BASF Chemical Emergency Medical Guidelines

Maleic-/ Phthalic anhydride ($C_4H_2O_3$ / $C_8H_4O_3$) B 1

Information and recommendations for paramedics and doctors at the site

- **Patients whose clothing or skin is contaminated with these solid acid anhydrides or their dusts can cause secondary contamination of rescue and medical personnel by direct contact.**
- **Acid anhydrides and their dusts and vapor are irritating when they come in contact with the eyes, skin, and upper respiratory tract causing coughing, sore throat and wheezing. Obstruction of the airways and respiratory distress with chest pain and dyspnea may occur. Skin and pulmonary sensitization is possible.**
- **Ingestion of acid anhydrides can cause irritation to the lips, mouth, throat, esophagus, and stomach.**
- **Immediate decontamination (first removal of solid acid anhydrides, thereafter extensive flushing of contaminated eyes, skin, and hair) is crucial**.
- **There is no antidote to be administered to counteract the effects of acid anhydrides. Treatment consists of supportive measures.**

1. Substance information

Maleic anhydride ($C_4H_2O_3$), CAS 108-31-6

Synonyms: 2,5-furandione, maleic acid anhydride.

At room temperature maleic anhydride is a white crystalline solid with an acrid odor. Maleic anhydride is soluble in water, acetone, ethyl acetate, chloroform, and benzene. Vapor pressure is 25 Pa at 25°C. In presence of water maleic anhydride hydrolyzes to maleic acid.

Phthalic anhydride ($C_8H_4O_3$), CAS 85-44-9

Synonyms: 1,2-benzenedicarboxylic anhydride, phthalic acid anhydride.

At room temperature, phthalic anhydride appears as white crystalline needles with a characteristic odor. Phthalic anhydride is soluble in in alcohol; slightly soluble in ether and water. Vapor pressure is < 0.3 Pa at 20˚C. In presence of water phthalic anhydride converts to phthalic acid.

2. Routes of exposure

Inhalation

Inhalation of dust and vapor is a relevant route of exposure. Acid anhydrides' irritant properties do not generally provide adequate warning of hazardous concentrations for acute exposures. Sensitized, allergic individuals may react to very low concentrations of acid anhydrides.

Skin/eye contact

Most exposures to acid anhydrides occur by skin contact. Direct contact with solid acid anhydrides or dusts on eyes or skin causes irritation.

Ingestion

Ingestion of acid anhydrides can cause irritation to the lips, mouth, throat, esophagus, and stomach.

3. Acute health effects

Respiratory

Acid anhydrides exposure usually causes coughing, sore throat and wheezing. Inhalation may result in obstruction of the airways and respiratory distress with chest pain and dyspnea. Several cases of occupational asthma have been reported.

Dermal

Irritation, redness and pain of the skin and mucous membranes may be caused by contact with acid anhydrides. Skin sensitization with occasional urticaria and eczematous response may occur.

Ocular — Eye irritation with burning discomfort, spasmodic blinking or involuntary closing of the eyelids, redness, and tearing may be caused by contact with acid anhydrides.

Gastrointestinal — Abdominal pain, nausea, and vomiting may occur. In cases of ingestion, irritation can involve the entire intestinal tract.

Dose-effect relationships — Dose-effect relationships are as follows:

Maleic anhydride concentration	Effect
1 mg/m^3	- TLV-TWA (USA, NIOSH)
1.0 mg/m^3	- Odor threshold
1.5 mg/m^3	- Mucous membrane irritation
2.5 mg/m^3	- Extremely irritating
10 mg/m^3	- IDLH (USA, NIOSH)

Phthalic anhydride concentration	Effect
6 mg/m^3	- TLV_TWA (USA; NIOSH)
0.32 mg/m^3	- Odor threshold
25 mg/m^3	- Mucous membrane irritation
30 mg/m^3	- Conjunctivitis
60 mg/m^3	- IDLH (UUS, NIOSH)

4. Actions

Rescuer self-protection — **If the zone which has to be entered by the rescuer is suspected of containing acid anhydride dusts or vapors, pressure-demand, self-contained breathing apparatus and chemical-protective clothing shall be worn; do not use equipment that is contaminated itself.**
Patients whose clothing or skin is contaminated with acid anhydrides can cause secondary contamination of rescue and medical personnel by direct contact.

Patient recovery — Patients should be removed from the contaminated zone immediately. Patients who are unable to walk may be removed on backboards or stretchers; if these are not available, carefully remove/transport patients with appropriate action to a safe zone, taking into account your self-protection.
Immediate priorities must follow the "**A, B, C's**" of resuscitation.

Decontamination — Patients exposed only to acid anhydride dusts or vapors who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination.

Patients who are able and cooperative may assist with their own decontamination. If the exposure involved solid acid anhydrides and dusts and if clothing is contaminated, remove and double-bag the clothing.

If any solid acid anhydrides or dusts are present on the patient's skin, hair or clothes, brush it away before flushing. Protect yourself and the patient's eyes.

Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 15 minutes, and that the pH of the conjunctival fluid has returned to normal (7.0). If not, continue eye irrigation during other basic care and transport. If eye irrigation is impaired by blepharospasm, one to two drops of oxybuprocaine 0.4% may be instilled into affected eyes to allow adequate irrigation.

Remove contact lenses if present and easily removable without additional trauma to the eye.

Then, assure that exposed skin and hair have been flushed with plain water for at least 15 minutes. If not, continue flushing during other basic care and transport. Protect eyes during flushing of skin and hair.

Initial treatment

Therapy will be empiric; there is no antidote to be administered to counteract the effects of acid anhydrides.

The following measures are recommended if the airborne exposure concentration is 1.5 mg/m3 maleic anhydride or greater or 30 mg/m3 phthalic anhydride or greater, if symptoms, e. g. eye irritation or pulmonary symptoms have developed, or if no exposure concentration can be estimated but exposure has possibly occurred:

- **Administration of oxygen**
- **Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.**

Patients with severe clinical respiratory symptoms (e.g. bronchospasms, stridor) should be treated as follows:
a) Nebulization of adrenaline (epinephrine): 2 mg adrenaline (2 ml) with
3 ml NaCl 0.9% and inhale through a nebulizer mask.

b) Administration of a ß2-selective adrenoceptor agonist, e.g., four strokes of terbutaline or salbutamol or fenoterol (one stroke usually contains 0.25 mg of terbutaline sulfate; or 0.1 mg of salbutamol; or 0.2 mg of fenoterol); this may be repeated once after 10 minutes. Alternatively, 2.5 mg salbutamol and 0.5 mg atrovent may be administered by nebulizer mask.
If inhalation is not possible, administration of terbutaline sulfate (0.25 mg to 0.5 mg) subcutaneously or salbutamol (0.2 mg to 0.4 mg over 15 minutes) intravenously.

c) Intravenous administration of 250 mg methylprednisolone (or equivalent steroid dose).

Patients with clinical signs of a toxic lung edema (e.g. foamy sputum, wet crackles) should be treated as follows:

a) Start CPAP-therapy (Continuous Positive Airway Pressure Ventilation).
b) Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose) is recommended.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.

Note: Efficacy of corticosteroid administration has not yet been proven in controlled clinical studies.

If acid anhydrides were in contact with the skin, chemical burns may result; treat as thermal burns: adequate fluid resuscitation and administration of analgesics, maintenance of the body temperature, covering of the burn with a sterile pad or clean sheet.

After eye exposure, irritation may result; apply supportive measures. Consult an ophthalmologist.

In case of ingestion of acid anhydrides, do not induce emesis; apply supportive measures.

Patients with an exposure concentration of 1.5 mg/m^3 maleic anhydride or more or 30 mg/m^3 phthalic anhydride or more or with ingestion of acid anhydrides as well as patients without available exposure measurements but suspected of being exposed to concentrations of 1.5 mg/m^3 maleic anhydride or

more or 30 mg/m³ phthalic anhydride or more should be transferred to a hospital/emergency department.

Patient release/ follow-up instructions

Asymptomatic patients exposed to an airborne concentration of **less than 1 mg/m³ maleic anhydride or 6 mg/m³ phthalic anhydride** as well as patients **who have a normal clinical examination and no signs or symptoms of toxicity may be discharged after an appropriate observation period in the following circumstances:**

a) The evaluating physician is experienced in the evaluation of individuals with acid anhydrides or irritant dusts exposure.
b) Information and recommendations for patients with follow-up instructions are provided verbally and in writing. Patients are advised to seek medical care promptly if symptoms develop or recur.
c) The physician is comfortable that the patient understands the health effects of acid anhydrides and the provided follow-up instructions.
d) Site physician is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release.
e) Heavy physical work should be precluded for up to 24 hours.
f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.
Patients who have serious skin or eye injuries should be reexamined in 24 hours.

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