ENZYMES SAFETY

Q&A from AISE/AMFEP webinar series

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The present document collects the questions received and the answers given by the experts during the live stream of the webinar series presented by the A.I.S.E./AMFEP companies.

Q1. If enzymes are made by bioengineering from fungus or bacteria. Is there a risk to humans?

A1. No! The enzyme additives for detergent are a purified protein and do not contain any live bacteria, or any of its DNA.

Q2. Does smoking put you at increased risk for getting sensitized?

A2. There are several studies in the literature that indicate that smoking increases the risk of being sensitized. Others do not. One thing that is clear—smoking does not protect people from being sensitized.

Q3. I heard that he application of heat or some chemicals to enzymes will deactivate the enzymes. If that occurs, I can't get sensitized to that enzyme, correct?

A3. An enzyme can be deactivated, that is, no longer show enzyme activity when working on stains, yet still be capable of sensitizing someone. That is because the portion of the enzyme protein which causes sensitization (a short section of amino acids called an "epitope") might not be destroyed.

Only when the enzyme protein is "denatured", that is, entirely broken up into small amino acid pieces, will it no longer sensitize. Denaturing can take quite some time at boiling water temperatures, but can be accelerated in the presence of caustics and bleaching chemicals. Pieces of proteins less than 20 amino acids in length are felt to no longer sensitize.

Q4. Why are peak exposures important? What is the relative importance of peaks versus continuous background levels?

A4. Historical laboratory studies show that both peak and background exposures are important in causing sensitization. However, peak exposures are felt to be of key importance because as an industry, the detergent industry has observed very low background levels of exposure, typically < 1 ng/m3 while peak exposure studies show that occasional peaks of up to 50x the OEG occur for periods of 2-3 minutes can occur during process changeover and as a result of process upsets. This is why supplementing engineering controls with good respiratory protection programs is very important.

Q5. Is there a vaccine or pill I can take to prevent me from being sensitized?

A5. No! Besides the focus should go into exposure control through engineering, administrative, and PPE in order to prevent sensitization rather than asking employees to take a pill or vaccine, each having its own risks.

Q6. Will antihistamines prevent me from being sensitized?

A6. Antihistamines may decrease any allergy symptoms, but they will not prevent you from being sensitized to any allergen including enzymes.

Q7. What if I already have asthma? Will enzymes affect me more?

A7. People with asthma will not necessarily be affected more when exposed to asthma producing agents (enzymes, pollen, animal dander ….) Their response will depend on the type of asthma they have and what triggers their asthma

Q8. Can the skin test actually sensitize someone?

A8. No. It is difficult to induce Type I allergy, with production of IgE, through skin exposure as compared with Type IV allergy that is easier and results in allergic skin disease. The lung is much better organized to process antigen and induce IgE production. Additionally, only 1/30,000 of a milliliter is introduced into the superficial layer of the skin. This is not enough to induce sensitization, but is enough to link with any IgE present to produce a skin test reaction if a person has already been sensitized.

Q9. What scenarios must be considered to determine when PPE may be needed when handling enzymes or enzyme containing products?

A9. Enzymes and enzyme containing product pose a direct skin irritation hazard, hence we want to prevent both incidental and prolonged skin exposure. This risk is heightened in the manufacturing of liquid products as the enzymes are not encapsulated and the liquid can stick to the skin. It is also important to prevent contamination of the skin and clothes as enzyme contamination can be transferred to the eye and nose (mucous membranes) creating a possible sensitizing exposure. It is also important to emphasize that Enzymes (powders and liquids) contaminating the skin and clothes can be transported by the exposed individual to other areas (offices, canteen, etc.) spreading contamination to other areas of manufacturing plant which needs to be prevented.

Q10. Scenario: R&D laboratory for cellulase improvement of about 1000 m2; 30 people using techniques at µl-ml scale, but also 20 L fermenters in a dedicated room. When setting up an environmental enzyme monitoring program, taking air samples for evaluation by ELISA, what could be the reccomended frequency for air monitoring with this method?

A10. This is a difficult question because there are some details regarding the type and number of tasks, frequency of operations, and higher risk tasks that would need to be considered.

However making the assumption that in the main laboratory where the work is at a micro/milliliter scale, and that the daily routine is fairly consistent, I would firstly identify any differences in the work pattern throughout the day that may lead to different types of exposures; for example some form of sample preparation may take place in the morning, sample analyses mid-day/early afternoon, sample disposal and cleaning / washing of glassware late afternoon; that leads to three specific segments of the day where exposures could be different. For each segment of the day identify where in the lab you think the highest exposure risk location[s] might be and these could be your defined sampling locations Sampling will be via high volume area sampling [which is described in AISE guidance and will be discussed in a future webinar]. Then we need to think about sample frequency. To begin with I would personally prefer to generate a higher number of samples to achieve

confidence quickly in the control measures; so for a period of a few weeks sample at one location each day, or two locations per day for a large lab with a higher number of potential sample locations. Having then established the capability of your controls, and assuming they are adequate, you can reduce the sampling frequency for the next few months to a lower level, maybe each location once per week, and then finally if you have absolute confidence with no excursions, reduce sampling to each location once per month. If you have an area that you do not have absolute confidence in then you can maintain a higher sample frequency at that location until improvements have been implemented and are demonstrated to be effective.

For the fermentation area the same principle applies; but making the assumption that this is a largely unmanned area with a good air exchange rate probably a single sample location during closed fermentation processes will suffice; with more targeted sampling during higher risk tasks such as charging / discharging / cleaning the fermentation vessels and associated equipment.

Q11. If engineering controls are not in place, can air monitoring be used to prove that the area is safe? For example, a packing line does not have enclosure or ventilation but the air monitoring never gives a high enzyme result, can this be used as evidence that engineering controls are not required?

A11. Area monitoring when coupled with condition audits that reinforce good hygienic practices in the workplace can provide an indication that exposures are limited and that the design and operation of a controlled process is acceptable. The high allergenic potency of enzymes as indicated by the Occupational Exposure Guidelines (OEGs) used within the detergent industry and the limitations of the currently available sampling and analytical methods make reliance on such results to support the **operation of an uncontrolled process is ill-advised**. While the mechanism is not completely understood, detergent industry experience indicates that relatively short, "peak" exposure conditions, above the referenced exposure limits, and not easily detected, are relevant to the potential development of allergy and asthma cases in the workplace. Thus, the industry experience which is outlined in the AISE Guidelines for the Safe Handling of Enzymes in Detergent Manufacturing emphasizes that well designed processes coupled with local exhaust ventilation are paramount to exposure prevention and the delivery of a successful enzyme management system.