

Working with enzymes

When enzymes are handled correctly,
there is no cause for concern

Rethink Tomorrow

novozymes® 



Contents

Introduction

- 6 What are enzymes?
- 8 Health issues related to working with enzymes
- 10 What is respiratory allergy?
- 12 What is respiratory enzyme allergy?
- 14 How do you test for enzyme allergy?

Handling precautions

- 18 Main principles of minimizing enzyme exposure
- 20 The design of enzyme products
- 24 How dust or aerosols can be generated accidentally
- 26 How to measure airborne enzyme levels
- 28 How to handle enzymes
- 30 Manage accidents, cleaning, repair work and spills
- 32 When to use respiratory protection
- 34 Personal hygiene is essential
- 36 First aid in the event of direct exposure to enzymes
- 38 Information for medical doctors

- 39 Safety summary

If after reading this brochure you have any questions or comments, please contact Novozymes.



Introduction

Like many other substances in concentrated form, enzymes should be handled with care. This booklet contains information on how to handle enzyme products in a safe manner. It also provides background information on enzymes and the risks of developing allergy and skin irritation when working with enzymes.

What are enzymes?

Enzymes are specialized proteins that are naturally present in all living matter. Human beings, animals, plants—all living cells depend on enzymes to sustain life and grow. For instance, in your digestive system, enzymes play a key role in breaking down the food you eat.

However, while enzymes are vital for life, they are not themselves living substances.

Enzymes are catalysts that in minute amounts, have the ability to speed up specific chemical reactions and processes. Enzymes can be produced industrially and are commonly used as components in detergents and as processing aids in the manufacturing of bioethanol, starch, textiles, food, beverages, feed and many other products.



Health issues related to working with enzymes

Enzymes are biodegradable, water soluble and generally non-toxic. However, if not handled correctly, health-related issues such as skin irritation and respiratory sensitization, may occur when working with enzymes in industrial settings.

Skin irritation may occur if you come into direct contact with protein-degrading enzymes (proteolytic enzymes). Prolonged and direct exposure of skin or mucous membranes (particularly eyes and nose) to proteolytic enzymes may in some cases cause redness and itching of skin or mucous membranes.

The irritation will cease shortly after the exposure to the proteolytic enzyme stops, and full recovery is normally observed within a few days.

Respiratory sensitization, on the other hand, is a more serious occupational health issue, as it may develop into respiratory allergy. The primary focus of this booklet is to explain how respiratory allergy develops and how to avoid developing this type of allergy.

Health issues are related to workers' safety only.

They do not apply to consumers, as enzymes are safe to use in consumer applications.

What is respiratory allergy?

Naturally occurring proteins from pollen, house dust mites, animal hair and fungi are known as common respiratory allergens and can cause allergies. These proteins are all able to become airborne.

Respiratory allergy

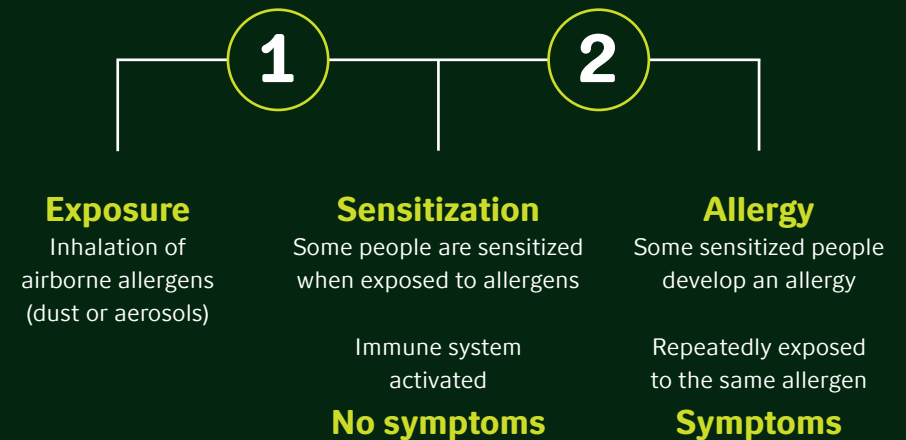
Development of respiratory allergy is a two-step process. In the first step, the allergen is inhaled, then transferred into the blood circulatory system via the lung tissue. In some individuals this will make the body produce antibodies against the allergen, but in most individuals, no antibodies against the allergen will be generated. If antibodies against the allergen are produced, the person is *sensitized*.

The presence of antibodies can be measured either by a skin test or blood analysis. At this point, a sensitized person does not experience any symptoms.

However, if a sensitized individual is repeatedly exposed to the same allergen, a second step may occur leading to the development of the symptoms described on the next page. If such symptoms appear, the person is *allergic*.

Allergic symptoms will disappear when the exposure to the allergen has stopped. However, the symptoms will reappear if the exposure is repeated.

The development of respiratory allergy is a two-step process



Respiratory allergy symptoms

The symptoms associated with respiratory allergy are similar to those commonly related to hay fever and asthma:

- Persistent sneezing
- Runny nose
- Watery eyes
- Breathing difficulties
- Coughing

What is respiratory enzyme allergy?

Like the common respiratory allergens mentioned earlier, enzymes are proteins that may become airborne as dust or aerosols.

Airborne enzymes can be inhaled and can cause respiratory allergy in susceptible individuals if repeatedly exposed.

If you develop a respiratory allergy when working with enzymes it is called an enzyme allergy. The symptoms will only occur if you inhale enzyme dust or aerosols.

Symptoms usually disappear within hours or, at most, a few days if exposure ceases. Apart from allergies, no long-lasting health effects from working with enzymes have been found.

Some allergens can cause sensitization via ingestion or skin contact. However, enzyme allergy has not been observed from oral intake of enzymes or from skin contact with enzymes.



Why do some people develop enzyme allergy?

Airborne enzymes do not affect everybody, in the same way that not all people suffer from hay fever.

Some people have an inherent risk of either becoming sensitized or allergic to common allergens. People who are either sensitized or allergic to common allergens are called *atopic*.

While atopic persons are not the only individuals who can develop allergic symptoms to enzymes, they are more susceptible than non-atopic individuals.

How do you test for enzyme allergy?

If you develop any of the symptoms listed earlier after working with enzymes, consult your company's medical staff or your own doctor. Remember that these symptoms may not occur until after working hours—in the evening or at night.

It is obvious that ordinary hay fever, cold or flu symptoms may resemble enzyme allergy. However, if the symptoms appear more often than normal, particularly during working days and less often or never during weekends and holidays, your symptoms should be investigated further.

When a person becomes sensitized or allergic to an enzyme, the body has produced antibodies against the enzyme. A simple skin test can show the presence of antibodies and thereby confirm if the person is allergic or is developing an allergy. Alternatively, a blood test can be used to quantify the number of antibodies produced against a specific enzyme.



A skin test may detect antibodies even if the person has no symptoms of allergy. If precautions are not taken to reduce exposure, allergic symptoms may develop later on



Handling precautions

When enzymes are handled correctly,
there is no cause for concern

Main principles of minimizing enzyme exposure

Enzyme allergies are associated only with inhalation of either enzyme dust or aerosols. Therefore, the way to minimize the risk of developing enzyme allergies is to reduce the risk of formation and spreading of enzyme dust or enzyme aerosols.

Three main aspects to consider in reducing enzyme exposure:

- The design of the enzyme product
- Process design and engineering control at enzyme-handling facilities
- Good work practices



Airborne enzymes

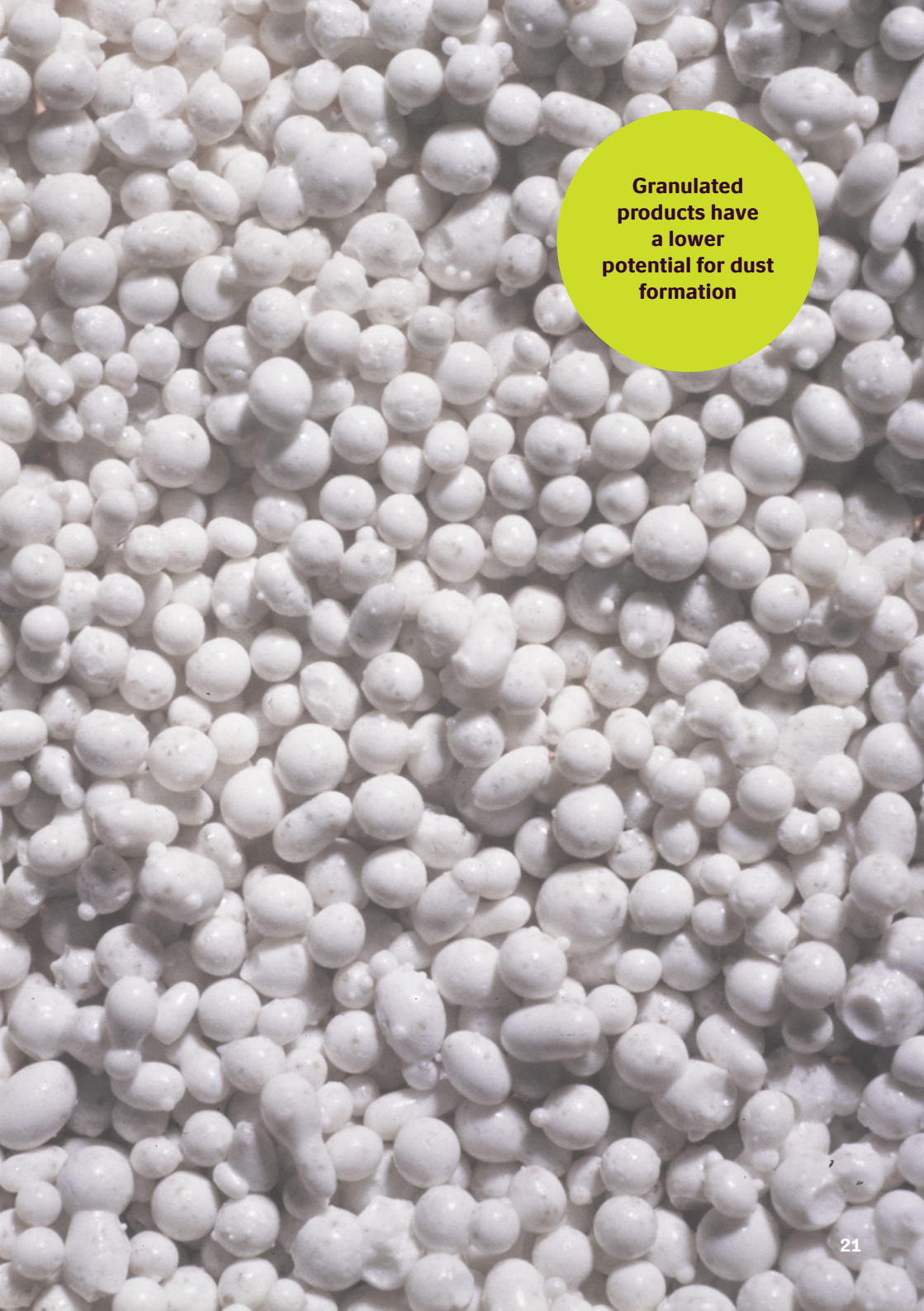


The design of enzyme products

The risk of developing enzyme allergy when handling enzymes has been known since the late 1960s. The earliest enzyme allergies were discovered at detergent factories handling huge amounts of enzymes in powder form—in other words, a very dusty product.

The level of airborne enzymes has been greatly reduced or virtually eliminated in factories by the introduction of safer formulations and closed handling systems with good ventilation.

In general, there are three main formulations of enzyme products: powder, granulates and liquid products.



Granulated products have a lower potential for dust formation



Liquid enzymes

Liquid products are generally safe during handling. However, it is important to remember that aerosols can be created from liquid enzyme products if they are handled incorrectly.

Airborne enzyme may be generated if a spill from the liquid enzyme product is left to dry out.



Granulated enzymes

Granulated products have a low potential for dust formation. The enzyme material is trapped in the granulates, thereby reducing the release of enzyme dust. The dry products sold by Novozymes are designed for minimal dust generation. The enzymes are either coated onto small particles, formulated into agglomerates, or encapsulated in a tough coating.

Be aware that enzyme dust can be released if the granulates are broken, for example by harsh mechanical stress.



Powder enzymes

If dry enzyme products are neither granulated nor coated in any way, they are powder formulations. Such powder products have a very high potential for dust formation. It is therefore difficult to control dust formation and airborne enzyme exposure when handling powder enzyme products. This is why it is Novozymes' general policy not to supply powder enzyme products.

How dust or aerosols can be generated accidentally

Despite the advanced design of the enzyme products, dust or aerosols can still be generated.

- When enzyme granulates are exposed to harsh mechanical forces, for example during mixing, agitation or pneumatic transportation
- When enzyme granulates are damaged, for example when stepped on or run over by a truck
- When enzyme granulates are milled into smaller particles
- When enzyme liquids are sprayed, splashed or stirred vigorously, pumped with air, cleaned with high-pressure air or water jets
- When liquid spills are left to dry
- When spills are not removed immediately
- When filling containers with enzyme materials, as the replaced air may contain airborne enzymes



How to measure airborne enzyme levels

The level of airborne enzyme can be measured using air-sampling equipment.

The level of enzyme dust or aerosols in the air can be measured using air-sampling equipment. Workplace air is passed through a filter that collects the dust and aerosol particles.

When the air sample has been collected, the filter is sent to a laboratory, where the amount of enzyme collected on the filter, if any, is measured by using sensitive analytical methods.

Such exposure measurements can be translated into valuable knowledge that can be used to improve workplace safety.

Examples of air-monitoring equipment



Portable medium-volume pump
Used for point monitoring



Stationary high-volume pump
Used for measurement of area exposure

How to handle enzymes

Even if there are no visible signs of dust or aerosols, safety precautions must be taken at all times.

Avoid direct contact with enzymes

Wherever possible, enzyme products should be weighed, poured and otherwise handled in a closed system. If enclosure is not possible, exhaust ventilation systems should be installed in positions where enzyme exposure potentially could occur.

Where open handling cannot be avoided, personal protection equipment must be used in order to protect skin, eyes and respiratory passages.

Remove spilled enzymes immediately

Spilled enzymes must be removed immediately. In the case of dry spills, it is recommended to use a vacuum cleaner. The filter specification must be “HEPA”. A low-pressure water hose may be used


to rinse the remains of dry spills or liquid spills into a nearby drain.

In the case of major spills, the area must be evacuated. Appropriate personal protection equipment must be carried by everybody during removal of the spill.

For major spills a clearing time (e.g. 1-2 hours) must be defined based on the volume of the spill, the cleaning operation and the type of ventilation system before re-entering the room without respiratory protection.

Do not spread dust to other areas

Be careful not to expose others e.g. when enzyme containers are disposed of or packaging material compressed.



Use vacuum cleaners equipped with an appropriate HEPA filter to remove spills of granulated enzymes

Manage accidents, cleaning, repair work and spills

Inform

In the event of the accidental release of enzyme dust or aerosols, your supervisor must be informed immediately so that the source of the problem can be located and corrective actions can be taken.

Depending on the location and extent of the release of enzyme dust, respiratory protection and protective clothing may be required temporarily.

Clean up

In the event of a breakdown, the production staff must, wherever possible, arrange cleaning before repair work begins. If cleaning has not been possible, maintenance staff must not start work on equipment used for handling enzymes until the area supervisor has given permission.

Maintenance staff must follow the safety precautions specified by the supervisor.

When repair work is complete, make sure that surfaces and components contaminated with enzymes are cleaned by the production staff in accordance with established procedures.



When to use respiratory protection

If there is a risk of dust levels in a factory exceeding the acceptable threshold value for enzymes, personal protection equipment must be used.

Under most operating conditions involving enzymes, respiratory protection is normally not necessary.

However, if there is a risk of dust levels in a factory exceeding the acceptable threshold value for enzymes, personal protection equipment must be used.

It is important that respiratory protection is clean and checked for proper fit at all times to ensure optimal protection. Masks should be stored away from enzyme exposure.

Appropriate respiratory protection must be worn.

The filter type specification must be P3, FFP3 or N100.



Examples of when to use respiratory protection:

- During open handling processes
- During manual disposal of packaging materials
- If the enclosure is breached, for example when process breakdown necessitates opening the enclosed system
- In the event of a major spill, in which case a clearing time must be defined before re-entering the room
- If the exhaust ventilation system is not working properly
- During certain maintenance operations
- When handling material collected by the local exhaust ventilation system
- If ordered by your supervisor, your safety officer or medical staff

Personal hygiene is essential


If the working environment is humid and relatively warm, the irritant effect of enzymes on your skin increases considerably. The moist parts of your body where you perspire are the most susceptible, especially the armpits, neck, forehead, feet and under a face mask.

Remember

- Wash your hands before eating, smoking or using the restroom. Use water and a mild soap, and dry your hands thoroughly afterwards
- Change your work clothes frequently
- Take a shower at the end of each working day

Avoid

- Direct contact with enzymes
- Contamination of clothes, as enzyme residues may be distributed to other parts of the plant or to your home
- Taking work clothes home for cleaning



Wash your hands
before eating,
smoking or using
the restroom

First aid in the event of direct exposure to enzymes

As the active component of enzyme products is water soluble, water should always be used to remove enzymes.

If enzymes are swallowed

- Rinse your mouth and throat thoroughly with clean water and spit out
- Drink plenty of water, soft drinks or juice afterwards

If enzymes are inhaled

- Move to an area with fresh air
- If symptoms of irritation or allergy occur, for example shortness of breath, wheezing or severe coughing, call a doctor. Symptoms may occur up to 12 hours after exposure

If enzymes come into contact with skin or eyes

- Rinse skin with plenty of water
- Hold your eyelids open while rinsing with plenty of clean water (use an eye fountain or an eye-rinsing bottle if available)
- See a doctor if irritation occurs

If clothes get contaminated

- Remove contaminated clothes. To avoid dust formation, soak the clothes in water and wash as usual
- Wash affected body parts or take a shower and change into clean clothes

Information for medical doctors

Show this information to your doctor in the event of allergic symptoms or skin irritation. Bring along the relevant Safety Data Sheet.

This medical information is intended only as a guideline. You should make your own diagnosis of the illness and prescribe the specific treatment required.

Symptoms similar to those of hay fever and asthma may occur up to 12 hours after enzyme exposure (inhalation) in sensitized persons. Symptoms affecting the respiratory tract are most likely to be of allergic origin, and we suggest that they should be treated as such in accordance with the standard treatment of respiratory allergies if treatment is

considered necessary. Expiratory dyspnea should be treated as allergic asthma.

When in direct contact, proteolytic enzymes may irritate the skin and mucous membranes, but the effect will cease with time. More pronounced skin irritation or eczema should be examined and treated.

Safety summary

Sensitization and allergy

Enzyme dust or aerosols can cause sensitization and eventually turn into an allergic reaction when inhaled

Prevent sensitization and allergy

Prevention of enzyme allergy = prevent inhalation of airborne enzymes

Skin irritation

Proteolytic enzymes may cause skin irritation

Avoid contact

Avoid unnecessary contact with enzyme products

Precautions

Acknowledge and follow handling precautions at all times

Enzymes are safe when handled correctly



About Novozymes

Novozymes is the world leader in biological solutions. Together with customers, partners and the global community, we improve industrial performance while preserving the planet's resources and helping to build better lives. As the world's largest provider of enzyme and microbial technologies, our bioinnovation enables higher agricultural yields, low-temperature washing, energy-efficient production, renewable fuel and many other benefits that we rely on today and in the future. We call it Rethink Tomorrow.

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