



# MONOCHLOROACETIC ACID

T E C H N I C A L G U I D E





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## INTRODUCTION

Monochloroacetic acid (MCAA) plays a major role in the manufacture of many products which are well-known and important in our daily lives. The most noteworthy characteristic of this chemical intermediate is its bifunctional reactivity. MCAA is used in manufacturing a variety of products including herbicides and pharmaceuticals, anesthetics, tranquilizers and amphoteric surfactants, which are cleansing agents used in shampoos.

As an acknowledged leader in the chemical industry, The Dow Chemical Company is firmly committed to advancing and maintaining the highest standards of purity, quality and safety. Since MCAA can pose significant health hazards if mishandled, safe handling procedures must be observed, and all personnel working with this product must be well trained.

In addition to this technical guide, the following materials on MCAA are available from your Dow representative, or by telephoning 1-800-447-4369:

- Material Safety Data Sheet
- Safe Handling Video
- Protective Equipment Fact Sheets

## PHYSICAL PROPERTIES

In its pure form, MCAA is a white or colorless, crystalline solid at room temperature. However, Dow only ships MCAA as an 80% solution in water by weight. At normal shipping temperatures, the odor of 80% MCAA solution is difficult to detect due to its low vapor pressure.

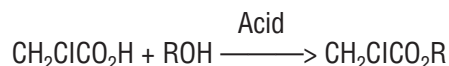
### 80% MCAA Solution Physical Properties

Freezing point:	63°F/17°C
Boiling point:	241°F/116°C
Vapor pressure:	10 mmHg @ 20°C
Vapor density:	2.75
Water solubility:	Mixes completely
Specific gravity:	1.33 (25/25°C)
Wt./gal. @ 25°C:	11.1 lbs
Molecular weight:	NA
Flash point (Setaflash):	None

## CHEMISTRY & END USES

MCAA ( $\text{CH}_2\text{ClCO}_2\text{H}$ ) is a bifunctional molecule, having both the acid and the  $\alpha$ -chlorine reactive sites. MCAA is a stronger acid than acetic acid due to the electron withdrawing effects of the  $\alpha$ -chlorine. Some of the many reactions that are possible with MCAA follow.

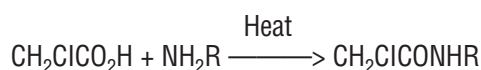
The acid function will react with alcohols to form chloroacetic esters.



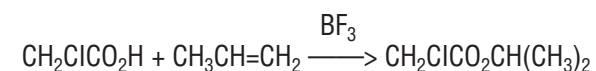
The  $\alpha$ -chlorine will react with ammonia to yield glycine.



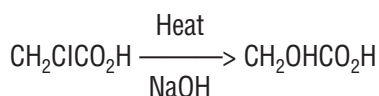
Dehydration of amine salts with MCAA produces the corresponding amide.



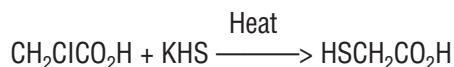
In the presence of a suitable catalyst, MCAA will react across a double bond to give the corresponding ester. For example, MCAA reacts with propylene to yield isopropyl chloroacetate.



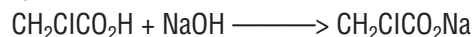
MCAA can be hydrolyzed to glycolic acid by heating it in the presence of water or a strong alkali.



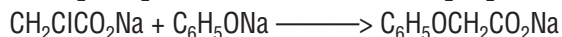
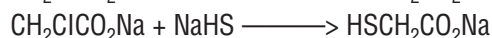
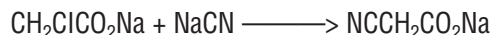
When heated, MCAA will react with potassium hydro-sulfide to form thioglycolic acid.



MCAA can be converted to an alkali chloroacetate by reacting it with a base.



Once the carboxyl group is blocked by the formation of the alkali salt, the  $\alpha$ -chlorine can be replaced by various sodium salts, such as sodium cyanide, sodium hydro-sulfide, or sodium phenate.



Acid treatment will convert these sodium salts back to their corresponding acid.

## End Uses

As indicated, MCAA and its alkali salts can be used in the manufacture of a wide variety of chemical products.

For example, MCAA is converted to sodium chloroacetate and then reacted with alkali cellulose to produce carboxymethylcellulose (CMC). CMC is used in a broad

range of applications, including detergents, food, textiles, coatings, drilling muds, pharmaceuticals and cosmetics.

Another common end use for MCAA is in the production of phenoxy herbicides. For instance, MCAA is converted to sodium chloroacetate and then reacted with 2,4-dichlorophenol to produce 2,4-dichlorophenoxyacetic acid (2,4-D).

Additional applications for chemicals derived from MCAA include pharmaceuticals, plastic additives and cosmetics.

## HAZARDS

Like all chemicals, MCAA must be handled properly to safeguard not only personnel but also the environment. Those who work with this chemical, as well as those who may come in contact with it, should be thoroughly familiar with correct procedures and equipment.

The degree of a chemical's hazard depends on its toxicity, concentration and duration of exposure. Extensive toxicological studies in animals have been conducted on MCAA. The health hazards to humans based on the results of these studies may be summarized as follows:

**Eyes:** MCAA liquid and its vapors can irritate or damage the cornea, causing permanently impaired vision or blindness.

**Skin:** A single exposure to a small area of skin can cause severe burns and may result in rapid absorption of lethal amounts.

**Ingestion:** There is little likelihood ingestion will occur in routine industrial applications. Nevertheless, small amounts may cause burns of the mouth and throat. Ingestion of large amounts can be fatal.

**Inhalation:** Excessive exposure to vapors may irritate the upper respiratory tract, nasal passages and lungs. Any pre-existing lung condition may be aggravated.

MCAA is toxic to animals, including fish. Therefore, it must be kept away from sewers and all water sources, especially rivers and lakes.

In the interest of environmental and personnel safety and in compliance with hazard communication, Dow supplies Material Safety Data Sheets for MCAA. Personnel should read this information carefully and must know the potential hazards before handling MCAA. In addition, all applicable federal, state and local health and safety laws and regulations should be followed.

## HANDLING PRECAUTIONS

Due to the hazards associated with MCAA, constant care must be exercised and adequate protective measures and equipment fully utilized to avoid any harmful effects to personnel or the environment.

## PROTECTIVE MEASURES AND EQUIPMENT

Adequate ventilation must be provided wherever MCAA is used. In enclosed areas, a power exhaust system is often advisable.

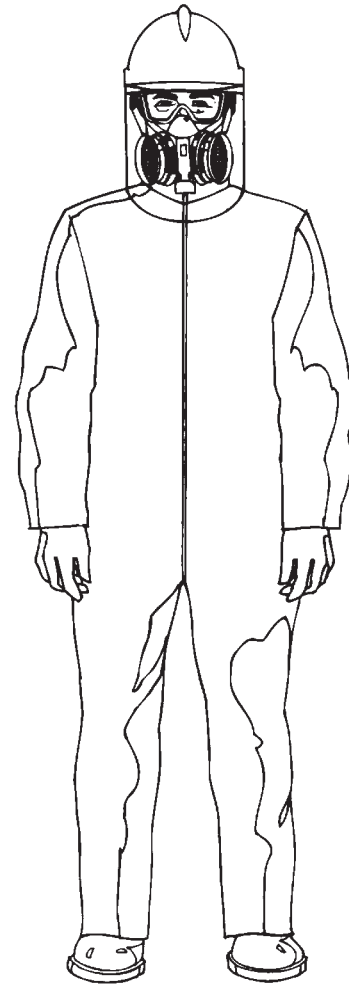
**Exposure Limits:** The American Industrial Hygiene Association (AIHA) exposure guideline for inhalation is 0.3 ppm Skin (8-hour TWA) and 1 ppm for 15-minute excursion. It should also be noted that liquid MCAA can be absorbed through the skin, which can result in excessive exposure even though vapor concentrations are below the recommended guidelines.

**Respirators and SCBA:** In specific situations, such as line or equipment openings where vapor levels may rise above exposure guidelines, an approved air purifying respirator is recommended. If vapor exposure causes eye discomfort, use a full-face respirator. Suitable positive-pressure self-contained breathing apparatus should be used for longer-term exposure in emergency situations such as spill clean-ups.

**Face and eye protection:** For normal operations, chemical worker goggles should be worn, along with hard hats. For situations such as line or equipment openings, where exposure potential is greater, a face shield should be worn.

**Protective clothing:** Where potential for exposure exists, Dow recommends protective clothing impervious to MCAA. Protective attire typically consists of gloves, boots, and full body suit.

**Showers and eye baths:** Safety showers and eye baths are essential in any operation involving MCAA. They should be conveniently located and readily accessible. Before every MCAA handling operation, both should be tested.



## FIRST AID

Because of MCAA's high toxicity, prompt action is necessary in order to minimize harm to workers. Emergency procedures should be covered thoroughly and reviewed often in training sessions. If you need any help in planning or conducting such training, your Dow representative can assist you with more detailed information.

**Eyes:** Use an eye bath immediately and irrigate eyes continuously in flowing water for at least 30 minutes. Prompt medical consultation is essential.

**Skin:** Enter safety shower at once and start water flow, then quickly shed all contaminated clothing, removing goggles last. Remain in shower for 30 minutes. Wash contaminated clothing before re-use and discard contaminated leather articles. Prompt medical consultation is essential.

**Inhalation:** Remove to fresh air quickly if any ill effects occur. Consult physician.

**Ingestion:** Do not induce vomiting. Give copious quantities of water, or milk if available. Promptly transport individual to medical facility.

In summary, administer appropriate first aid measures immediately. Then, secure the advice and assistance of qualified medical personnel.

# SAMPLING, UNLOADING, SPILL CLEAN-UP

**Sampling:** Sampling devices should be placed in enclosures designed to isolate the product from personnel and the environment. If samples are taken using such an enclosure, goggles and gloves should be worn. If an enclosure is not used, full protective clothing and a respirator should be worn.

In any case, the operator should review sampling procedures with a supervisor in advance to determine the best sampling method and protective equipment required.

**Unloading:** When unloading MCAA, use an unloading checklist. Wear appropriate clothing and protective

equipment, barricade the area and restrict access. Then, make sure safety showers and eye baths are accessible and operational. Use extreme care when removing caps from any trailer outlets and clean up any spillage immediately. Monitor the transfer with another person in attendance and after transfer, blow out the unloading line.

**Unloading System Design:** MCAA is shipped in top unload only trailers, which are equipped with dry-disconnect fittings. MCAA should be unloaded using a pump, but air or nitrogen pressure may be necessary to prime the pump initially. A typical tank truck unloading design is shown in Figure 1.

The storage tank should either be vented back to the bulk container or to a scrubber to avoid emissions of MCAA. If the tank is vented to a scrubber, the bulk container should be padded with air or nitrogen. Consideration should be made for purging the unloading line clear of product to allow for a clean disconnect.

## SUGGESTED TANK TRUCK UNLOADING CHECKLIST

Date: \_\_\_\_\_

Tank trailer: \_\_\_\_\_

Material to unload: \_\_\_\_\_

### Before unloading:

- Engine off?
- Drivers out of cab?
- Receiving tank level verified?
- Discharge valves open?
- Receipt material identification checked?
- Truck vented properly?
- Wheels chocked, or tractor in gear and brakes set? Confirm with driver.
- "Men Working in Trailer" sign placed? Confirm with driver.
- Ground wire attached?
- Trailer jack positioned properly?
- Proper personal protective clothing being worn?
- Safety shower & eye bath flushed?
- Barricades and warning signs placed, if needed?
- Appropriate fire extinguishers in place?
- Check for leakage?

### After unloading:

- Trailer empty, verified?
- All valves closed and capped?
- Vent piping disconnected?
- Unloading line purged?
- Wash down exterior contamination?
- Ground wire removed?
- Chocks removed?
- Jack and "Men working in Trailer" sign removed?
- Pumps off?
- Unloading valves closed?
- Barricade and warning signs removed?
- Dome cover tight?

*Unloader's signature*

\_\_\_\_\_

Safety showers and eye baths should be in the unloading area and should be checked to make sure that they are operational. A source of water should be nearby to wash down any small leaks of product. Consideration should be made to contain leaks and avoid discharging the product to the environment.

If it is necessary to heat the truck, use tempered water (less than 50°C). Do not use steam on tank truck coils under any circumstance, as this will cause excessive corrosion.

*For more information on MCAA transportation or materials of construction, contact your Dow sales representative.*

**How to handle spills:** Use the appropriate protective equipment, including a respirator. Keep upwind, isolate the area, deny entry to non-essential personnel and ventilate the area. Then stop the leak if feasible and dike to contain the MCAA.

For small spills, wash down the area with copious amounts of water. Then, collect, treat and dispose of the waste water and waste material in accordance with all federal, state and local guidelines.

For large spills, allow the MCAA to freeze or use a suitable absorbent material. Transfer the waste to recovery drums, for proper disposal. Wash down the area with copious amounts of water. Collect, treat and dispose of all waste water and waste material in accordance with all federal, state and local guidelines.

Under no circumstances should MCAA be allowed to enter sewers and natural waters.

## STORAGE

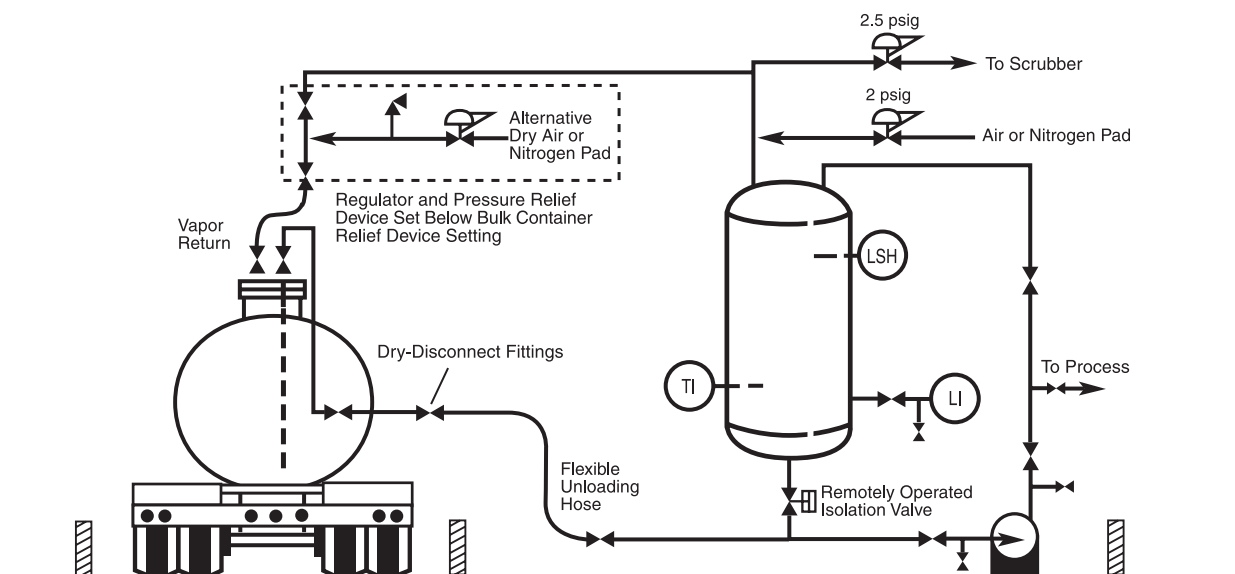
Suggested materials of construction for MCAA storage and handling systems include glass-lined steel storage tanks, PTFE plastic-lined pipe and valves, and alloy C-276 pumps. Contact your Dow representative for information on other materials of construction.

Storage tanks should be equipped with a regulated air or nitrogen pad-depad system. The tank should be vented to a scrubber system to avoid emissions of MCAA. Tank levels should be continuously monitored and have a redundant high level alarm.

If the potential for freezing exists, the tank should be equipped with a temperature control system to maintain the temperature well above the freezing point and the tank should be insulated. Also, the tank temperature should be monitored to make sure that the product does not reach its freezing point.

Secondary containment should be constructed from or coated with an acid resistant material. Safety showers and eyebaths should be located nearby. To clear piping and equipment for maintenance, all piping should be sloped to a drain. Double block valve and bleed systems should be utilized whenever possible to isolate MCAA from maintenance workers.

**Figure 1 — Typical MCAA Tank Truck Unloading and Storage System Design, Top Unloading with a Pump**



## RESPONSIBLE CARE® AND PRODUCT STEWARDSHIP

Dow's commitment does not end with a product's delivery. At Dow, we have a fundamental interest in, and concern for, the environment and for everyone who makes, distributes, and uses our products. This concern is the basis for our Product Stewardship philosophy, which is our means of assessing the health and environmental information on our products and then taking appropriate steps to protect employees, public health, and the environment.

**Responsible Care.** Dow is also dedicated to meeting the guiding principles of the chemical industry's worldwide Responsible Care® initiative — wherever we do business. The principles of Responsible Care emphasize continuous improvement in pollution prevention, employee health and safety, distribution, process safety, product stewardship, and community awareness and emergency response.

The Dow Chemical Company urges you to review your applications regularly to ensure that personnel handling MCAA are thoroughly trained and properly equipped. These individuals should be aware of all potential hazards, and should know how to administer first aid.

**Samples and Service:** For further technical information on monochloroacetic acid, contact The Dow Chemical Company, Chemicals & Metals Department, Midland, MI 48674. Or call 1-800-447-4369.



**For more information  
call 1-800-447-4369.**



Responsible Care®

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