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Safe Handling of Enzymes

By the Enzyme Technical Association, Washington, D.C.

Enzymes have been used for over 35 years in the textile industry for the desizing of cloth and fabric finishing. Implementing an enzyme safety program is important for limiting exposure to enzymes and maintaining employee health and safety in the workplace. Elements of an enzyme safety program include employee training, control measures, and medical surveillance.

This article, written by the Enzyme Technical Association (ETA), provides information on safe enzyme handling practices for the textile industry. The ETA is a trade association of U.S. enzyme producers and distributors, and has supported the safety production and use of enzyme products since 1970.

The information presented here is general information and may not be entirely applicable to all enzyme handling situations. It is important to recognize that the article is not a substitute for evaluations conducted by specialists or professionals in the areas of industrial hygiene, safety, medicine, and engineering. Many articles have been published on the various aspects of enzyme safety. Information for this article was obtained from the Soap and Detergent Association's (SDA) document titled Work Practices for Handling Enzymes in the Detergent Industry published in 1995. This document can be obtained from the SDA; telephone 212-725-1262.

Health Effects

According to the SDA document, "Exposure to enzymes may cause irritation and/or respiratory allergies." The primary routes of exposure to enzymes are by inhalation and skin and eye contact. Preventing exposures by these routes is the goal of an enzyme safety program. Enzymes can be safely handled by using safe product design, engineering controls, safe work practices, and appropriate personal protective equipment.

Skin and Eye Exposure

Skin and eye contract with proteolytic enzymes, those with the ability to break down complex proteins into simpler products, may cause irritation. Other classes of enzymes are less irritating or pose no risk of irritation. However, formulation ingredients may be irritants so it is important to consult each product's material safety data sheet (MSDS) for safety precautions. Exposed areas should be protected by using hand and eye protection and other protective clothing. When

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the exposure is discontinued, the irritation should disappear. There is no evidence to indicate that enzyme allergies are developed through skin contact.

Inhalation

As with any protein that is foreign to the respiratory system, repeated inhalation of enzyme containing aerosol (dust or mist) can cause a respiratory allergy in some individuals.

There are two main stages to the development of a respiratory allergy, which is also called Type 1 immediate hypersensitivity.

The first stage is called sensitization and this occurs when the individual is first exposed by inhalation to the allergen such as an enzyme, house dust, or pollen. As stated in the SDA document, "if enough enzyme is inhaled, the body will begin to recognize the enzyme as a foreign material and will produce allergic antibodies. Once allergic antibodies are produced, the individual is said to be sensitized." However, sensitization is not a disease as there are no allergic symptoms at this stage.

In the second stage, clinical allergic symptoms can occur when a sensitized individual is re-exposed to an allergen such as an enzyme. Symptoms of enzyme allergies are no different than allergies to other materials such as house dust, animal dander, or pollen and can include sneezing, congestion, coughing, watery eyes, or a runny nose. Symptoms will only occur if enzyme dust or aerosols are inhaled and should disappear when the exposure is discontinued. It is important to note that not all sensitized individuals will develop allergic symptoms. The development of allergies depends on the susceptibility of the individual and the exposure concentration.

Control Methods

The goal of an enzyme safety program is to maintain employee exposures below a level that could cause an adverse health effect. The elements of a safety program include product design, engineering controls, work-practice controls, and personal protective equipment.

Product Design

The physical form of the enzyme can greatly influence the potential for aerosol formation. Therefore, the product form often dictates the selection of engineering controls, handling procedures, and the type of protective equipment needed to provide adequate protection to the employee. Enzyme aerosols can be in the form of liquid droplets, mists, solid particles, or dusts. Powdered enzyme formulations present the greatest potential for exposure because they are easily aerosolized. Granular enzyme formulations encapsulate the enzyme to prevent its release into the air. They have low dusting capabilities, but care must be taken not to crush them. Liquid

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enzyme formulations have a potential for aerosolization when any type of mechanical agitation is taking place, such as container filling or cleaning of spills.

Engineering Controls

Engineering controls should be designed for the specific product form and production process. A qualified ventilation expert should evaluate and design the control measures. Key components of an effective program include overall plant and equipment design, performance verification, system maintenance, process design, and management of process changes.

Engineering controls in the form of enclosures and local exhaust ventilation are the most effective methods to control enzyme exposures. Using enclosures and local exhaust ventilation together will assist in isolating the enzyme preparation from the employee. Local exhaust ventilation and enclosures should be used in the following areas: locations where enzyme preparations are added into the process, material transfer points, and where the enzyme-containing product is packaged into containers.

Work Practice Controls

Proper work practice procedures are also important in controlling enzyme aerosols and are often used in conjunction with engineering controls and personal protective equipment. Operational goals in the facility should include making sure that there are no visible dust or recurring spills; minimizing skin contact as much as possible; avoiding prolonged temporary repairs on equipment; and preventing, as well as containing, aerosol generation.

Each site that works with enzyme preparations should have programs which address good housekeeping and work practices. It is important to implement work practices that do not generate enzyme aerosols or result in direct skin contact. Safe work practices include proper enzyme transfer procedures, cleaning procedures, spill cleanup, and good personal hygiene. High-pressure water, steam, and vacuums without HEPA (high-efficiency particulate arresting) filters should be avoided. Spills should not be swept or brushed, and washing facilities should be accessible and well maintained. Good personal hygiene should be encouraged and practiced.

Initial and continuing education of employees and contractors on the health effects of enzymes will allow better understanding and compliance with safe work practices.

Personal Protective Equipment

Personal protective equipment should only be used as a supplement to engineering controls and work practice controls. The exclusive use of personal protective equipment instead of these other controls is strongly discouraged.

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When needed, respiratory, eye, and skin protective equipment are used.

Respiratory protection equipment prevents exposure by filtering airborne enzyme aerosols or supplying clean air to the worker. The type of respirator that should be used depends on the airborne concentration of the enzyme, time spent in the production area, and worker activity.

As in any industrial environment where chemicals are used, eye and skin contact should be avoided. Commonly used protective eye wear includes safety glasses with side shields, splash goggles, or, for more protection, a face shield. The type of eye protection should be determined by the potential for contact with enzymes and the type of process or operation the employee is conducting. Protective clothing is important when the potential for splashing or immersion is possible. Common pieces of equipment used to protect the skin are rubber gloves, splash aprons, and full protective suits.

Again, the type of protective equipment to use depends on the potential for contact with enzymes and type of process or operation the employee is conducting. A qualified safety and health professional should be consulted for the selection of personal protective equipment. Education and training is vital to ensure the proper use of protective equipment.

Air Monitoring

An air monitoring program can evaluate the potential for employee exposure to airborne enzymes and determine if current engineering control measures are working properly or if additional control measures are needed. Air monitoring is also valuable for the proper selection of respiratory protection. Contact your enzyme supplier for additional information on air monitoring for enzymes.

Medical surveillance

A medical surveillance program monitors employees' health and can provide early detection of potential health problems. >Such a program includes a medical history, a medical examination of the employee, pulmonary function tests, and the determination of enzyme sensitization. All these elements become a baseline for the health and well being of the worker.

There are always many questions asked about the medical evaluation of allergies or a person's sensitization to specific allergens. There are two commonly used tests. The first is called the skin prick test which is commonly used by allergists. In this test a small drop of the specific enzyme allergen is placed on the forearm and a sterile needle is used to gently lift the skin. A sensitized individual will have a wheal and flare appear on the arm. This is a indication of the presence of allergic antibody. The second method is a blood test called a RadioAllergoSorbent Test (RAST) which evaluates a specific enzyme allergen present in a person's blood stream.

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While sensitization is not an illness, it is an indication that an employee has been exposed to sufficient enzyme concentrations to cause the development of allergic antibody. If a worker is found to be sensitized to an enzyme, it could mean that current work practices, engineering controls and personal protective devices are not meeting their goals and would need to be reevaluated by plant personnel.

Sensitization does not prevent an employee from working in an adequately controlled plant environment. Sensitized employees are at a grater risk of developing allergy symptoms. Because of this, all employees should be educated in safe work practices that minimize exposure. If allergy symptoms start to develop, the employee should be instructed to notify their supervisor immediately.

Summary

Enzymes can be handled safely through the use of appropriate control methods. Establishing safety programs and educating employees are the first steps to a safe and productive plant operation. If you should have further questions, please contact your enzyme supplier.