuming nature of the concentration monitoring procedure.

Test Atmosphere Generation

Test atmospheres of the two compounds at the concentration ranges indicated in Table I were generated by bubbling dry air (10% R.H.) from a Miller-Nelson Model 201 flow-temperature-humidity system through a water-jacketed fritted glass bubbler containing the compound and combining the resulting partially saturated air with appropriate amounts of air from a second Miller-Nelson Model 201 system which by-passed the bubbler. The air from the second Model 201 was adjusted to the humidity necessary to give the desired humidity in the final test atmosphere. The schematic design of this apparatus is shown in Figure 1.

The respirator cartridges were challenged with test concentrations of MEA and DETA at an air flow rate of 64 liters per minute at relative humidities of 20% (MEA), 47% (DETA), and 61% (MEA). The respirator test apparatus shown in Figure 1 was constructed using glass tubing and 1/2 inch O.D. Teflon tubing.

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The respirator test chamber was made of glass. The challenge atmosphere was sampled at the test atmosphere sampling port while the exhaust air stream was tested via Teflon tubing connected to the top of the respirator test chamber.

Analytical

The protocol specified that a capillary gas chromatograph equipped with flame ionization or nitrogen-phosphorous detector and an automated sampling valve would be used to analyze the challenge and exhaust air streams for MEA and DETA. Investigation of this technique showed it to be not sensitive enough for DETA and not stable enough for monitoring a 40 hour run with MEA.

Concentrations of both the challenge and exhaust air streams of MEA were monitored using the Foxboro Miran IB IR Analyzer (microprocessor controlled) set at the wavelength specified by the manufacturer for MEA (12.93 μm). The detection limit for MEA was determined to be 3 ppm.

Concentrations of both the challenge and exhaust air streams of DETA were determined by sampling them at 172 ml/minute (DuPont P125A Portable Air Sampling Pump) onto 1500 mg silica gel sorption tubes (SKC Corp.), desorbing the DETA in 0.2 N aqueous HCl solution and measuring the fluorescence of the fluoroescamine--DETA reaction product at pH 9.1 according to the procedure described by the fluorogenic reagent manufacturer (Roche). The detection limit for DETA was determined to be 0.8 ppm.

RESULTS AND DISCUSSION

There was no breakthrough detected during the 40 hour test for any of the respirator cartridges tested for either MEA or DETA.

Because the test concentrations used in this study probably represent maximum possible concentrations in actual use situations, any of the respirator cartridges tested would be expected to provide adequate protection.

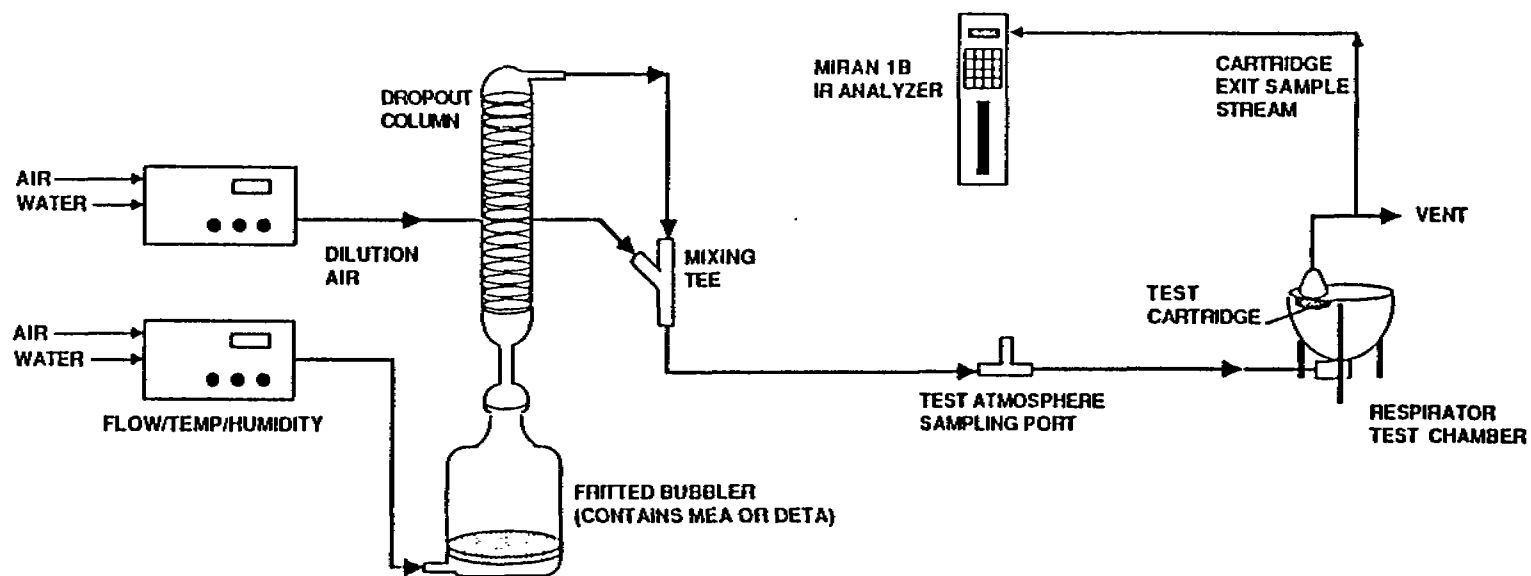
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Table 1. EXPERIMENTAL TESTING MATRIX: RESPIRATOR CARTRIDGES
CHALLENGED WITH MONOETHANOLAMINE (MEA) AND
DIETHYLENETRIAMINE (DETA)

Respirator Cartridge	Concentration in ppm (v/v) -- Number of Tests		
	20% RH	47% RH	61% RH
AO-R51A	65-108(MEA)-3	12-26(DETA)-1	46-53(MEA)-2
AO-R54A	80-93(MEA)-2	12-26(DETA)-1	50-56(MEA)-2
3M-8712	64-84(MEA)-2		55-70(MEA)-2
3M-8727	74-83(MEA)-2		53-63(MEA)-2
Scott-282-0AAM-L			47-55(MEA)-2

FIGURE 1. RESPIRATOR TEST APPARATUS



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