



Fog Making With Dry Ice

Subject: Using dry ice (CO ₂) to make low lying stage fog		
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What Is Dry Ice?

At normal temperature and pressure Carbon Dioxide (CO₂) is a colourless gas, one that we exhale when we breathe. Dry ice is CO₂ in its solid form. It is much heavier and colder than traditional (frozen water) ice. Dry ice has a temperature of -78.4°C whilst the temperature of traditional ice is 0°C . Unlike traditional ice, dry ice doesn't melt - it sublimates. Sublimation is the process of a substance, in this case CO₂, changing directly from its solid form to its gaseous form, without passing through an intermediate liquid phase, hence the term "dry" ice.

Storing Dry Ice

Dry ice sublimates at an approximate rate of 4.5kg every 24 hours when stored in a standard insulated container. The more dry ice you have stored the longer it will last. Plan to collect the dry ice from your supplier as close as possible to the time that you will use it. Use a polystyrene container (chilly-bin) to collect and store the dry ice until it is used. Do not use plastic containers as the plastic may crack at the very low temperature of the dry ice. Do not use a sealed container as the CO₂ gas that sublimates off the stored dry ice will cause an airtight container to explode. Always store dry ice in a well-ventilated area. Refrain from opening and closing the container as much as possible.

Making the Fog

To make fog from your dry ice simply add dry ice to hot water. The Carbon Dioxide snow form of dry ice is best, if your dry ice is in blocks it is necessary to break the blocks into small pieces prior to use. Four litres of hot water for every one to two kilograms of dry ice will be about right; the exact ratio is not critical.

The variables that determine the amount of fog and its dissipation rate are the water temperature and the surface area of the dry ice. The smaller the size of the dry ice pieces the more the fog. The higher the temperature of the water the more the fog but the shorter the time the fog lasts before dissipating.

Small dry ice fog machines comprise of a water container with a heating element, a lid that's opened to add the dry ice and an opening through which the fog leaves the machine. These machines produce fog from the moment dry ice is added until the dry ice has all sublimated away. Larger fog machines operate in much the same way but usually employ a pump to spray hot water over the dry ice. This allows fog production to be stopped and started at will, by simply switching the pump on and off.

Safety

Using dry ice to make fog is generally considered to be the safest method creating stage fog effects. Avoid contact with the skin and eyes; always use gloves and wear safety glasses when handling dry ice. Keep away from children. Do not ingest. People walking in dry ice fog must be instructed to be aware of stairs, obstructions or openings in the stage that may be obscured by the thick fog. Be careful of water vapour condensing on the stage floor.

Carbon Dioxide gas is normally present in the atmosphere at a concentration of approximately 0.03% and is non-toxic in small concentrations. Carbon Dioxide does affect human respiratory stimulation, blood circulation and acidity of body fluids and therefore exposure to high concentrations of CO₂ gas may be harmful.

Carbon Dioxide is heavier than air and will collect in low-lying areas such as orchestra pits and basements, depleting the Oxygen concentration in the process. Asphyxiation due to lack of Oxygen is possible. Therefore always ensure low-lying areas are well ventilated while and after dry ice fog is used. Never lay down in dry ice fog or any other fog.

The Oxygen concentration in air at normal temperature and pressure is 20.9%. Symptoms of Oxygen depletion usually begin at concentrations below about 19%, with impaired co-ordination. As the Oxygen is depleted further the victim's breathing and pulse rates increase, co-ordination and perception are impaired, and the victim's lips take on a blue colour. The victim may feel nauseous or vomit, faint and become unconscious. A victim exposed an atmosphere with an Oxygen concentration of less than 8% for more than six to eight minutes is likely to die.

WARNING: Never enter an Oxygen deficient atmosphere alone or without the correct protective breathing apparatus. Exposure to an atmosphere with an Oxygen concentration of less than 8-10% will cause you to loose consciousness without warning and so quickly that you cannot help or protect yourself.