2,4-Dichlorophenol (DCP) is an important intermediate in the manufacture of 2,4-dichlorophenoxyacetic acid (2,4-D), the well-known industrial commodity herbicide. It is also used in the manufacture of other pesticide products and pharmaceuticals.

As an acknowledged leader in the production of DCP, Dow AgroSciences is firmly committed to advancing and maintaining the highest standards of purity, quality, and safety. Because DCP can pose significant health hazards, safe-handling procedures must be observed, and all personnel working with this product must be well trained. For new customer sites, Dow AgroSciences requires and provides a site stewardship assessment prior to the first shipment of product.

### Personnel Training

Personnel handling 2,4-dichlorophenol must understand its hazards, must be trained to avoid those hazards, and must be given specific instructions concerning the personal protective equipment required for particular situations. Safety equipment must be readily available and properly maintained. Workers must be trained in procedures to follow if exposure occurs.

The emphasis should be on preventing exposure, not reacting to an exposure. Safety procedures and material safety data sheets (MSDS) must be reviewed with workers according to OSHA Hazard Communication Standard 29 CFR 1910.1200. The entire training program must be documented in writing, and records must be kept of individual participation.

### Physical Properties

DCP is a white, crystalline solid at room temperature. When molten, it is a colorless liquid. It has a strong phenolic odor, which serves as a good indicator of its presence.

**DCP Physical Properties**

- **Freezing Point**: 108°F/42°C
- **Boiling Point**: 419°F/215°C
- **Vapor Pressure @ 20°C**: 0.10 mm Hg
- **Vapor Density (Air = 1)**: 5.6
- **Water Solubility**: 0.45 g/100 g
- **Specific Gravity (60°C/4°C)**: 1.382
- **Molecular Weight**: 163
- **Flash Point (TCC)**: 219°F/104°C
Chemistry and End Uses

DCP exhibits two major types of reactivity: reactions of the phenolic –OH group and electrophilic substitution in the aromatic ring. The most important type of reactivity is related to the acidity of the –OH group. DCP reacts with bases to form salts. For example, reaction with sodium hydroxide yields the sodium salt of DCP:

\[ \text{HOCl}_2 + \text{NaOH} \rightarrow \text{NaCl}_2 + \text{H}_2\text{O} \]

The sodium salt of DCP can then react further with alkyl halides or sulfates to form 2,4-dichlorophenyl ethers. For example, reaction with methyl iodide yields 2,4-dichloroanisole.

\[ \text{NaCl}_2 + \text{CH}_3\text{I} \rightarrow \text{Cl}_2\text{OCH}_3 + \text{NaI} \]

The sodium salt of DCP also reacts readily with acid chlorides or acid anhydrides to produce esters. For example, reaction with benzoyl chloride yields 2,4-dichlorophenyl benzoate.

\[ \text{Cl}_2\text{OCl}_2 + \text{C}_6\text{H}_5\text{COCl} \rightarrow \text{Cl}_2\text{OCOC}_6\text{H}_5 + \text{NaCl} \]

An example of electrophilic ring substitution in 2,4-dichlorophenol is the reaction with chlorine, which yields 2,4,6-trichlorophenol.

\[ \text{Cl}_2\text{OCl}_2 + \text{Cl}_2 \rightarrow \text{Cl}_2\text{OHCl}_2 + \text{HCl} \]

End Uses

DCP and its alkali salts are used in the manufacture of a wide variety of chemical products. A common end use for DCP is in the production of phenoxy herbicides. For instance, the sodium salt of DCP is reacted with sodium chloroacetate to produce 2,4-dichlorophenoxyacetic acid, commonly known as 2,4-D. Additional applications for chemicals derived from DCP include pharmaceuticals, fungicides, and insecticides.

Hazards

In the interest of environmental and personal safety and in compliance with hazard communication policies, Dow AgroSciences supplies an MSDS for DCP. All personnel should read this information carefully and understand the potential hazards associated with DCP before handling it. In addition, all applicable federal, state, and local health and safety laws and regulations should be followed.

MSDS

To display or print a copy of the dichlorophenol MSDS from the Dow AgroSciences web site, visit www.dowagro.com, click on the “U.S. Label and MSDS System” link on the home page, and follow the on-screen instructions.

To obtain copies of the MSDS by fax, please call the Dow AgroSciences self-service document center.

1-800-891-9157

If you are in California, call 1-888-847-6858 for the document center.

Copies of the MSDS can also be ordered by telephone from Dow AgroSciences Customer Service.

1-317-337-7850

Stability and Reactivity

DCP is stable under normal handling and storage conditions. However, the product can decompose at elevated temperatures. Hydrochloric acid and other toxic, irritating products can be produced if DCP is burned.

Corrosivity

DCP is moderately corrosive. The suggested material of construction for handling solid and liquid DCP is carbon steel. Copper is corroded by DCP at elevated temperatures and is therefore not recommended for use. Moisture in DCP increases the potential for corrosion, therefore rendering carbon steel inadequate as a material of construction. If the DCP contains moisture, materials such as Hastelloy C or Monel, which contain a greater nickel content, should be used. Stainless steel should be avoided due to the potential for stress-corrosion cracking.
Physical Hazards

**Eye:** Direct contact can cause severe irritation with corneal injury, which could result in permanent impairment of vision, even blindness. Handling DCP at elevated temperatures can generate vapor levels sufficient to cause eye irritation. Contact with heated material can also cause thermal burns.

**Skin:** DCP is more readily absorbed through the skin when in solution and especially when molten. Molten or hot DCP is immediately absorbed through the skin in amounts that have caused death to humans. Rapid death in humans has been caused by skin exposure without immediate decontamination. Amounts of molten DCP that cover as little as 1% body surface area (e.g., palm-of-hand-sized) could result in death.

**Ingestion:** Small amounts of DCP that might be swallowed incidental to normal handling operations are unlikely to cause injury. However, swallowing large amounts could cause injury. Ingestion can also cause chemical burns of the mouth and throat.

**Inhalation:** Although the formation of DCP dust is unlikely, such dust can result in severe irritation in the upper respiratory tract (nose and throat). Elevated temperatures can generate vapor levels sufficient to cause respiratory irritation.

Handling Precautions

Because of the hazards associated with DCP, constant care must be exercised, and adequate protective measures and equipment fully utilized to avoid harmful effects to personnel or the environment. Written procedures for handling DCP in all applicable operations should also be established. A self-contained system with dry-break connections and sufficient ventilation is recommended in areas where potential exposure can occur. Use extreme caution when handling hot or molten DCP. *Molten or hot DCP is immediately absorbed through the skin in amounts that have caused death to humans. Rapid death in humans has been caused by skin exposure without immediate decontamination. Amounts of molten DCP that cover as little as 1% body surface area (e.g., palm-of-hand-sized) could result in death.*

Protective Measures and Equipment

*See First Aid section on page 4 for decontamination guidelines.*

The sharp, pungent odor and low odor threshold of DCP provide good early warning properties of the presence of DCP. Adequate ventilation should be provided to control airborne concentrations below exposure guidelines when handling DCP.

**Exposure Limits**

Dow AgroSciences’ Industrial Hygiene Guideline (IHG) for DCP is 1 ppm. The IHG is based upon an 8-hour time-weighted average exposure by vapor inhalation. It should also be noted that inhalation might not be the only route of exposure. Skin contact is another potential exposure route, and molten or hot DCP can be immediately absorbed through the skin in amounts that have caused rapid death in humans. Absorption through skin accelerates with temperature such that additional measures to minimize exposure to hot or molten DCP should be considered.

**Respiratory Protection**

When DCP levels are below the exposure guideline, personnel in areas where the material is stored or used should not need to use respiratory protection. However, if personnel are handling DCP at elevated temperatures (when vapors are likely to be generated) without sufficient ventilation, or if respiratory irritation is experienced, use of a NIOSH-approved, full-face, air-purifying respirator for organic vapors is recommended. Suitable positive-pressure, self-contained breathing apparatus should be used for longer-term exposure in emergency situations, such as spill clean-ups, or in situations when the atmospheric level is unknown.

**Face and Eye Protection**

For normal operations, chemical goggles should be worn, along with hard hats. For situations in which the potential for exposure is greater, a face shield is also recommended. When handling DCP at elevated temperatures without sufficient ventilation, the use of a NIOSH-approved, full-face, air-purifying respirator for organic vapors is recommended.
Protective Clothing
When the potential for exposure exists, Dow AgroSciences recommends protective clothing impervious to DCP. The following personal protective clothing is recommended: neoprene or nitrile gloves; neoprene boots; and Saranex, neoprene, or Kapler CPF3 full-body suit. Use DCP-impervious gloves at all times. When needed, use gloves insulated for thermal protection. Selection of specific personal protective equipment—such as face shield, boots, apron, or full-body suit—will depend on the operations being undertaken.

Safety Showers and Eyebaths
Safety showers and eyebaths are essential in any operation involving DCP. They should be located in the immediate work area and readily accessible to personnel. Both should be tested routinely and frequently to ensure proper operation.

First Aid
Because of the toxicity of DCP, prompt action after exposure is necessary to minimize harm to personnel. Emergency first-aid procedures should be covered thoroughly and reviewed frequently in worker training sessions. If you need help in planning or conducting such training, your Dow AgroSciences representative can assist you with more detailed information.

Note: First aid responders should pay attention to self-protection and use the recommended personal protective equipment (chemical resistant gloves, splash protection).

Eyes
Use an eyebath immediately, and irrigate eyes continuously in flowing water for at least 30 minutes. Prompt medical attention is essential.

Skin
Enter the safety shower and immediately wash thoroughly any size exposure with nonabrasive soap and large quantities of water for 30 minutes, while removing contaminated clothing and footwear.

It is recommended that further amounts of DCP be removed from the skin by repeatedly spraying/swabbing with a polyethylene glycol or polypropylene glycol mixture, alternating with rinsing with large quantities of water for 30 minutes. Examples of decontamination mixtures include a 2:1 ratio of PEG300/ethanol (or industrial methylated spirits), available polypropylene/rapeseed oil proprietary mixtures, or polyvinylpyrrolidone/detergent mixtures.

An option available in the U.S. is D-TAM® Safe Solvent (Colorometric Labs, Des Plaines, IL; 847-803-3737). Used undiluted, it is effective in removing DCP from the skin. Apply gently to avoid abrading injured skin and promptly rinse with water for 1 to 2 minutes. If water is unavailable, wipe the material off with a paper towel. Follow up with repeated applications and rinse (or wipe) for 30 minutes.

A companion product, D-TAM Skin Cleanser, which also contains propylene glycol and emulsifiers, has similar efficacy and is relatively interchangeable with D-TAM Safe Solvent.

Prompt medical attention is essential. Rapid death in humans has resulted from skin exposure to hot or molten DCP without immediate decontamination.

Ingestion
Do not induce vomiting. Give large amounts of water or milk if available. Promptly transport individual to a medical facility. Do not give anything by mouth to an unconscious person.

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

Contaminated Materials
Destroy and dispose of any items that cannot be decontaminated, such as footwear, belts, watch straps, etc.
Shipping Information

Containers

DCP can be supplied in bulk containers such as rail cars, tank trucks, or ISO tanks, or it can be packaged in 55-gallon, galvanized-steel drums. Because DCP freezes at 108°F, it is very likely that the shipment you receive from Dow AgroSciences will require some degree of heating before the container can be completely unloaded into your storage system. Prior to unloading operations, review any written procedures that have been established for handling molten DCP. Make sure all personnel unloading the containers are aware that the containers will need to be safely vented to relieve excess pressure resulting from thawing of DCP. Either low-pressure steam or hot water can be used to melt DCP. Caution must be exercised when opening any container of molten DCP. To minimize the risk of exposure to DCP, the following minimum personal protective equipment is recommended: nitrile or neoprene gloves; neoprene boots; Saranex, neoprene, or Kapler CPF3 full-body suit; and face shield. In situations involving potential exposure to DCP vapors, a NIOSH-approved, full-face, air-purifying respirator is recommended.

Bulk Vehicles

All bulk vehicles used for the transportation of DCP must be returned to the Dow AgroSciences DCP production facility for decontamination prior to being released for cleaning. Every effort will be made to use dedicated equipment to minimize the number of vehicles in this service. This practice can affect the scheduling of product shipments.

Special Routing

Dow AgroSciences will use two drivers when molten DCP must be shipped by tank truck. Restricted routing might be required for such shipments. Adequate lead-time is necessary to ensure that appropriate equipment, drivers, and routings are available.

Placarding and Labeling Requirements

Regulations require documentation, labeling, marking, placarding, and package/container approval for materials that meet certain criteria. The shipping description must include the above information and the emergency response telephone number. Any storage tank for DCP must be properly identified and labeled. Other tank labels required by federal, state, or local regulations must also be installed.

Global Transportation [I.M.D.G.]—Dry or flake: TOXIC SOLIDS, CORROSIVE, ORGANIC, N.O.S. (2,4-DICHLOROPHENOL)/6.1/UN 2928/PG II/RQ (2,4-DICHLOROPHENOL) 100 LBS./MARINE POLLUTANT/EMS 6.1-04/MFAG 711/STCC=4921250

Land [North America]—Dry or flake: TOXIC SOLIDS, CORROSIVE, ORGANIC, N.O.S. (2,4-DICHLOROPHENOL)/6.1/UN 2928/PG II/RQ (2,4-DICHLOROPHENOL) 100 LBS./MARINE POLLUTANT.

Land [North America]—Molten or hot: TOXIC LIQUID, CORROSIVE, ORGANIC, N.O.S. (2,4-DICHLOROPHENOL)/6.1/UN 2927/PG I/RQ (2,4-DICHLOROPHENOL) 100 LBS./MARINE POLLUTANT/HOT.

Labels

To display or print a copy of the dichlorophenol product label from the Dow AgroSciences website, visit www.dowagro.com, click on the “U.S. Label and MSDS System” link on the home page, and follow the on-screen instructions.

To obtain copies of the product label by fax, please call the Dow AgroSciences self-service document center at 1-800-891-9157. If you are in California, call 1-888-847-6858 for the document center.

Copies of the label can also be ordered by telephone from Dow AgroSciences Customer Service at 1-317-337-7850.

Transportation Emergencies

Contact Dow AgroSciences Emergency Response at 1-800-992-5994 to speak with personnel who will provide advice and arrange for professional help, as needed, to assist with an emergency.

Dow AgroSciences Emergency Response

1-800-992-5994
Sampling, Unloading, and Spill Clean-Up

Sampling
The proper approach for sampling solid DCP depends on the working conditions and type of container or system from which the sample will be obtained. Good judgement should be used to determine the method for obtaining a representative solid sample that minimizes the potential for exposure. Chemical goggles and impervious gloves must be worn to obtain the sample.

Sampling hot or molten DCP should be done using a properly designed sampling system. Sampling devices should be placed in enclosures designed to isolate the product from personnel and the environment. Whenever samples are taken using such an enclosure, goggles and neoprene or nitrile gloves must be worn. If an enclosure is not used, full protective clothing (impervious gloves, boots, and suit) and a full-face respirator must be worn. **Direct sampling of hot or molten DCP should be avoided.**

In any case, operating personnel should review all sampling procedures with supervision in advance to determine the best sampling method and proper protective equipment required for the task.

Unloading
Because DCP is a solid at ambient temperatures, tanks containing DCP will need to be thawed prior to unloading. Medium-pressure steam is recommended for melting DCP. The tank should be equipped with steam coils to aid in the thawing process. When unloading molten DCP, use an unloading checklist (see example at right). Review all written procedures established for your facility for unloading DCP from a tank.

Wear appropriate protective equipment, barricade the immediate area, and restrict access. Ensure that safety showers and eyewashes are located nearby and are immediately accessible and operational. Use extreme caution when connecting any unloading lines and steam lines to the tank. Monitor the transfer with another person in attendance and, after transfer, blow out the unloading line with either nitrogen or dry air.

**Unloading System Design**

DCP is primarily shipped in top-unload, insulated tanks equipped with dry-disconnect fittings and external steam coils for melting the solid DCP. The use of a pump to unload molten DCP is recommended. A nitrogen pad can be used to help prime the transfer pump. A typical unloading design is shown in Figure 1.

The storage tank should be vented back either to the bulk container or to a scrubber to avoid emissions of DCP. If the tank is vented to a scrubber, the bulk container should be padded with nitro-
Consideration should be made for purging product from the unloading line to allow for a clean disconnect. Safety showers and eye baths should be in the unloading area and should be tested routinely and frequently to ensure proper operation. Consideration should be made to contain leaks and avoid discharging DCP to the environment.

Warning!
Molten DCP leaking through holes in piping, storage, or handling equipment will solidify when exposed to normal ambient temperatures and can plug existing holes. Steam cleaning will melt the product. Precautions (use of all recommended personal protection equipment) must be taken to avoid the potential for exposure from spraying or splashing molten or hot product during clean-up, maintenance, repairs, etc.

For more information on DCP transportation or materials of construction issues, contact your Dow AgroSciences representative.

Spill Clean-Up
Use the recommended personal protective equipment: neoprene or nitrile gloves; neoprene boots; face shield; and Saranex, neoprene, or Kapler CPF3 full-body suit. Contain small amounts of solid material and scoop into a steel or plastic container for disposal. Do not use water to wash down spill area.

For molten DCP, wear full personal protective equipment (neoprene or nitrile gloves; neoprene boots, NIOSH-approved, full-face, air-purifying respirator; and Saranex, neoprene, or Kapler CPF3 full-body suit), contain and isolate the spill, and allow the material to solidify. Scoop solid material into a steel or plastic container. For large spills, the use of self-contained breathing equipment should be considered.

Dispose of containers in accordance with all federal, state, and local guidelines and regulations. Under no circumstances should DCP be allowed to enter public sewers (sanitary or storm) or natural waters because of its toxicity to fish and aquatic organisms. See the MSDS for detailed ecological information.

CERCLA/SARA Reportable Quantities
A spill of 100 pounds or more of product is a reportable quantity (RQ) and must be reported to federal, state, and local emergency agencies. Verify with state and local agencies that this RQ is applicable at your location.
**Storage**

The suggested material of construction for dry DCP storage and handling systems is carbon steel. The use of copper is not recommended because DCP at elevated temperatures is corrosive to copper. If moisture is likely to be present in the DCP, carbon steel is also unsuitable. Under these circumstances, only materials with a greater nickel content, such as Hastelloy C or Monel, should be used. Stainless steel should be avoided because of the potential for stress-corrosion cracking. Contact your Dow AgroSciences representative for more information on materials of construction compatibilities.

Storage tanks should be equipped with a regulated nitrogen pad/depad system. The tank should be vented to a scrubber system to avoid emissions of DCP. However, the scrubber must be properly isolated from the storage tank to avoid contamination of DCP with scrubber solution. Tank levels should be continuously monitored and have a redundant high-level alarm. Secondary containment should be constructed from or coated with an acid-resistant material. Safety showers and eyewashes must be located nearby and routinely and frequently tested to ensure proper operation.

To clear piping and equipment for maintenance, all piping should be sloped to a low point for drainage and proper disposal in accordance with all federal, state, and local guidelines and regulations. Double-block valve and bleed systems should be used whenever possible to isolate DCP from maintenance personnel. To minimize the potential for contaminating the DCP system with water, no water lines should be hard-piped into the system.

**Warning!**

*Molten DCP leaking through holes in piping, storage, or handling equipment will solidify when exposed to normal ambient temperatures and can plug existing holes. Steam cleaning will melt the product. Precautions (use of all recommended personal protection equipment) must be taken to avoid the potential for exposure from spraying or splashing molten or hot product during clean-up, maintenance, repairs, etc.*

**Commitment to Responsible Care® and Product Stewardship**

This 2,4-Dichlorophenol Safe Handling Guide has been prepared as part of Dow AgroSciences’ product stewardship program and Responsible Care. Dow AgroSciences is dedicated to meeting the guiding principles of the global Responsible Care initiative. These principles emphasize continuous improvement in pollution prevention, employee health and safety, distribution, process safety, product stewardship, and community awareness and emergency response.

This guide includes considerations for handling DCP and describes equipment suitable for storage and handling of bulk quantities. The guide details Dow AgroSciences’ interpretation of many codes and regulations relevant to this type of product. If government requirements applicable to your facility are more stringent, those requirements must be followed.

This guide is not intended as, and should not be used as, a substitute for engineering or legal advice. Applicable legislation and regulations are constantly changing. Future regulatory and judicial developments could necessitate changes to the procedures recommended in this guide. Each user or handler of 2,4-dichlorophenol is responsible for compliance with all applicable federal, state, and local laws, regulations, and codes.

Dow AgroSciences urges you to review your applications and procedures regularly to ensure that personnel handling DCP are thoroughly trained and properly equipped. These individuals should be aware of all potential hazards and should know how to administer first aid. For more information regarding this product, contact your Dow AgroSciences representative.
For more information call 1-317-337-7850.
For emergency response information call 1-800-992-5994.

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