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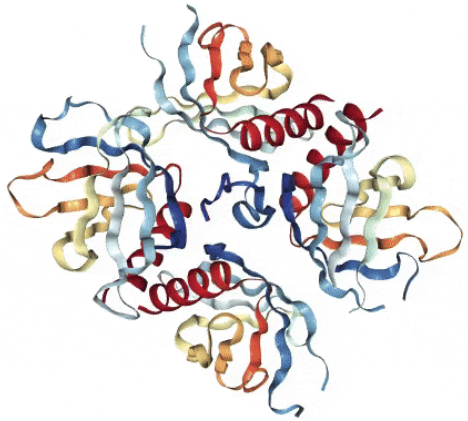
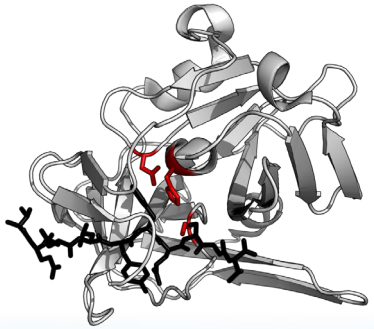
Why and Where do we Need to Utilize Protease Enzymes for Protein Fouling?



Enzymes in cleaning programs

There is a difference in opinion as the to best wash step to utilize a Protease enzyme:

- Junk wash? 1st wash? 2nd wash? 3rd wash? Or 4th Or if needed at all?
- Does it matter where the enzyme is used in a MF,UF, Nano or RO?



Three Cleaning Approaches In Protein Removal

1. High Alkaline (non-chlorinated), or High Acid

    a. Strong oxidizing acids (e.g., nitric) can remove proteins, and are used in only specific cases to do so (example: potato dryers).
    b. Acids are effective in removing minerals films with only minor protein content (e.g., milk stone)

1. Chlorinated Alkaline Cleaner—oxidizing agent additive such as chlorine (i.e., sodium hypochlorite) However this cannot be used in a Reverse Osmosis or Nanofiltration system (polyamide degradation)

2. Enzymes (Protease-type) also attack the peptide bonds (but at a slower rate and performs poorly for burn-on); it is used for membrane cleaning. Enzymes are catalysts used to hydrolyze proteins (enzymes are not consumed in the reaction like hypochlorite/chlorine)

Protease Enzyme Detergent Applications

- Main systems for enzyme-based detergent cleaners are for Reverse Osmosis and Nanofiltration membrane systems, and sometimes include Ultrafiltration systems as well.

- Specialty detergents containing enzymes are used in several cleaning applications, or soaking membrane systems

- Often protease-based products are buffered to an alkaline pH range of 8.0 to 10.5. Some alkaline-stable proteases function effectively (even optimally) at a higher pH between 10.5-11.0

Liquid Protease Enzyme Detergents

- A liquid protease enzyme detergent contains a combination of wetting agents and enzyme stabilizing agents + one or more types of protease. They contain a high level of active enzyme that catalytically breaks down proteinaceous soils.

- The enzyme detergent should still perform well even at a high pH (up to ~11.0) and elevated temperatures of 115-125^{o}F. The protease enzyme product is used with a built alkali membrane cleaner to adjust the pH to the appropriate level.

Liquid Protease Enzyme Detergent Benefits

- Very effective on proteinaceous soils
- Contain a multi-surfactant blend for optimized wetting and detergency
- Accurate dispensing equipment systems provides highly accurate dosing and product control, eliminating waste and providing more consistent, repeatable results.
- All product components are biodegradable and non-toxic to aquatic life
- Minimal sodium and chlorides contribution to plants effluent
- Contain no phosphorus

Enzyme Reaction Rate Factors

Enzymes are catalysts ~ Increase the rate of the reaction

- Dose: Using more enzyme makes the reaction go faster. There is a cost implication.
- Time: A specific dose of enzyme requires a certain amount of time to complete the reaction
- Temperature: Enzyme reactions are faster at higher temperatures up to a point. At too high a temperature the enzyme may be degraded. There is a "sweet spot"
- Environment: The pH, amount of substrate and the enzyme activity level all influence rates.

Summary

- Enzymes should not be used in first wash step or junk wash as the soil load is to high. The enzyme will work on the saturated solution more than the elements themselves

- To achieve a completely beneficial clean step, use a protease enzyme proficient at a pH over 10.5 This way there is A total cleaning benefit of an enzyme step as well as alkaline.

- Enzyme soak steps may be performed when factors such as poor feed streams are known. This is not to be confused with other factors such as fat, mineral or Bio film fouling. A better planned cleaning program will remove them allowing the Enzymes to get to the proteins that they are covering.