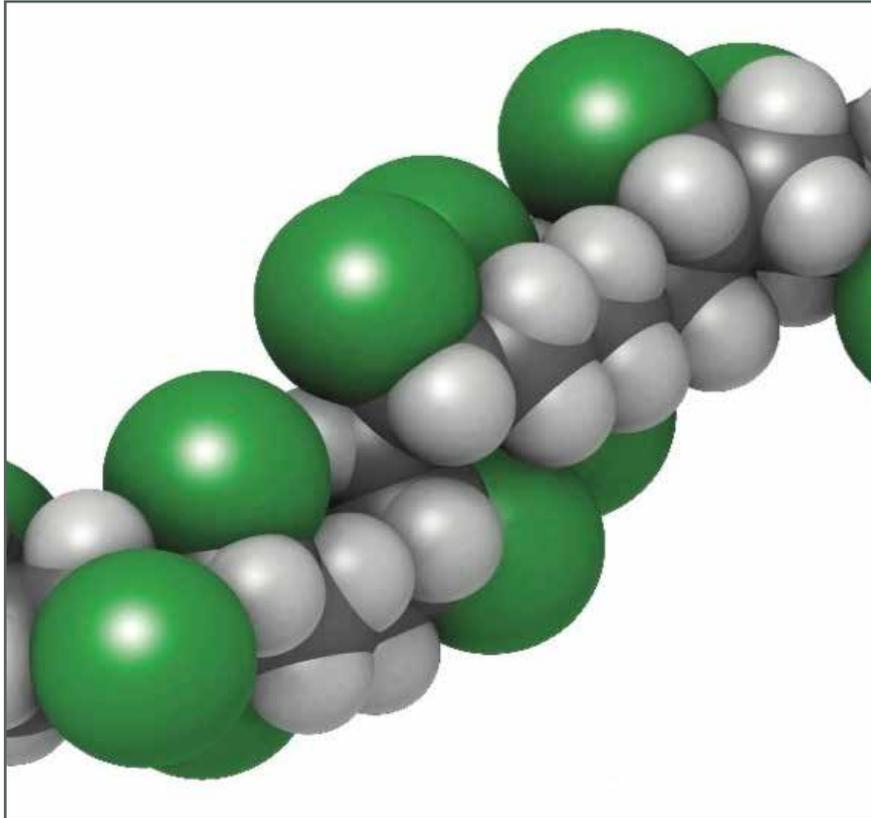




WITH YOU ALWAYS

# Marine *Newslink*

JANUARY 2021



## FEATURE ARTICLE

VINYL CHLORIDE MONOMER (VCM)

## PHOTO(S) OF THE MONTH

GAS CARRIERS

## BACK TO BASICS

QUESTION OF THE MONTH

# VINYL CHLORIDE MONOMER (VCM)



Vinyl chloride monomer (VCM) is one of the world's most important and largest commodity chemicals. VCM is used primarily for the production of polyvinyl chloride (PVC) homopolymer and copolymer resins. PVC has the advantage of being utilized in conversion and fabrication processes with great flexibility, such that end products cover a wide range, including pipe and fittings, profiles and tubes, siding, wire and cable, windows, doors, floorings, film and sheet, and bottles. While the most important ultimate end-use markets are commercial, residential, and non-residential construction, a wide variety of PVC converted products are also utilized in agricultural, electrical (wire and cable) and health care markets. The vinyl's chain, comprising ethylene dichloride (EDC), vinyl chloride monomer (VCM) and polyvinyl chloride (PVC) is a key component of the global petrochemical and thermoplastics sectors.

VCM transportation is challenging because VCM as a gas, needs to be shipped and stored liquefied under pressure, requiring sophisticated LPG ships for its transportation. In 2018, the total volume of VCM exported globally represented about 7% of world production. The largest exporters

are North America and Northeast Asia, which together accounted for more than 80% of the world's VCM exports in 2018. The Middle East is also an important source of the world's VCM export supply, with the advantage of low-cost production located near major markets. The major importers are China, India and Southeast Asia.

Vinyl chloride vapours are denser than air, are highly flammable and can travel significant distances from the release point. Liquid VCM is extremely cold and skin exposure can lead to frostbite.

## VCM HAZARDS

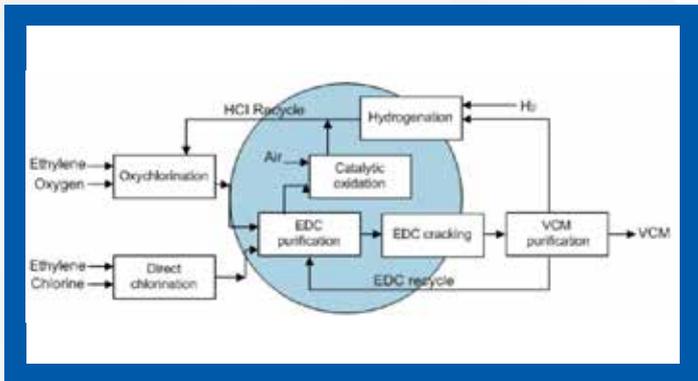
- May mass explode in fire
- Extremely flammable gas
- Contains gas under pressure; may explode if heated

Hence care has to be taken in handling and storing VCM. Mostly because it is a highly flammable and potentially explosive gas (like the lighter fuel butane). Also, because if breathed in quantity, it is a strong narcotic (like chloroform). In fact, during the 1950's

VCM was tried as a potential anaesthetic gas for medical applications. However, from clinical studies at PVC polymerisation plants it was found that VCM can be a carcinogen, with the potential to cause a rare form of cancer (cancer of the blood vessels of the liver known as angiosarcoma), if there is significant exposure over a prolonged period.

## FLAMMABILITY

VCM has a wide flammability range of 3.6% to 33% (36,000-330,000 ppm), and combustion of VCM produces irritant gases, primarily hydrogen chloride (HCl). The flash point of vinyl chloride is  $-108.4^{\circ}\text{F}$  ( $-78^{\circ}\text{C}$ ). Therefore, vinyl chloride is extremely flammable and potentially highly explosive.



## REACTIONS

VCM is shipped in a stabilized state and is generally stable at normal temperatures and pressures. However, certain conditions or mixtures with certain materials can cause VCM to

violently polymerize or cause other hazardous conditions. Exposure to air, sunlight, excessive heat, oxidizers, catalytic metals such as Copper, Aluminium & their alloys & certain catalytic impurities or mixtures can cause explosive or violent polymerization of VCM.

Vinyl chloride must be stabilized for shipment. Stabilization is intended to inhibit uncontrolled polymerization reactions during transportation but does not alter the chemical composition or properties of the VCM. VCM can be stabilized for transport by addition of a chemical inhibitor or purging of the tank to remove oxygen.

Additives, such as hydroquinone, can be added to containers (i.e. storage tanks, tank cars, cylinders, etc.) that will be sitting outside in high heat for extended periods of time to prevent polymerization. These containers should be purged to remove as much oxygen as possible prior to storing VCM.

In addition to violent polymerization, VCM may also react with organic peroxides, strong bases and oxidizing agents resulting in potential heat generation, fire, and/or explosion. In particular, at  $59^{\circ}\text{F}$  -  $406.4^{\circ}\text{F}$  ( $15^{\circ}\text{C}$  -  $208^{\circ}\text{C}$ ) ultraviolet (UV) can initiate a reaction between VCM with excessive oxygen, to produce peroxides; it's also commonly referred to as polyperoxides, polyvinyl peroxides. These reactants can automatically ignite on their own to create an explosive condition under

extreme heat or impact. Further heating to 676.4°F (358°C) causes peroxides to decompose to formaldehyde, carbon monoxide and hydrogen chloride. Peroxides may also cause uncontrollable polymerization reactions at high concentrations or temperatures. Storage and shipping containers should be purged of as much oxygen as possible to eliminate this hazard.

Due to vinyl chlorides flammability and toxicity, considerations must be made when handling and storing to avoid dangerous conditions. Operations involving and storage vessels of VCM must be kept away from heat, open flames, direct sunlight, and other heat/ignition sources. All equipment used when handling VCM must be grounded and precautionary measures should be taken against static charge. Only non-sparking tools should be used. No one should be permitted to smoke in the area. VCM should not be stored with incompatible materials. Empty storage vessels that may still contain residue materials, so repair/disposal work (cutting, welding, puncturing, incinerating, etc. should not be performed until after the container has been cleaned and purged of all residue and vapours.

gases such as propane, butane (LPG) or natural gas (for which the same safety regulations apply). Vinyl Chloride Monomer can be transported via rail or truck as a liquefied gas under its own vapor pressure.

VCM is typically transported in customised wagons and are typically marked for Vinyl Chloride Monomer. The safety systems applicable to VCM wagons & road tankers include jackets, thermal protection systems, insulation systems, tank head puncture resistance systems, coupler vertical restraint systems, and a protective housing as required by regulation.



## TRANSPORTATION

Transporting VCM presents the same risks as transporting other flammable

Wagons or road tankers should be loaded with VCM only if there is no possibility of a dangerous reaction with the residual contents. The last product shipped has to be determined either from waybill information or by

analysis. If necessary, the tank should be cleaned, and nitrogen purged to a defined oxygen content before loading.

The wagon or road tanker and its equipment should be free from any type of damage. Wagons or road tankers which are damaged must not be used for shipping VCM. Before filling a check must be made that the loading module tank is free from mechanical damage such as dents and cracks. If an obvious defect becomes apparent at the loading point the wagon should not be filled.

Due to the flammability of VCM & to reduce the potential fire hazard, wagons or road tankers should be electrically grounded when carrying out loading or unloading operations. The grounding connection should be interlocked to shut down the product flow if the ground connectivity is lost.

The equipment on the wagon & road tankers should also be free of any deficiencies. When filling, particular attention has to be paid to the seals. All seals must be present, suitable, and free of damage. Missing, damaged or defective seals must be replaced.

Before filling, all valves, apertures, and shut-off devices not needed for the filling process must be correctly closed. During filling, the tank must be checked for leaks.

After filling, all closure devices must be checked for leaks. This also involves apertures and valves which are not

used during filling. It is particularly necessary to check whether the internal shut-off devices are adequately sealed. For this purpose, the leak proofing of the valves must be checked. Any leaks must be repaired by suitable means. Subsequently, blank-off flanges or other equally effective devices should be fitted to the valve outlets.



Responsibilities for marking and labelling the rail wagons or road tankers is very important. The labels can be painted or stencilled on the body of tank. Any old labels, signs & shunting labels which do not relate to the product to be transported or are damaged must be removed before shipment.

Road tankers used for the transportation of VCM must fulfil the requirements similar to for LPG gas tankers.

Wagons or road Tanker loading and unloading operations should always be carried-out and documented. Some salient points to be checked before during & after operations are as below:

Prior to loading ensure that:

- The wagon/road tanker is an approved type for loading Vinyl Chloride Monomer
- The wagon/road tanker is clean & suitably prepared for loading Vinyl Chloride Monomer
- The wagon/road and equipment are undamaged
- The wagon/road tanker is duly grounded

Prior to unloading ensure that:

- The wagon/road tanker contains the desired product
- Unloading operations are carried out using only approved equipment
- The receiving tank has enough space to receive the discharged quantity

VCM producers should only use service of accredited transport companies to transport VCM. It is highly recommended for the chemical company to carry out checks to ensure that the appointed transport company is competent and operates in accordance with relevant regulations and safety standards. Contractual agreements with transport companies should stipulate explicitly that no transport is to be passed on to subcontractors without the prior written consent of the consignor.

Prevention Summary for all modes

- Keep away from heat/sparks/open flames/hot surfaces - No smoking
- Stabilize with a polymerization inhibitor (e.g. p-Methoxyphenol [Hydroquinone Monomethyl Ether]) or purging to remove oxygen

- Keep only in original container or container compatible with product
- Ground/ bond container and receiving equipment
- Obtain special instructions before use
- Do not handle until all safety precautions have been read and understood
- Do not breathe dust/fume/gas/mist/vapours/spray

Two major components that can cause cargo losses in terms of insurance are:

- Shortages in transit may be reported & hence appropriate deductible may be applied in the policy. To reduce the risk of shortages, qualified & independent cargo surveyors should be appointed for each shipment.
- Contamination of VCM can cause it to go off-specifications. Stringent process controls can manage this risk and avoid such loss to cargo.

# PHOTOS OF THE MONTH

## Gas Carriers



# BACK-TO-BASICS

## QUESTION OF THE MONTH

In which state is Vinyl Chloride Monomer transported?

## LAST MONTH'S QUESTION

Why is molten aluminium preferred over solid ingots?

## LAST MONTH'S ANSWER:

Since melting Aluminum is such an energy-intensive process, transporting it in a liquid state can be cheaper than moving a solid brick and re-melting it.

## CORRECT ANSWERS SENT BY: (In order of replies received)

- SOHAG PARIKH - Cadila Healthcare Ltd., Ahmedabad
- HEMA RAGHAV - Optima Insurance Brokers Pvt Ltd., New Delhi
- JAYA SOPHAN - Bharat Re-Insurance Brokers Pvt Ltd
- AZAD KUMAR - UIB Insurance Brokers (India) PVT. Ltd., Mumbai
- V.P. MOHANKUMAR - Link-K Insurance Broker Co. Pvt. Ltd. Coimbatore
- BHARAT BHUSHAN - Optima Insurance Brokers Pvt Ltd., New Delhi

Please send your replies/answers ONLY to: [marine.newslink@tataaig.com](mailto:marine.newslink@tataaig.com)

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