

1. Background

- Microorganisms in WWT produces enzymes to degrade organic matter in WW
- Industrial enzymes are worth >US\$ 5 billion globally (BCC Research, 2014)
- 75% from hydrolytic enzymes (Li & Zong, 2010)
- Used in various industries (Novozymes, 2015)



Agriculture



Bioenergy



Food



Housecare



Leather



Paper

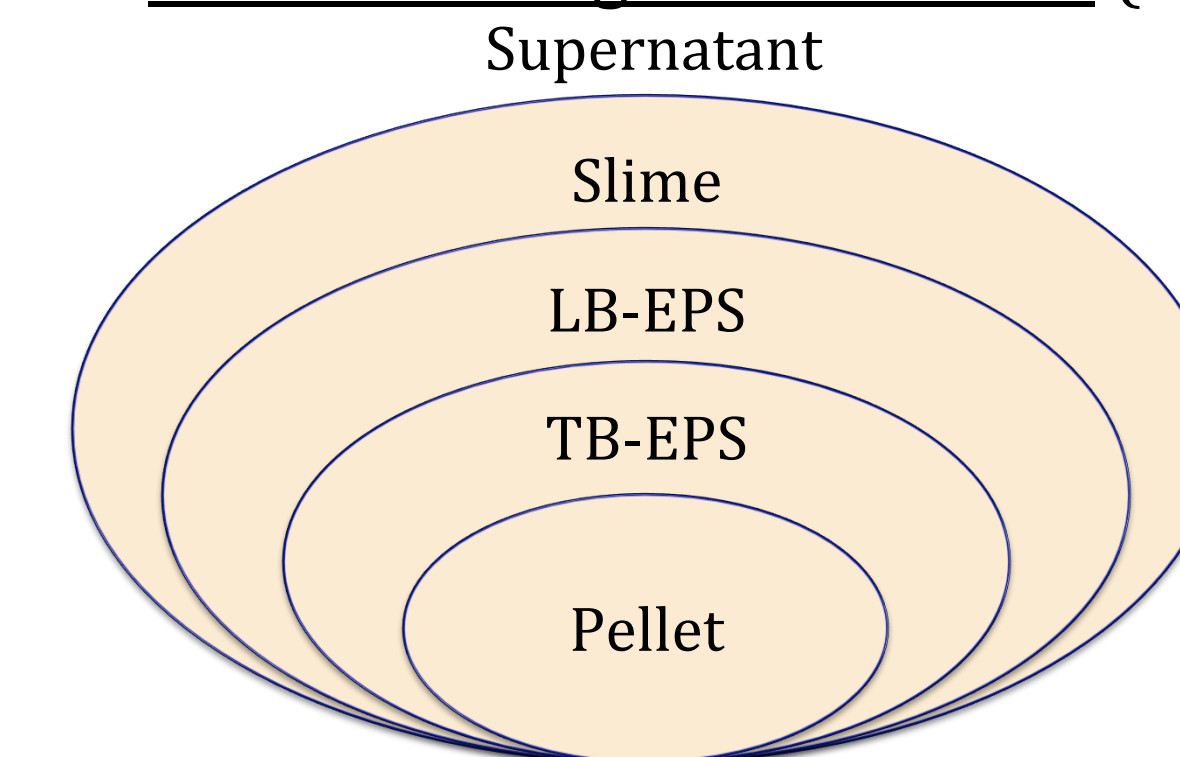


Textile

- Diversifies sludge management

2. Where are enzymes found in WWT?

- In activated sludge floc fractions (Yu et al., 2007, 2008)



Enzymes found:

- protease
- amylase
- lipase
- glucosidase
- phosphatase

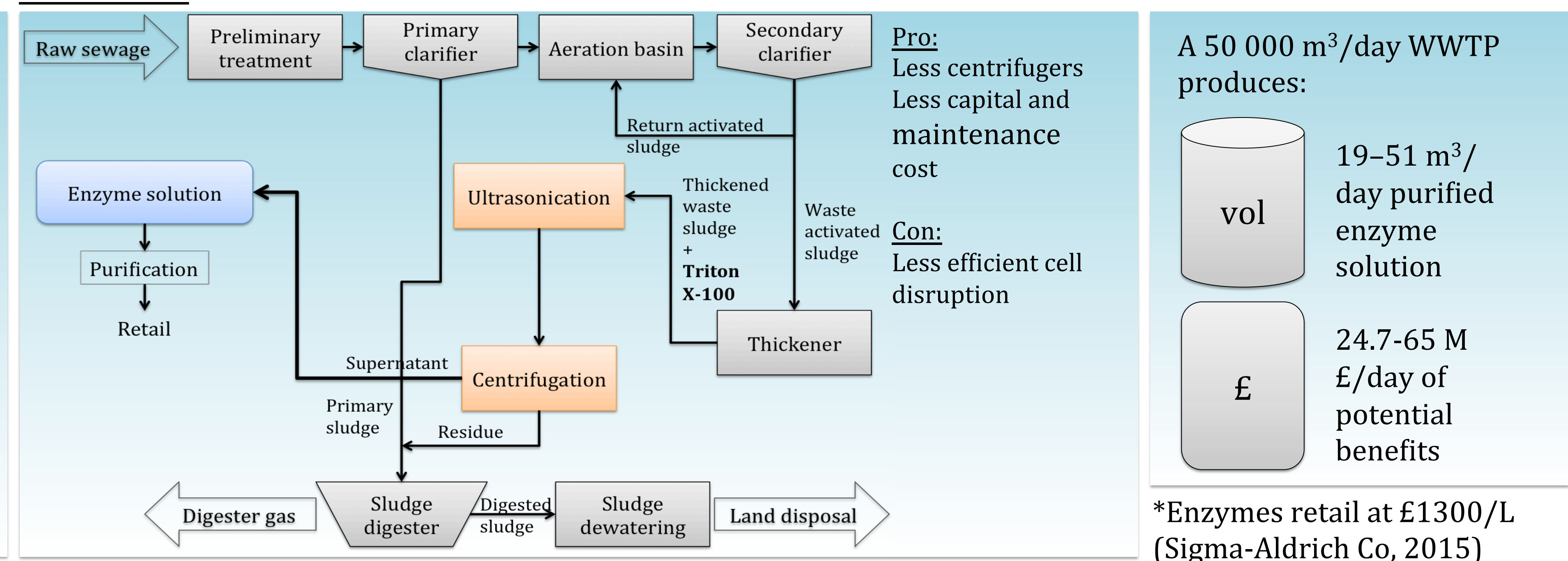
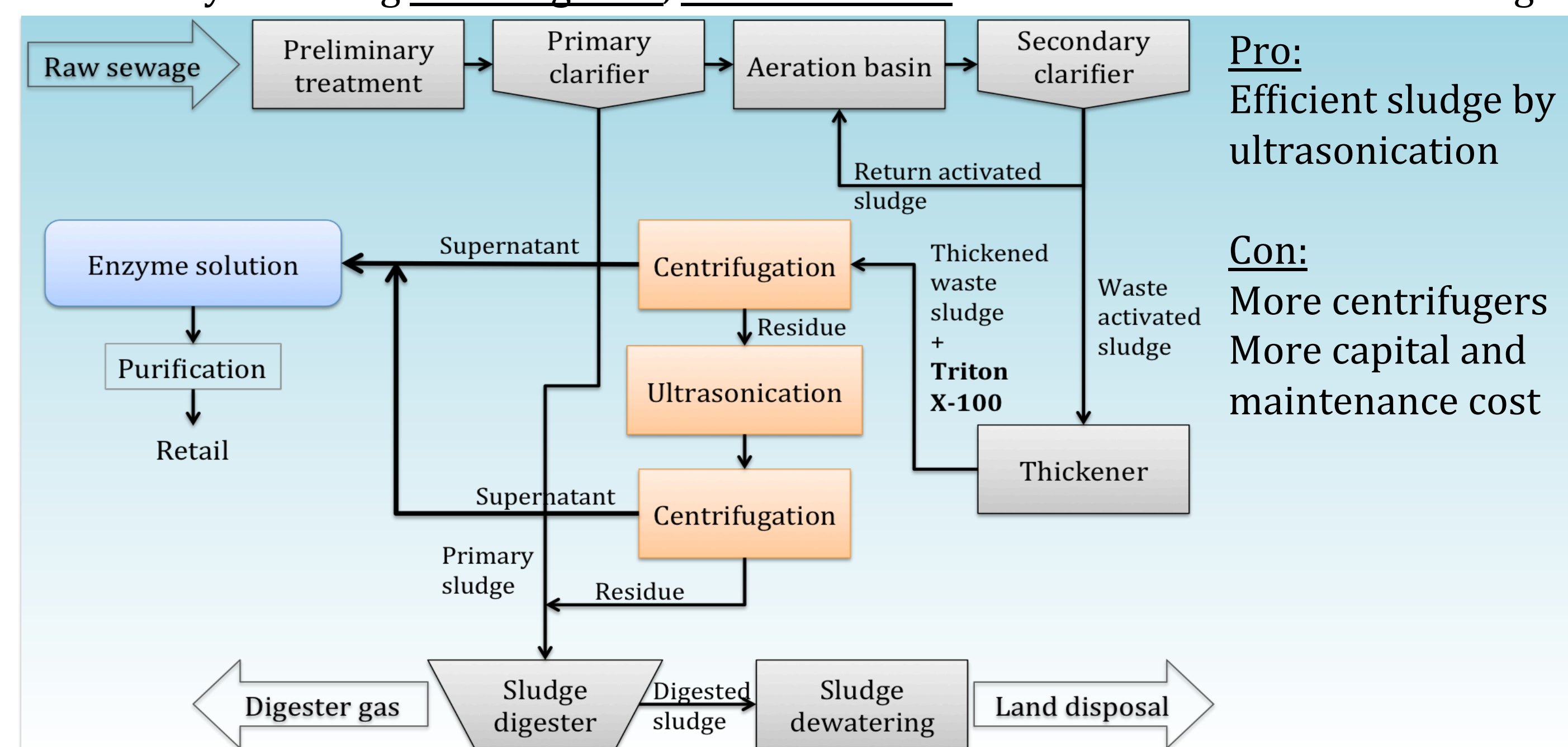
Enzyme types are not fraction specific

Enzyme activities vary with fractions

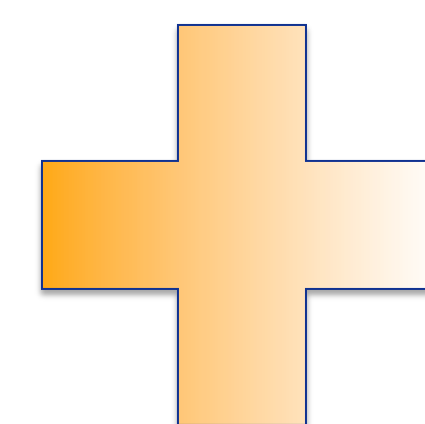
Enzyme amount is wastewater dependent

3. How can enzyme recovery be integrated in WWTPs?

- By including centrifugation, ultrasonication and addition of non-ionic detergent Triton X-100



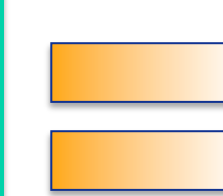
4. How is WWT affected by enzyme recovery?



Enhances:

- Sludge degradation
 - Sludge dewaterability
 - Sludge settling
 - Biogas production
- (Shao et al., 2009, Carrère et al., 2010, Xu et al., 2011)

5. How does enzyme recovery from WWTP compare to industrial production?



- Microorganisms such as bacteria and fungi produce biomass
- Biomass cells are agitated by ultrasonication and solvent addition to release enzymes (Bankar et al., 2010)
- Enzymes from WWTPs have enzymatic activities within the range of industrially produced enzymes



- Feedwater in industry is carefully chosen to maximize production
- Operational conditions such as pH and temperature are adjusted according to microorganism used

6. Conclusion

Enzyme recovery processes are both economically and technically viable due to its significant potential commercial benefits outweighing production costs and the familiarity of recovery methods, ultrasonication and centrifugation to both WWT and enzyme producing industries

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