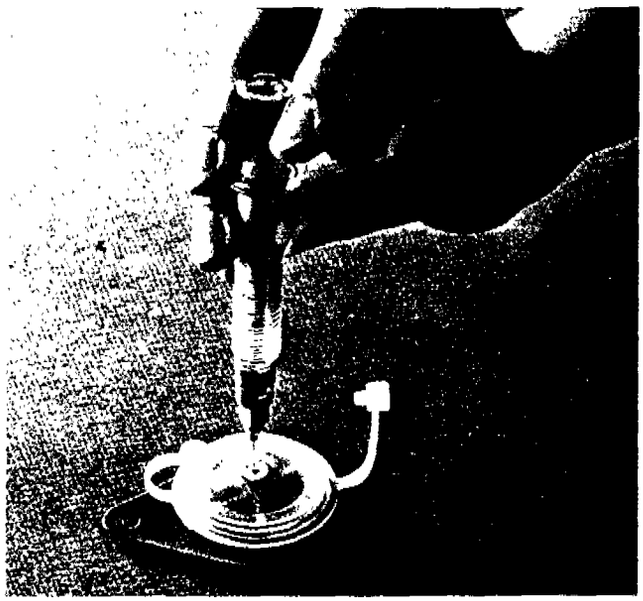
Worn near breathing zone, organic vapor monitor is first such unit that does not require analyst to handle active medium in multiple-step operation. Carbon layer is never touched during analysis.



Patented elutriation cap hermetically seals monitor. Note ports for introducing and removing solvent that desorbs contaminants.

NEW DESIGN IDEAS

Organic vapor concentrations recorded by badge

Monitoring device acts as sample container

Brian J Hogan, Midwest Editor

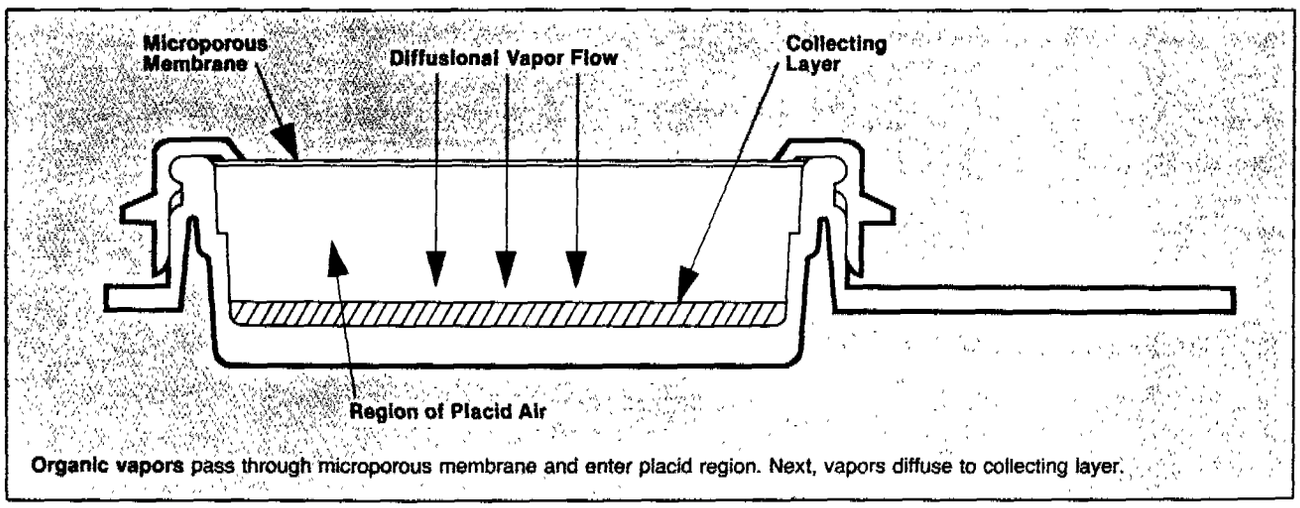
St. Paul, MN—Airborne concentrations of organic vapors are recorded by adsorbing their molecules upon a layer of carbon. That active medium rests within a housing made from a proprietary, impermeable, solvent-resistant polymer.

A microporous front shield on the housing admits air and organic molecules to the monitor, and creates a layer of placid air and organic molecules between the shield and the active medium. Molecules diffuse from the shield to the 0.015-inch-thick carbon layer. The carbon adsorbs the organics, creating a zone (near the carbon) that's starved of organic molecules. Thus, as more organics enter, they flow down a concentration gradient from the shield to the carbon layer.

Molecules inside the sampler travel at approximately one mile/second, but each experiences about 100 billion collisions/second. Thus, a molecule's trip from the front of the monitor to the carbon layer takes about 2 seconds.

Mechanical engineers John A. Trine and David L. Braun of 3M's Occupational Health and Safety Products Div. worked together to design that firm's new Model 3500 Organic Vapor Monitor. This diffusion-type device measures the Time-Weighted-Average (TWA) exposure of personnel to organic vapors.

Carbon tubes and battery-operated pumps have been used previously to monitor organic vapors. But the 3M unit is small (2.5 inches OD) and can be clipped to a collar near one's breathing zone. Also, when your shift ends, you don't need to remove the carbon for analysis



Organic vapors pass through microporous membrane and enter placid region. Next, vapors diffuse to collecting layer.

3M 100535

of adsorbed organics. Instead, you snap over the monitor something called an elutriation cap. This cap hermetically seals the sample. You write the total exposure time on the unit's shell.

To measure your exposure to, for example, benzene, analysts at 3M (or your company lab) inject a premeasured amount of solvent (eluent)—usually carbon disulfide—into the monitor through one of two ports on the cap. After a half hour, eluent is decanted through a second port into a vial, and it's analyzed by using a gas chromatograph.

The active medium will adsorb organic molecules until it loads up completely and few or no adsorption sites are available. The capacity of the sampler varies for different organic compounds, and is specified as the "upper exposure limit" of each compound. That number is related to the weight of contaminant collected when significant deviation from linear adsorption is seen. It's generally 15 mg for strongly adsorbing materials.

Some compounds do not adsorb well to carbon or won't desorb. Obviously, the monitor can't be used to measure exposure to such substances.

Diffusion-type samplers require a slight air movement across or impinging upon the front shield. In stagnant air, the supply of contaminant is adsorbed from the placid zone beneath the shield, and not renewed. Thus, the concentration of organic recorded is slightly low. On the other hand, the device will function effectively in all normally ventilated indoor environments and also outdoors in moderate winds.

Results of Gasoline Exposure Test

Components of Gasoline	Test Concentration (PPM)	3M No. 3500 Concentration (PPM ± 2σ)	Charcoal Tube Concentration (PPM ± 2σ)
Pentane	5.602	5.832 ± 0.408	5.053 ± 0.500
Heptane	0.573	0.570 ± 0.045	0.578 ± 0.082
Octane	0.294	0.307 ± 0.047	0.329 ± 0.056
Benzene	0.928	0.892 ± 0.160	0.873 ± 0.180
Toluene	1.768	1.710 ± 0.119	1.552 ± 0.220
Xylenes	1.153	1.230 ± 0.086	1.034 ± 0.160

Diffusion-type monitor samples complex hydrocarbon mixtures; it traced concentrations of components of gasoline in test. Each vapor is sampled as if it were present individually.

Typical Monitorable Compounds	Typical Unsuitable Compounds
Acetone	Carbon Monoxide
Acrylonitrile	Hydrogen Sulfide
Benzene	Ethylene Oxide
Carbon Tetrachloride	Methyl Alcohol
Chloroform	Methyl Chloride
Heptane	Sulfur Dioxide
Methyl Ethyl Ketone	Formaldahyde
Styrene	Isocyanates
Toluene	
Trichlorethane	
Vinyl Chloride	
m-xylene	

Typical monitorable and typical unsuitable compounds.

Reprinted from **DESIGN NEWS** March 24, 1980

3M 100536

R-DNAR(90.25)R1

Litho in U.S.A.