



Safe Handling of Enzymes in the Baking Supply Chain

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Introduction



This presentation will provide information on enzyme safe handling for the baking supply chain

Agenda

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Introduction to Enzymes?

2

Enzymes used in the Baking Industry

3

Health Effects of Enzyme Exposures

4

Working Safely with Enzymes

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References

What are Enzymes?

1 Enzymes are proteins produced in living cells

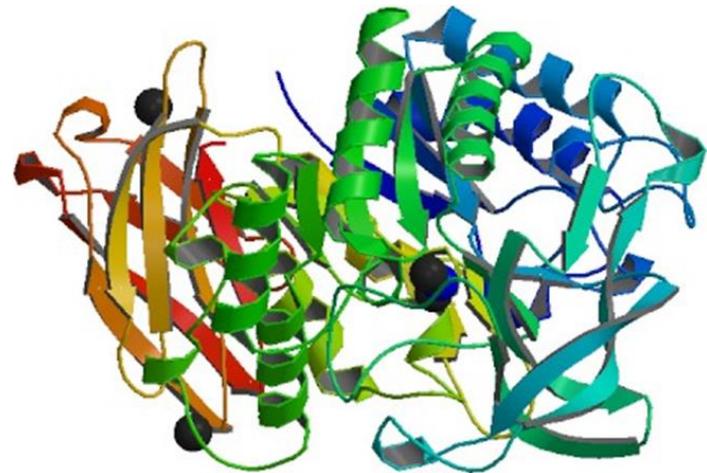
- Plants
- Animals
- Microorganisms

2 Essential for all living organisms

- Growth
- Production and utilization of energy

3 Act as catalysts

- Accelerate the breakdown or synthesis of organic compounds such as carbohydrates, fats, and proteins



Crystal structure of *Bacillus amyloliquefaciens* alpha-amylase
<http://www.rcsb.org/pdb/explore/explore.do?structureId=3BH4>

Enzymes Used in the Baking Industry

Enzyme class	Contribution
Fungal alpha-amylase	Flour correction: ensures desired end product characteristics such as volume, crust colour, and crumb structure
Lipase	Improves crumb structure and crumb colour
Phospholipase	Improves dough strength and stability, loaf volume and crumb softness
Xylanase	Improves dough stability, bread appearance and texture, superior volume of baked goods
Glucose oxidase	Improves gluten strengthening
Amyloglucosidase	Improves bread crust colour and bread volume
Maltogenic amylase	Improves moistness, softness and texture of baked goods
Protease	Reduces the strength of flour protein, thereby reducing mix time and elasticity and increasing the extensibility and softness of the dough.
Cellulase	Improves dough conditioning and nutritional profile in whole wheat or whole grain breads

**Note: Malted Barley Flour is as a source of amylase activity*

Reference: https://amfep.org/library/files/Industry_Guidelines_on_the_Safe_Handling_of_Enzymes_in_the_Bakery_Supply_Chain_-_MARCH_2018.pdf

Health Effects of Enzymes

Hazard Communication

1

The Hazard Communication Standard for most countries is UN Globally Harmonized System (GHS)

2

Enzymes are classified as respiratory sensitizers

3

Section 2 of the Safety Data Sheet (SDS) contains the hazard communication information for enzymes including: the hazard symbol, signal word, hazard statements and precautionary statements

4

All enzymes contain the same hazard communication information however, only proteases will carry an additional warning for skin irritation

Section 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture
Regulation (EC) No 1272/2008
Respiratory sensitisation

Category 1 - (H334)

2.2. Label elements
Contains: Alpha Amylase Phytase



Signal word
DANGER!

Hazard statements
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled

Precautionary Statements
P261 - Avoid breathing dust/fume/gas/mist/vapours/spray
P284 - In case of inadequate ventilation wear respiratory protection
P304 + P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P342 + P311 - If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician

EX

Danger

May cause allergy or asthma symptoms or breathing difficulties if inhaled. Avoid breathing dust/fume/gas/mist/vapors/spray. Wear respiratory protection. IF INHALED: Remove victim to fresh air and keep comfortable for breathing. If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.



Danisco US Inc.
Danisco Division
10000 Danisco Blvd.
Columbus, OH 43240
614-318-3916

Sample product label on package

Health effects associated with enzyme exposure



- Enzymes are known respiratory sensitizers – commonly called allergens
- Similar to other protein allergens, enzymes may cause respiratory allergy when *inhaled*.
- Allergy symptoms are similar to hay fever and can include:
 - Persistent sneezing
 - Runny nose
 - Watery eyes
 - Breathing difficulties
 - Coughing
- Skin irritation may occur in some cases, but has only been observed with proteases.
 - These are transient symptoms and are not related to allergies

How Does Allergy Develop?



Exposure

Inhalation of airborne allergens

Sensitization

Immune System Activated

- A person develops protein specific antibodies
- No Symptoms

Allergy

- May occur after repeated exposure
- Symptoms are present when enzyme protein is inhaled
- Not all sensitized people will develop allergy

Asthma

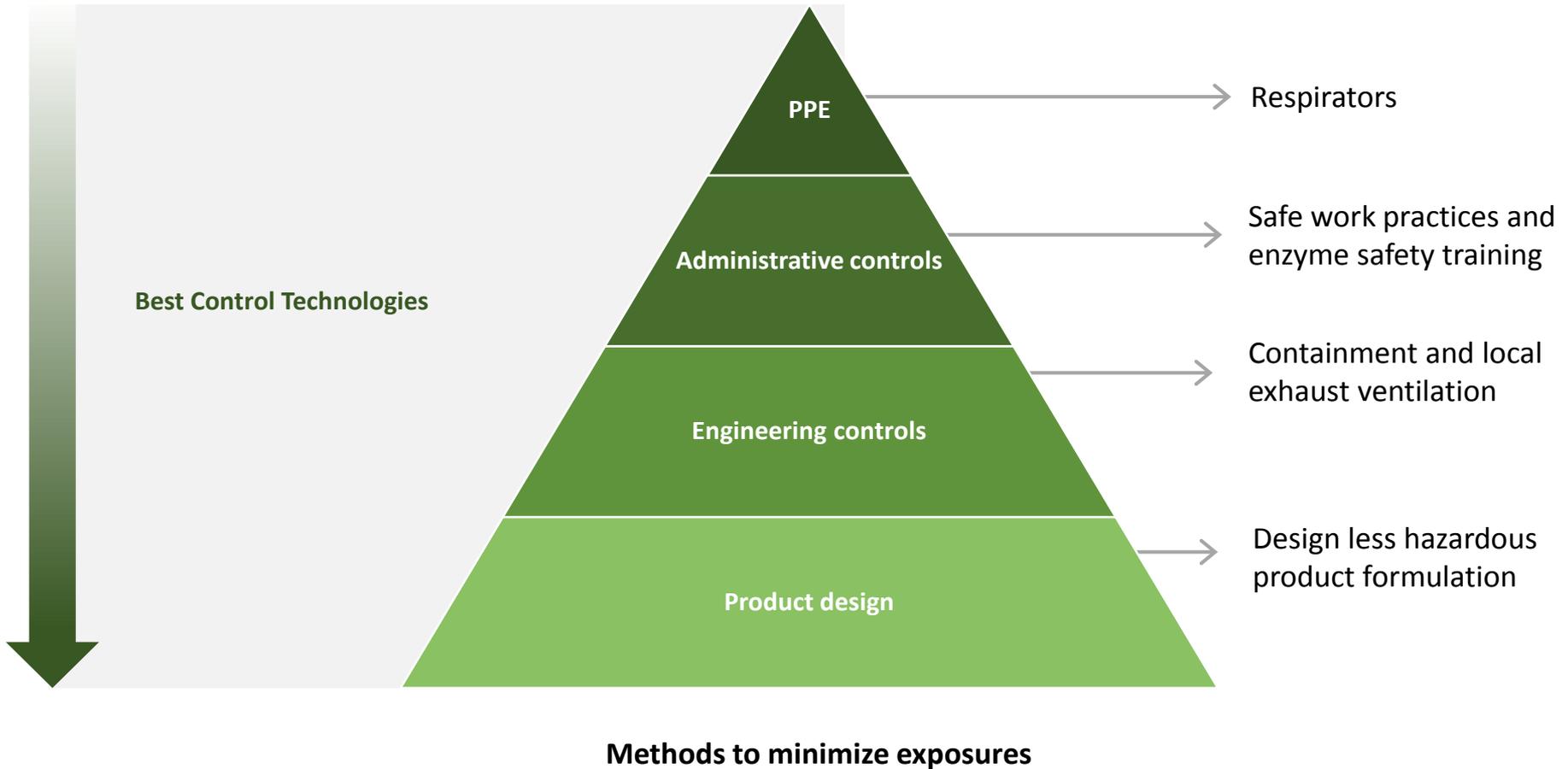
With continued exposure, some people may develop Occupational Asthma

Working Safely with Enzymes

Enzyme Safety Risk Management

Hierarchy of Controls

How to Control Enzyme Exposure



Product Design



Product design is an important control technology aimed to reduce aerosolization potential and minimize exposures

Granules

- Encapsulation of the enzyme provides a protective layer
- Damage can result in enzyme dust



Liquids

- Enzymes in a liquid formulation are easily contained in closed systems
- Spilling, spraying, mixing liquids can produce aerosols

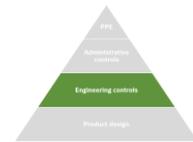


Baking Industry

Uncoated Particles and Tablets

- Small enzyme particles can more readily become airborne
- Some companies spray oils to lower dustiness in enzyme powders
- Large bakeries use tablets rather than powders





Engineering Controls

Engineering controls are designed to contain enzymes and minimize exposures.
A number of methods are used to control enzyme exposures.



Isolation

Isolation can be used to segregate the enzyme process from the worker through a physical barrier

Examples:

- Enclosed bag discharge systems

Enclosure and ventilation

Ventilated enclosures can be designed to contain the enzyme product

Examples:

- Weighing
- Bag waste collection

Local exhaust ventilation (LEV)

LEV can be used to prevent the release of dust/aerosol in the work environment

Examples:

- Point source ventilation for small mixing bowls

Examples of engineering controls



Weighing enzymes



Bag waste collection



Mixing and blending

Safe Work Practices



Administrative controls are work procedures such as written safety policies, supervision, schedules, and training with the goal of reducing the duration, frequency, and severity of workplace exposures. A combination of administrative controls are used for enzyme handling.

Work practice controls

- Use established control measures
- Follow procedures for enzyme handling and spill clean up

House-keeping

- Visually monitor for enzyme spills
- Immediately clean up spills with approved methods

Maintenance

- Routinely check control devices (ventilation systems, valves, hoses)
- Avoid temporary fixes

Training and awareness

- Education on enzyme health hazards and measures to control exposures

Work Practice Controls



Avoid aerosol generation

- Aerosols form through high energy operations such as mixing, grinding, and material transfers
- Cleaning actions such as sweeping and high pressure spraying will also generate aerosol



Follow good personal hygiene practices

- Wash hands after contact with enzyme materials
- Change work clothes whenever they are soiled with enzyme material
- Avoid contact to the face and eyes with enzyme contaminated clothing or gloves



Prevent spills

- Use secondary containment and appropriate controls during material transfers to minimize spills

Housekeeping



Maintain a culture of good housekeeping

- Visually monitor for enzyme spills
- Immediately clean up spills
- Conduct routine cleaning
- Remove contaminated clothes immediately



Routine cleaning using safe techniques

- Do not use brooms or high pressure water/air
- HEPA filtered vacuums
- Use a low flow water hose for rinsing remaining dry spills and liquid spills into a nearby drain
- For smaller spills, gently wipe up liquids with absorbent material
- Take care not to crush granules

Respiratory Protection

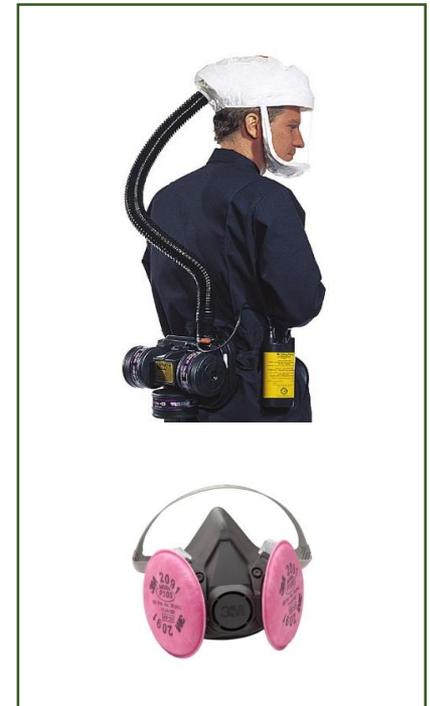


Personal Protective Equipment (PPE) is an effective method to control exposures and should be used in combination with other controls. PPE is also critical when dealing with non-routine tasks such as spills.

- Respiratory protection is used secondary safeguard when exposure potential is high
- Air-purifying respirators should be fitted with filters having >99% removal efficiency at 0.3 microns (P100/N100).
- The table shows acceptable respirator types for airborne enzyme concentrations based on the recommended exposure limit of 60 ng/m³

Type	Filter Efficiency	Protection Factor*	Concentration ng/m ³
Half-face	HEPA	10	up to 600
Full-face	HEPA	50	up to 3,000
PAPR (tight)	HEPA	1,000	up to 60,000

* Verify assigned protection factor with manufacturer



Summary

- Enzymes can be handled safely with the implementation of a comprehensive safety program
- By following the work practices and engineering control measures discussed, enzymes can be handled safely
- Enzyme safety training is an essential component of a safe handling program
- Enzyme industry guidance documents are available to help the Baking industry with enzyme safety (see references)
- Work with your enzyme provider for additional assistance with enzyme handling and safe practices

*Note- enzymes are not the only substances that involve the use of personal protection equipment and safe use procedures in the bakery industry



References

Enzyme Technical Association



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The Enzyme Technical Association

The Enzyme Technical Association promotes the development, preservation, maintenance and general welfare of the industry to the world of manufacturing and distributing enzyme preparations from any source for direct and indirect addition or application to foods, drugs, and other articles of use by humans or animals.

LEARN MORE



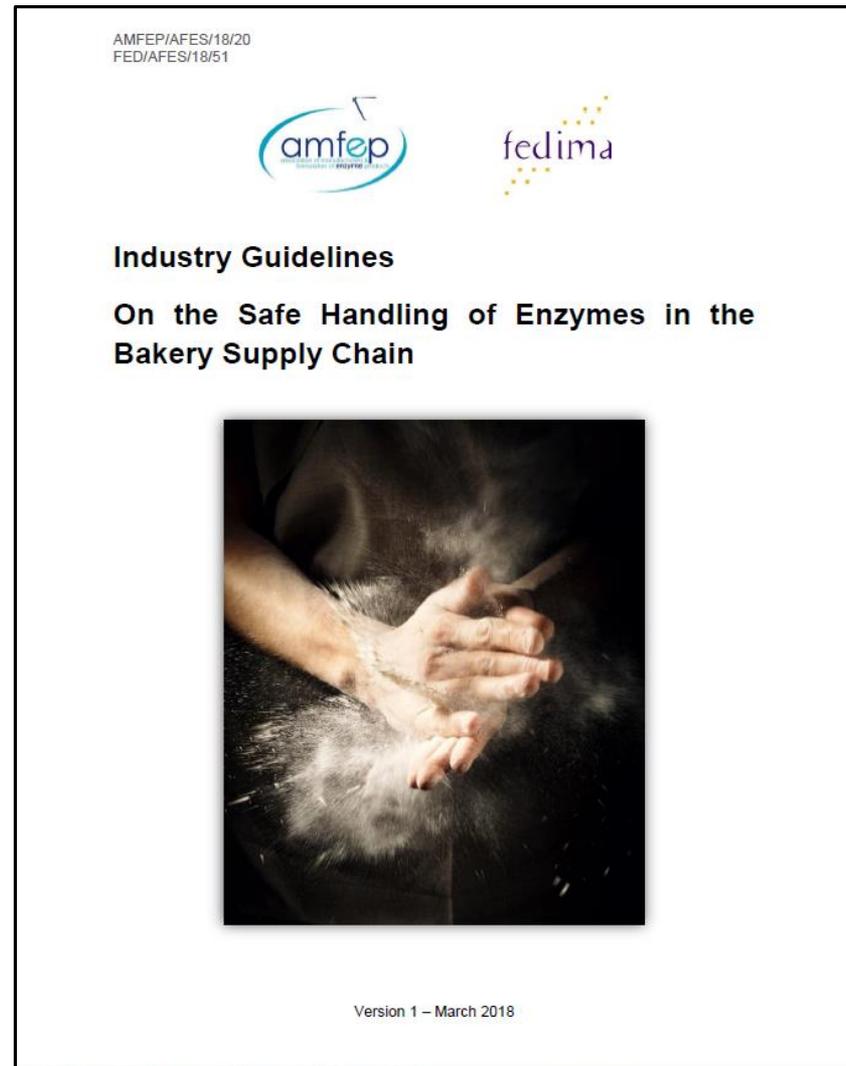
- ▶ Enzyme Safety Handbook
- ▶ Web-based training (coming soon)

<http://www.enzymeassociation.org>

AMFEP / FEDIMA

Guidance document for the baking industry

<https://amfep.org/publications/guidelines-on-the-safe-handling-of-enzymes-in-the-bakery-supply-chain/>



AMFEP / FEDIMA - Posters

HANDLING AND WORKING WITH ENZYME CONTAINING INGREDIENTS IN THE BAKERY SECTOR

ALWAYS FOLLOW THESE IMPORTANT GUIDELINES

CONTAINMENT AND CONTROL OF ENZYME DUST AND AEROSOL SPRAY

- ▶ Enzyme-containing ingredients must always be handled and processed in ways that avoid the formation of dust clouds or aerosol spray.
- ▶ Engineering control measures should be in place to avoid the formation of dust or aerosol as far as possible.
- ▶ Where any openings are unavoidable in the process then suitable ventilation and air flow control should be in place.

SAFE WORKING PRACTICES

- ▶ Weighing of flour and ingredients:



Pouring ingredients from height creates airborne dust.

- ▶ Unloading flour and improvers from a silo into mixing bowls (semi-industrial craft bakery):



Elevated dumping height and violent shaking of the guidance hose creates airborne flour dust.

- ▶ Unloading flour and improvers from bags into mixing bowls (artisan bakery):



1. Open the bag at the stitched end.

2. Place the open bag end in the mixing bowl.

3. Make a slit in the opposite end of the bag with a knife.

4. Tip the bag gently into the bowl.

5. Lift the bag so that the flour slides out cleanly into the bowl.

SPILLAGE CLEAN-UP / CLEANING PLANT AND EQUIPMENT FOR INGREDIENTS THAT CONTAIN ENZYMES

Always clean up immediately after any spillage.

Do not use:

- ▶ Brushes, brooms, high pressure water hoses and/or compressed air.



Please use:

- ▶ A vacuum cleaner fitted with two filtration steps. The final filter should be a high efficiency HEPA H14.
- ▶ Always wear respiratory and personal protective equipment when dealing with spillages or undertaking cleaning operations.



A typical hazard label for enzyme-containing formulations looks like this.

WHY DO WE NEED A DUST CONTROL PROGRAMME?

Dust exposure can damage our health!

- ▶ Enzyme dust may provoke sensitization in the same way as inhaling common allergens like pollen or house dust.
- ▶ Symptoms include red eyes, runny nose, shortness of breath and wheezing.

Flour and other bakery ingredients - like enzymes - are allergens

Exposure can be prevented or minimised to a safe level by:

- ▶ Preventing the dust from becoming airborne.
- ▶ Using appropriate protective equipment.
- ▶ Always following the correct operating procedures.

BEST PRACTICES

- ▶ Prevent dust formation.
- ▶ Avoid spreading dust from one area to another.
- ▶ Always clean up after a significant spillage.
- ▶ Change your working clothes according to company instructions.
- ▶ Some operations, for instance during spill clean-up, may require respiratory protection (a P3, FFP3 or N100 should be used).
- ▶ Use additional protective clothing such as gloves and safety glasses to minimise any risk of skin contact.



FIRST AID MEASURES IN CASE OF EXPOSURE TO ENZYME

Eye contact: Rinse carefully with clean water for several minutes. Remove contact lenses if they are present and it is easy to do so. Continue rinsing if eye irritation persists.

Skin contact: Wash with plenty of soap and water. Remove contaminated clothing.

Ingestion: Rinse mouth thoroughly. If swallowed, call a doctor/physician if you feel unwell.

Inhalation: If breathing is difficult, move to fresh air and remain resting in a position that is comfortable for breathing.

- ▶ General advice: Seek medical advice from local first aid or a company doctor if respiratory irritation or shortness of breath persists.



Disclaimer

This presentation is given as a basic guidance for handling enzymes safely, only and should not supersede any internal working procedures to manage safety and occupational health in your work environment.

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