Product Safety Assessment
Vinyl Acetate

Select a Topic:

Names

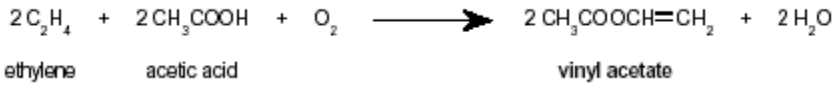
- CAS No. 108-05-04
- Vinyl acetate
- Vinyl acetate monomer
- 1-Acetoxyethylene
- Vinyl ester acetic acid
- VAM
- Ethenyl acetate
- Ethenyl ester

Product Overview

- Vinyl acetate monomer (VAM) is an essential chemical building block used in a wide variety of industrial and consumer products. VAM is a key ingredient in emulsion polymers, resins, and intermediates used in paints, adhesives, coatings, textiles, wire and cable polyethylene compounds, laminated safety glass, packaging, automotive plastic fuel tanks, and acrylic fibers.[1] See Product Uses.
- VAM is flammable and reactive, but can be stored, transported and handled safely if the compound's properties are understood.[2] VAM is not considered to be highly toxic[3], but exposure can irritate the respiratory tract, eyes and skin. Skin contact may cause sensitization and an allergic skin reaction in a small proportion of individuals.[4] Animal studies found that long-term exposure to VAM can cause a carcinogenic response. The tumors observed in laboratory animals at very high exposure concentrations for their lifetimes are not considered to be of relevance to humans who are exposed to low concentrations under typical use conditions.[5] See Physical Hazard Information and Health Information.
- Occupational and consumer exposure is dependent upon the conditions under which VAM is used. See Exposure Potential.
- VAM is considered to be slightly to moderately toxic to aquatic organisms[6] and highly toxic to fish.[7] VAM will partition to air where it is rapidly degraded. Bioaccumulation is unlikely.[8] See Environmental Information.

Manufacture of Product[9]

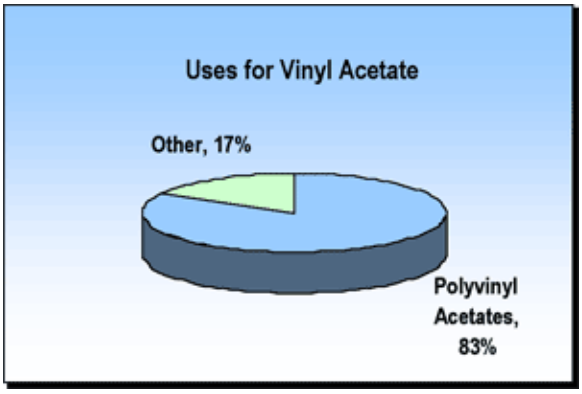
- **Capacity –** The Dow Chemical Company has VAM manufacturing facilities in the U.S., Brazil and the Republic of Korea, and produces 9% of the world's capacity of VAM. Global consumption of VAM in 2003 was 9.4 billion pounds (4.3 million metric tons).
- **Process –** VAM is produced by reacting ethylene with acetic acid and oxygen in the vapor phase using a catalyst. A simplified reaction equation appears below.



Because of VAM's high reactivity, the inhibitor hydroquinone is added at very low levels (3-17 ppm). This inhibitor minimizes VAM reaction (polymerization) under ambient conditions (<86ºF or 30ºC), allowing longer storage times.[10]

Product Description

VAM is a colorless liquid that is immiscible with but slightly soluble in water, and is considered a flammable liquid. It has a sweet, fruity smell in small quantities, but the odor may become sharp and irritating at higher levels.[11]



Product Uses

About 83% of the VAM manufactured is used to produce polyvinyl acetate emulsions and resins.[12] Polyvinyl acetates can be homopolymers (polymerized alone) or copolymers (polymerized with other monomers such as acrylate esters) to produce polymers for a wide variety of industrial and consumer products, including:[13]

- Emulsion polymers – for paints, coatings, adhesives and textiles. Adhesives made with VAM have excellent adhesion to a host of substrates, including metal, porcelain, wood and paper, and are more color stable than other adhesives and odor-free. It is also widely used in water-based coatings and latex paints.
- Polyvinyl alcohol (PVOH) – for use in textiles, adhesives, paper sizing and fibers.
- Ethylene vinyl acetate (EVA) polyethylene resins – for film, hot-melt adhesives and wire and cable applications.
- Polyvinyl butyral (PVB) – for use as inter-layers in safety glass for automotive and architectural applications.
- Ethylene vinyl alcohol (EVOH) – to produce barrier films used in co-extruded food packaging and automotive plastic fuel tanks. EVOH has excellent gas, odor, flavor and aroma barrier properties.
- Acrylic fibers / textile applications – for fabric treatments, pigments and adhesives. For example, to control shrinkage in polyester compounds and solution vinyl resins.

Exposure Potential

VAM is used in the production of many consumer products, but is not sold directly for consumer use. Based on the uses for VAM, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a VAM manufacturing facility or in the various industrial facilities that use VAM. VAM should be handled in a well-ventilated area or in completely closed systems. Each manufacturing and industrial facility should have appropriate work process and safety equipment policies in place to limit VAM exposure. Good industrial hygiene practices minimize the risk of exposure.
- **Consumer exposure to products containing VAM** – Although The Dow Chemical Company does not sell VAM for consumer use, there may be very small residual levels in products manufactured using VAM, such as molded plastics items, adhesives, paints, food packaging containers, hair spray, etc. VAM is approved by the Food and Drug Administration for several food-contact uses, and is not considered to be highly toxic, especially at such low exposures. See Health Information.
- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil, surface or ground water. If VAM does reach soil and water nearby, it can pose a flammability and health concern. All ignition sources should be removed from the area, proper grounding and bonding techniques used, and proper protective equipment worn. See Environmental, Health and Physical Hazard Information.
- **Large release** – Industrial spills or releases are infrequent and are generally contained. If a large spill does occur, the material should be captured, collected and re-processed, or disposed of according to federal, state/provincial or local regulations. Emergency personnel should wear proper protective equipment and follow emergency procedures carefully. All ignition sources should be removed from the area, proper grounding and bonding techniques used and flammability concerns communicated to the community, when appropriate. See Environmental, Health and Physical Hazard information.

Health Information

As with all chemical substances, the health effects associated with exposure to VAM depend on the exposure level and duration. VAM is not considered to be highly toxic.[14]

VAM can penetrate the skin, but does not do so readily.[15] Prolonged skin contact may cause sensitization and an allergic skin reaction in a small proportion of individuals.[16]

If VAM contacts the eyes, it may cause severe irritation, including corneal burns, redness and swelling. VAM vapors have been reported to be irritating to the eyes at 21 ppm, but not at 10 ppm. The odor detection threshold is reported to be about 0.5 ppm. Acute high-level exposure in animals has been shown to result in pulmonary edema.[17]

In 1995, the International Agency for Research on Cancer (IARC) designated VAM as a Group 2B carcinogen, meaning "possibly carcinogenic to humans." There was "inadequate evidence" in humans for establishing the carcinogenicity of VAM and "limited evidence" in experimental animals. However, because VAM is metabolized to acetaldehyde, a substance previously classified as Group 2B, IARC classified VAM as Group 2B. As a result, Safety Data Sheets for products containing 1,000 ppm (0.1%) or more VAM include a statement regarding the IARC classifications as required by law. However, the tumors that were observed in laboratory animals at very high exposure concentrations for their lifetimes are not considered to be of relevance to humans exposed to low concentrations under typical use conditions.[18]

For more information on the health hazards of VAM and recommended protective equipment, view the Safety Data Sheet.

Environmental Information[19, 20]

VAM is considered to be slightly to moderately toxic to aquatic organisms. It is, however, considered to be highly toxic to fish.

When accidentally released into the environment, VAM will partition to air where it is rapidly degraded by photochemical pathways involving hydroxyl radicals or ozone. Releases of VAM into the soil or water tend to volatilize to the air. VAM that remains in the soil or water readily biodegrades by either anaerobic or aerobic mechanisms. Bioaccumulation, the increase in chemical concentration in an organism over time, is unlikely.

VAM has low solubility in water, so a large spill could float on the surface and cause a fire/explosion hazard if it drained into a sewer. For more information on flammability, see Physical Hazards.

Physical Hazard Information[21, 22]

VAM has a flash point below 37ºC (100ºF) and as such is considered a flammable liquid. When mixed with air at room temperature, VAM can form a flammable mixture. VAM labels typically contain a warning about its flammability and every precaution should be taken to prevent exposure to ignition sources. Proper grounding and bonding procedures should be followed.

Vapors from this product are heavier than air and may settle in low or confined areas or travel a long distance to an ignition source and flash back explosively. The vapors may travel or be moved by air currents and ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharges or other ignition sources at locations distant from the product handling point. [23]

VAM can react with itself and polymerize, so it is always shipped containing a polymerization inhibitor such as hydroquinone. Properly inhibited, VAM is stable under recommended storage conditions. Prolonged or intense exposure to heat, sunlight, ultraviolet (UV) light or X-rays may result in spontaneous polymerization. Pressure generated during such polymerizations may rupture insufficiently vented containers.

To prevent uncontrolled polymerization and protect shelf life, VAM should be stored out of direct sunlight. Storage temperatures should be kept below 30ºC (86ºF). VAM should be kept out of contact with peroxides, hydroperoxides, hydrogen peroxide, azo compounds and other polymerization initiators, as well as amines, strong acids, alkalis or oxidizing agents. VAM should be stored and handled in rust-free carbon steel or mild steel equipment. Stainless steel, aluminum and high-baked phenolic-lined steel are also suitable. Copper, copper alloys (such as brass or admiralty metal), zinc and galvanized steel should be avoided.

Additional physical property information for VAM is available on the Technical Data Sheet (92KB PDF).

Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use and/or disposal of Vinyl Acetate Monomer. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant Safety Data Sheet or Contact Us.

Additional Information

- Safety Data Sheet
- Technical Data Sheet (92KB PDF)
- Vinyl Acetate Council (VAC)
- European Chemical Industry Council (CEFIC)
- Acetyls Sector Group

For more business information about VAM, visit Dow's Vinyl Acetate Monomer web site.

References

[1] Vinyl Acetate Monomer Web site (www.dow.com/vam/).
[2] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 7 (http://www.vinylacetate.org/guide.shtml).
[3] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2 (http://www.vinylacetate.org/guide.shtml).
[4] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, pages 1-2.
[5] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2.
[6] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2.
[7] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, page 5.
[8] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, pages 2-3.
[9] *Chemical Economics Handbook Report Vinyl Acetate,* SRI Consulting, November 2004, pages 5-7.
[10] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 1.
[11] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 1.
[12] *Chemical Economics Handbook Report Vinyl Acetate,* SRI Consulting, November 2004, page 12.
[13] Vinyl Acetate Monomer Applications (www.dow.com/vam/app/) and Vinyl Acetate Monomer Products (www.dow.com/vam/products/).
[14] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2.
[15] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2.
[16] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, page 3.
[17] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2.
[18] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2-3.
[19] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, page 2-3.
[20] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, pages 3 and 5.
[21] *Vinyl Acetate Safe Handling Guide March 2005*, Vinyl Acetate Council, Washington, D.C., 2005, pages 1, 2, 3 and 10.
[22] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, pages 4-5.
[23] *Dow Vinyl Acetate Safety Data Sheet*, No. 11961, August 15, 2002, pages 4-5.

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