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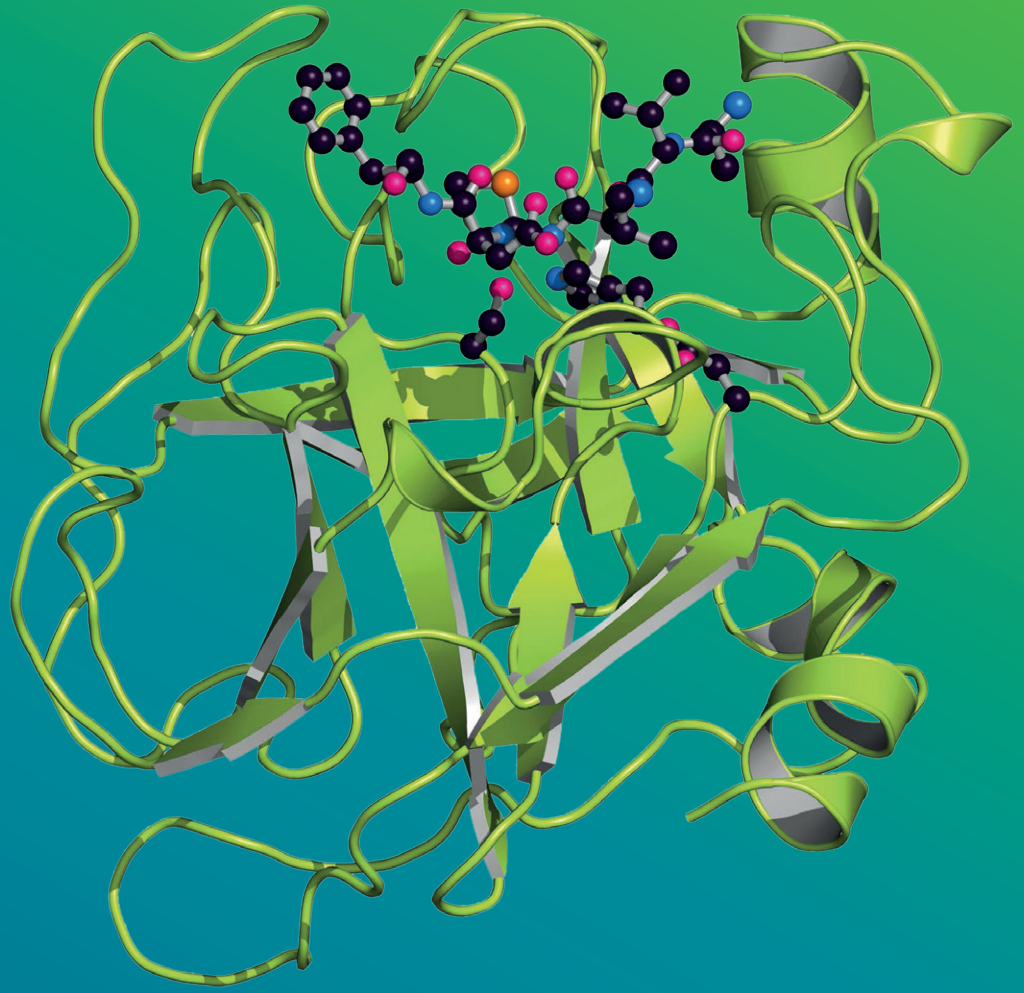
association of manufacturers & formulators of enzyme products

HOUSEHOLD & COMMERCIAL PRODUCTS ASSOCIATION
Innovative Products For Home. Work. Life.

The role of enzymes in detergent products

The industry's commitment to safe and sustainable use



What is an enzyme?

An enzyme is a catalyst which can speed up biological processes. Enzymes exist in all of nature – in microorganisms, plants, animals, as well as human bodies. Enzymes were introduced as ingredients in cleaning products in the early 1960s and are now widely used for their innovative and wide-ranging functionalities. Today, enzymes for detergents are produced by microorganisms, in fermentation processes, that have sometimes been improved by means of modern biotechnology. This fermentation process uses sugar and other agricultural products as feedstock for the microorganisms.

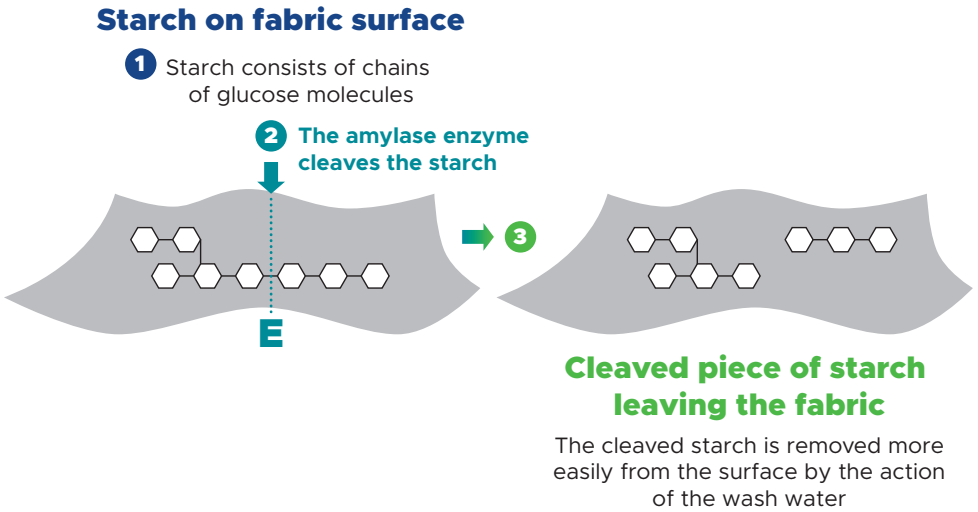
Enzymes work at mild conditions, which means they can function at low temperatures and mild pH. In addition, enzymes are only required at low concentrations in cleaning products to be effective. Enzymes are also readily biodegradable, resulting in no negative environmental impact.

The function of enzymes in cleaning

Enzymes are catalysts that increase the rate of chemical reactions occurring in a variety of biological processes including digestion and growth. In the detergent industry, commercial enzymes are used to provide a higher degree of stain removal, whiteness, fabric and colour care and overall cleaning performance. These ingredients are selected based on performance and the use that is required.

Enzymes act like small selective scissors to break down stains into pieces. Typically, enzymes are carefully optimised molecules for their respective processes – such as the removal of a specific protein, starch or fat stain. Thus, each enzyme has specificity for one type of reaction, which results in specific enzymes being targeted to specific types of stains. By being broken down into smaller pieces, stains on laundry are more easily removed.

Enzymes are used in various cleaning applications - these highly targeted bio-catalysts help effectively eliminate stains by making them more easily removed by surfactants.



Specific enzymes target specific stains

- **Protease:** Proteases degrade stains comprised mainly of protein, such as grass, blood, egg, and others, giving clothes a clean appearance.
- **Amylase:** Amylases break down starch-based stains commonly caused by pasta, potatoes and baby food, which are commonly found on dishes.
- **Lipase:** Lipases target fat-based stains such as butter, oil, and human sebum. These types of stains can cause unsightly marks after washing. Fat based stains can also contribute to increased appearance of staining after repeated washes.
- **Cellulase:** For cotton fabrics, cellulases improve overall cleanness by reducing redeposition of particulate soils such as soot, clay, and rust during the wash. In addition, cellulases also provide fabric and colour care.
- **Mannanase:** Mannanases degrade stains containing mannans. These stains are commonly caused by things like barbecue sauce, chocolate, ice cream and toothpaste.
- **Pectate lyase:** Pectate lyases act on pectin-based stains from fruits and vegetables, jams and other food containing thickeners.

Enzymes have a high safety profile

Enzymes have a low order of toxicity (see Basketter et al). The main toxicological endpoint associated with enzymes is the potential to cause respiratory sensitisation. Inhaled enzyme dust or aerosols may potentially lead to the development of allergen-specific immunoglobulin E (IgE) antibodies. To minimise this, since the early 1970s, enzymes used in detergents are provided as low dust, granulated, and coated enzyme preparations or liquid formulations. Several studies have demonstrated that the risk of consumers being sensitised is extremely low and that enzymes can be safely used in consumer products.

Enzymes enable significant environmental savings

Washing at low temperatures

Did you know that 60% of CO_2 emissions from laundry and dish detergents come from the use phase? For example, the energy consumed by the washing machine and the dishwasher to heat the wash water is the largest environmental impact of washing across all life cycle stages. Thus, washing at lower temperatures is a pivotal driver to improve the overall sustainability profile of the washing process. Lower wash temperatures reduce CO_2 emissions and save energy and money. Low temperature washing also ensures that clothes will last longer.

Enzymes are important ingredients in low temperature wash applications for laundry detergents, due to their ability to provide washing performance at lower temperatures.

In Europe, the average temperature for washing in 2020 was 42.4°C (108.32 F) based on consumer research done by the European detergent industry (see A.I.S.E. consumer research). Data collected through the "I Prefer 30°" campaign (which promotes washing at 30°C/86F) estimated a saving of 1307.9 GWh/year of current total laundry energy in the five campaign countries, based on a 3°C reduction of the average wash temperature (see I Prefer 30° close out report).

The detergents industry continues to engage with consumers to promote more sustainable laundering habits with colder washes.

COLD WATER SAVES

In the US:
http://coldwatersaves.org

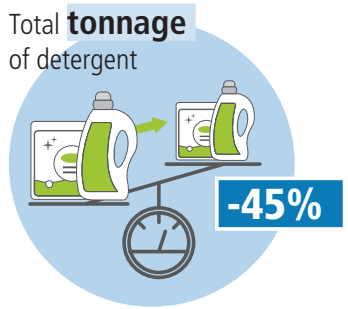
I PREFER 30°

In Europe:
https://www.iprefer30.eu/en

Innovating compact products

The detergent industry has globally engaged in various projects to drive the compaction of detergent products as part of its strategy to drive sustainable cleaning. Compaction means that the product is in a form that reduces weight and packaging to be used, because it is more concentrated. This has had positive consequences leading to an optimal use of ingredients, reduced transport, savings in packaging and reduced CO_2 emissions.

Compaction has been enabled through process technology innovation. In early innovation efforts compaction was facilitated by removing water and fillers. Innovation became more sophisticated, by employing new catalytically active performance ingredients such as enzymes, which have a high performance at low concentrations in the formula. Such innovation with enzymes has enabled significant environmental savings, while securing equivalent cleaning performance (see Compaction of household laundry detergents).



Alternative technology to replace phosphates

Phosphates and phosphonates were previously used in detergent products to remove soap scum and mineral deposits caused by hard water. Within the United States, phosphates were phased out of laundry detergents in the 1990's and in automatic dishwasher detergents in 2010 due to concerns of negative impacts on water systems. The European Detergents Regulation restricted the use of phosphates and phosphonates due to concerns with excess of algae growth in water environment. The restriction in Europe resulted in the equivalent reduction of some 55 000 tonnes of phosphorus per year across the EU. Enzymes provided the alternative technology to transition away from phosphates and phosphonates, and still maintain cleaning performance.

Specific applications for enzymes

In consumer detergents

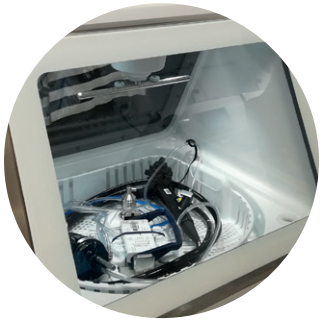
Dishwashing
Automatic and hand dishwashing detergents contain enzymes that remove food soils effectively with only mild mechanical action required. This allows reduced usage of water, less time spent on cleaning dishes and tableware that lasts longer.

Laundry
Enzymes remove stains effectively under mild conditions. Clothes can last longer and keep a good appearance, thereby reducing the need to replace them.

Whiteness
Enzymes cleave off damaged cotton fibres, thus preventing particulate soil from depositing and participating in fabric greying, improving whiteness performance.

Colour and fabric care
Specific types of enzymes improve the appearance of fabrics (colour care and smoothening the surfaces) which helps to prolong their lifetime. Cellulases degrade cellulose and contribute to fabric care.

In detergents for professional use



Cleaning of medical devices
The basic properties of enzymes being able to function at low concentration, low-temperatures and mild pH is useful in cleaning of medical devices that cannot be cleaned in normal sterilisation machines, e.g. endoscopes. Enzymes are effective at loosening soils on delicate pieces of equipment where mechanical action is difficult to achieve. This allows the devices to be properly cleaned prior to disinfection. Better cleaning is important to reduce risk of patient infection from contaminated equipment, it also leads to a longer lifespan of the device and less time wasted in the operating suite from turning away dirty equipment.

Laundry
Enzymes are necessary to remove blood stains, particularly in hospital linens.

Ware-washing applications
Industrial dishwashing products have begun to introduce enzymes for improved cleanliness by means of sump maintenance as well as less time cleaning and reduced water use. As commercial dishwashing machines recirculate wash water for the cleaning process the sump, or water reservoir, becomes soiled from food residue. Enzymes aid in the breakdown of food waste, helping to maintain the sump water for longer. Maintenance of sump water means not having to replace the water as frequently or heat new water.

Floor cleaning
Enzymes can be used to remove food soils from floors, especially in commercial kitchens. Lipases are effective at breaking down fat, or lipid, based soils. The soils can be destructive to grout in tiled floors. Fat based soils can also be a safety concern for staff in kitchens.

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For more information please go to:

www.cleaninginstitute.org

www.aise.eu/enzymes

www.amfep.org

www.thehcpa.org

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