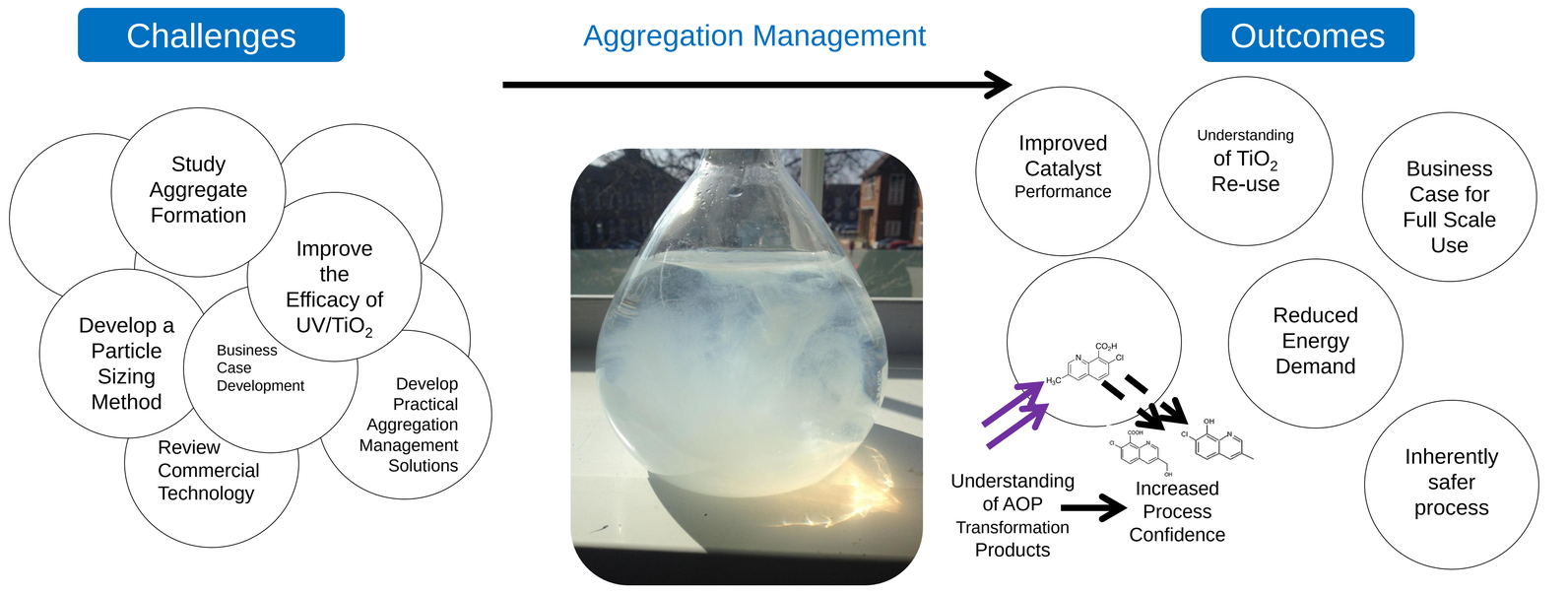
Advanced Oxidation Processes for Pesticide Control: Implementation and Business Case Development

Matthew Hobbs[1], Dr Peter Jarvis[1], Prof. Bruce Jefferson[1] and Helen Pickett[2]
[1] Cranfield University [2] Severn Trent Water

stream
The Industrial Doctorate Centre for the Water Sector

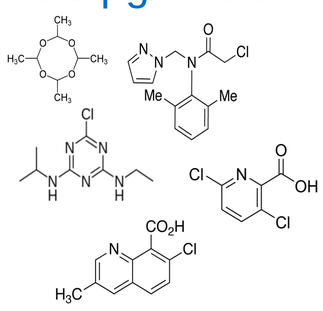
Introduction

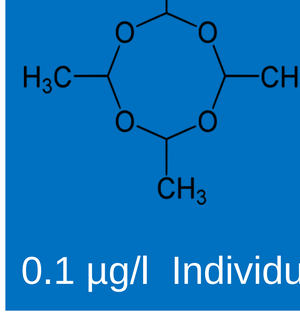
Water treatment works are at risk of failing the regulations for some pesticides, the most prominent example being Metaldehyde. These pesticides present a treatment challenge as they cannot be completely removed by current treatment technology. Advanced Oxidation Processes offer a treatment solution through the destructive, oxidative power of •OH radicals. Photocatalysis (UV/TiO_2) offers a chemical-free solution to water treatment and further study will demonstrate its feasibly.



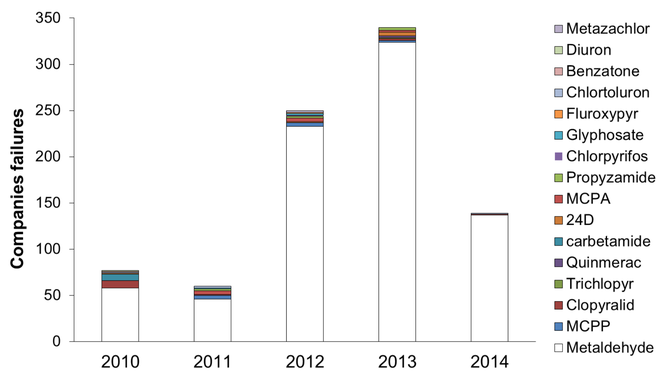
Regulation of Pesticides - Discharge Limits

0.5 µg/l Total





0.1 µg/l Individual



Project Context

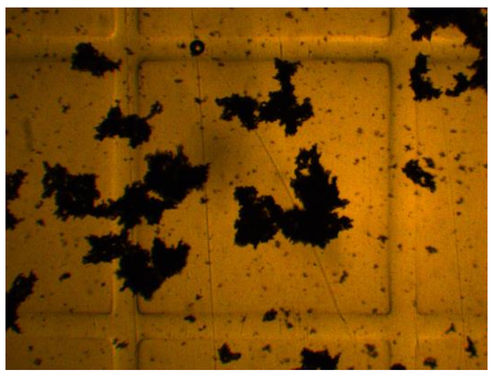
Treatment or Catchment Management?

2017 — EngD Project Submission

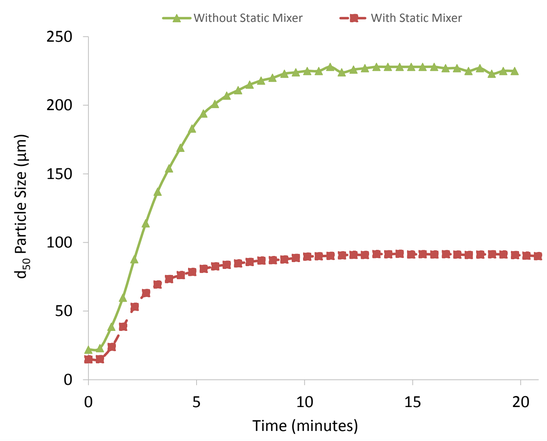
2018 — Submission of Water Companies' Metaldehyde Control Plans to DWI

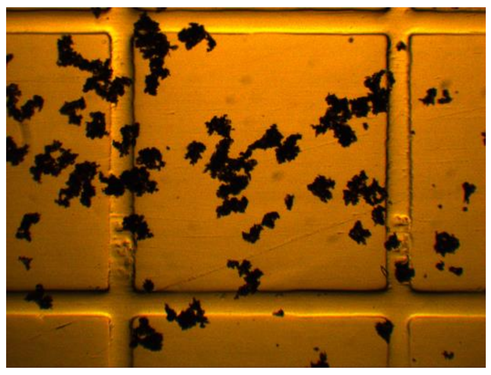
2019 — Evaluation of Solutions and Final Metaldehyde Plan Submission

Titanium Dioxide Aggregation and Particle Size Management in Post GAC Water



Aggregation without static mixer





Aggregation with static mixer

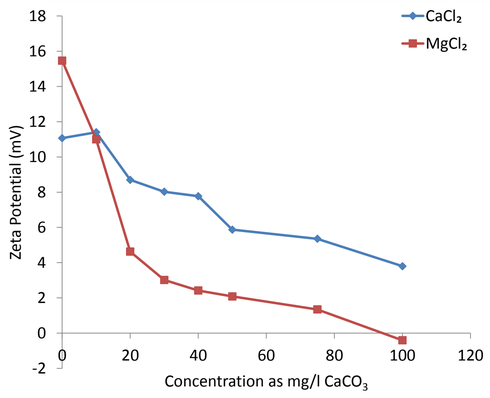
Why does titanium dioxide aggregate?

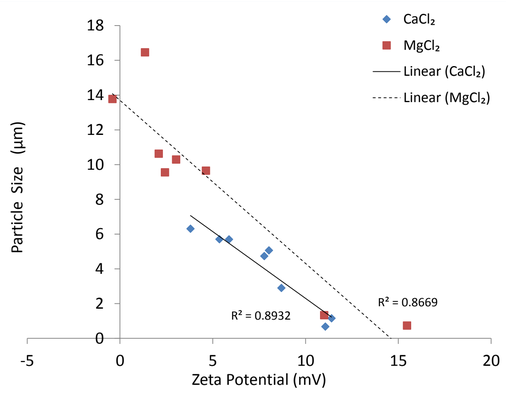
Alkalinity and hardness ions affect the surface charge of titanium dioxide causing instability

How does particle size affect the reaction rate?

Smaller TiO_2 particles provide greater surface area for catalytic reaction than larger aggregates

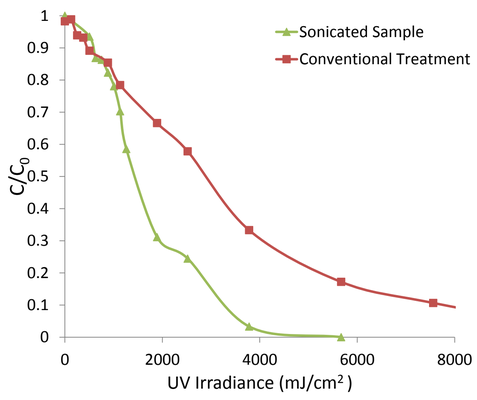
Effect of ion concentration on TiO_2 Zeta Potential and Zeta Potential on Particle Size

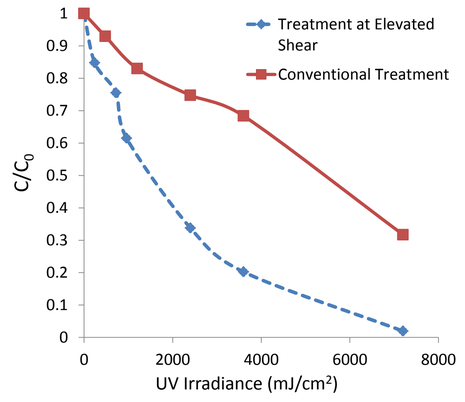




Degradation of Quinmerac by UV/TiO_2

10 µg/l Quinmerac with 200 mg/l of TiO_2. Left in Post-GAC water Right in Di Water





Conclusions

- AOPs can be used to treat problematic pesticides
- UV/TiO_2 is a viable solution, but the energy demand is high
- Particle size affects rate of reaction and is affected by alkalinity and hardness
- Treatment at increased shear breaks up particles and lowers the energy demand

www.stream-idc.net/

Email: m.j.hobbs@cranfield.ac.uk
Address: b52a, Vincent Building
Cranfield University, Cranfield, MK43 0AL

Cranfield UNIVERSITY
SEVERN TRENT WATER
EPSRC Pioneering research and skills