North Carolina Department of Labor
Occupational Safety and Health Division

Raleigh, NC

Field Information System Standards Notice 69

Subject: The use of pH to determine the hazards associated with corrosive chemicals.

A. **Purpose.**

The pH of a chemical can be used to document its "injurious corrosive" nature for citation purposes. However, there are differing opinions as to which pH ranges should be used for citing the lack of eye protection and eye washes or the lack of skin protection and deluge showers. This notice is intended to provide a numeric system that will be of maximum protection to employees; that is medically documented and, therefore, more legally defensible; and that will provide consistent guidance to Compliance Officers.

B. **Standards.**

1. **1910.132(a) - Application.** Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, **chemical hazards**, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

2. **1910.133(a)(1).** The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, **liquid chemicals, acids or caustic liquids**, chemical gases or vapors, or potentially injurious light radiation.

3. **1910.138(a) - General requirements.** Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; **chemical burns**; thermal burns; and harmful temperature extremes.

4. **1910.151(c).** Where the eyes or body of any person may be exposed to **injurious corrosive** materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.

C. **Discussion.**

The pH of a chemical is one of the physical properties that may be an indicator of a potential hazard. The pH alone will not identify all chemicals that can damage the eyes and skin, nor should having the

pH be a requirement for issuing citations. However, if the pH can be determined, the information can be used for evaluating the hazard.

There is documentation of strong acids and bases damaging eyes and skin. (See the Reference section.) As such, OSHNC requires employers to provide eyewashes and to provide and require employees to use eye protection for acids in the pH range of 0 to 4 and alkalis in the range of 10 to 14. Additionally, employers must provide and employees must use skin protection for acids in the 0 to 2 range and alkalis in the 12 to 14 range.

<table>
<tr><th colspan="14">pH</th></tr>
<tr><th colspan="5">Acidic</th><th colspan="5">Neutral</th><th colspan="4">Basic</th></tr>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr>
<tr><td colspan="3">skin</td><td colspan="7"></td><td colspan="4">skin</td></tr>
<tr><td colspan="5">eyes</td><td colspan="5"></td><td colspan="4">eyes</td></tr>
</table>

The pH can be determined by using indicating paper specific for pH or by contacting the manufacturer. The pH of diluted solutions can also be determined as every 10-fold dilution brings the pH one unit closer to neutral (7).

D. **Action.**

CSHOs will use the information above when evaluating when eye and skin protection and eyewashes are required.

E. **Effective Date.**

This Standards Notice is effective on the date of signature. It will remain in effect until revised or canceled by the Director.

Signed on Original
Roseanne P. Morgan, MS, CIH
Health Compliance Officer II

Signed on Original
Allen McNeely
Director

7/01/04
Date of Signature

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References and Supporting Documentation

1. http://www.revoptom.com/handbook/sect3h.htm

Handbook of Ocular Disease Management; Joseph W. Sowka, OD, FAAO; Andrew S. Gurwood, OD, FAAO; and Alan G. Kabat, OD, FAAO; c 2000 - 200,1 Jobson Publishing L.L.C.

Chemical Burns

PATHOPHYSIOLOGY

"Both acidic (pH<4) and alkaline (pH>10) solutions are capable of inducing a chemical burn. Acids tend to bind with tissue proteins and coagulate the surface epithelium. This bars further penetration so acid burns are typically confined to superficial tissues. Most commonly, acid burns to the eye result from exploded car batteries, which contain sulfuric acid.

Alkaline burns occur more frequently and are generally more severe than acid burns. These solutions destroy the cell structure not only of the epithelium but also of the stroma and endothelium. While acids create an initial burn and then cease, alkalis may continue to penetrate the cornea long after the initial trauma. Common sources of alkalis include ammonia, lye and lime."

MANAGEMENT

"A chemical burn requires immediate care. The patient needs prompt, copious fluid irrigation of the affected eye, particularly with alkaline trauma. If the initial contact with the patient is by telephone, advise flushing the eye with water for twenty to thirty minutes before coming to the office or clinic. If a patient presents without having irrigated the eye, perform a prolonged lavage with saline solution before any other procedures.

Next, test the eye with litmus paper to establish the residual pH. If near neutral (i.e. 6 to 8), the lavage may be discontinued. Check the lids and fornices and remove any particulate matter (more common with drain cleaners, cement, etc.). Debride any necrotic corneal or conjunctival tissue under the biomicroscope, using a cotton-tipped applicator moistened with antibiotic solution; swab the fornices in a similar fashion. Following this, a strong cycloplegic agent (e.g. 0.25% scopolamine) and broad spectrum antibiotic ointment should be instilled.

If significant epithelial erosion has occurred, consider a pressure patch. In cases of very severe burns, the patient may need to use a topical corticosteroid judiciously during the first week following trauma (1% prednisolone acetate Q2-4H). Depending upon the level of pain, a narcotic analgesic may also be necessary. Evaluate patients daily, and continue medications until resolved. It is also important to monitor the intraocular pressure; IOP spikes may occur as late complications of chemical burns due to blockage of the trabecular meshwork by inflammatory debris.

Most acid burns are manageable if they present with mild to moderate stromal haze-they will only get better with time. Alkaline burns, on the other hand, may require some thought, as the presentation at day one may be far better than that seen at day two or three. If there is significant necrosis and perilimbal ischemia at presentation, and if the cornea is even moderately hazy, consider referring the patient as soon

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as the immediate condition is stabilize."

2. http://www.nlm.nih.gov/medlineplus/ency/article/000054.htm

"With acidic burns, the hazing of the cornea often clears with a good chance of recovery. However, alkaline substances -- such as lime, lye, commercial drain cleaners, and sodium hydroxide found in refrigeration equipment -- can cause permanent damage to the cornea. Ongoing damage may occur in spite of prompt treatment."

3. http://www.emedicine.com/derm/byname/burns-chemical.htm

"In addition, acids with a pH lower than 2 cause coagulative necrosis upon contact with the skin. On the other hand, alkali agents with a pH higher than 11.5 cause liquefactive necrosis, allowing deeper penetration of the chemical. However, chemical classification is not an easy task because chemical agents can often be classified into more than 1 category."

4. http://www.cdc.gov/elcosh/docs/d0300/d000303/d000303.html

What are work-related skin problems?

"Among Portland cement products workers, the most common skin disorders are dry skin, irritant contact dermatitis, allergic contact dermatitis, and cement burns.

Dry skin may include irritation, scaling, itchiness, burning, and redness.

Irritant contact dermatitis (ICD) can be acute or chronic. Symptoms include stinging, pain, itching, blisters, dead skin, scabs, scaling, fissures, redness, swelling, lumps, and watery discharge.

Allergic contact dermatitis (ACD) is an immune response involving the skin. Hexavalent chromium in cement is a primary cause. ACD includes many of the same symptoms as ICD. ACD is difficult to cure and may persist for years.
Cement burns produce blisters, dead or hardened skin, or black or green skin. If you get a cement burn, go straight to a burn specialist or the emergency room for treatment. By the time you are aware of a cement burn, much damage has already been done. A cement burn can continue to get worse even after you have rinsed off the cement."

What is pH?

"pH is a measure of the alkalinity or acidity of a material. Pure water is pH 7. pH 7 is considered pH-neutral. The pH scale runs from 1 to 14. Strong acids are less than pH 1 to 3. Vinegar is a weak acid (3.5 pH). Skin is 4.5 pH. Strong alkalies are 12 to 14 pH. Wet cement -- and lye -- are 12 to 13 pH.

Like the Richter scale for earthquakes, the pH scale is logarithmic. For every whole number increase or decrease, the pH changes 10-fold! The pH of wet cement is one billion times higher than the pH of your skin.

Skin exposed to wet cement becomes more alkaline. At higher pH, skin is more permeable and absorbs

more chemicals. Higher alkalinity also may encourage bacterial growth, causing infections that worsen skin problems."

What is an alkali?

"An alkali is a caustic material. Alkalies have a corrosive or irritating effect on living tissue. Like acids, alkalies burn skin. But alkalies are sneakier than acids. Alkalies damage skin slowly. An alkali such as wet Portland cement can stay on your skin for several hours before you feel the chemical burn. Acidity and alkalinity are measured on a pH scale."