

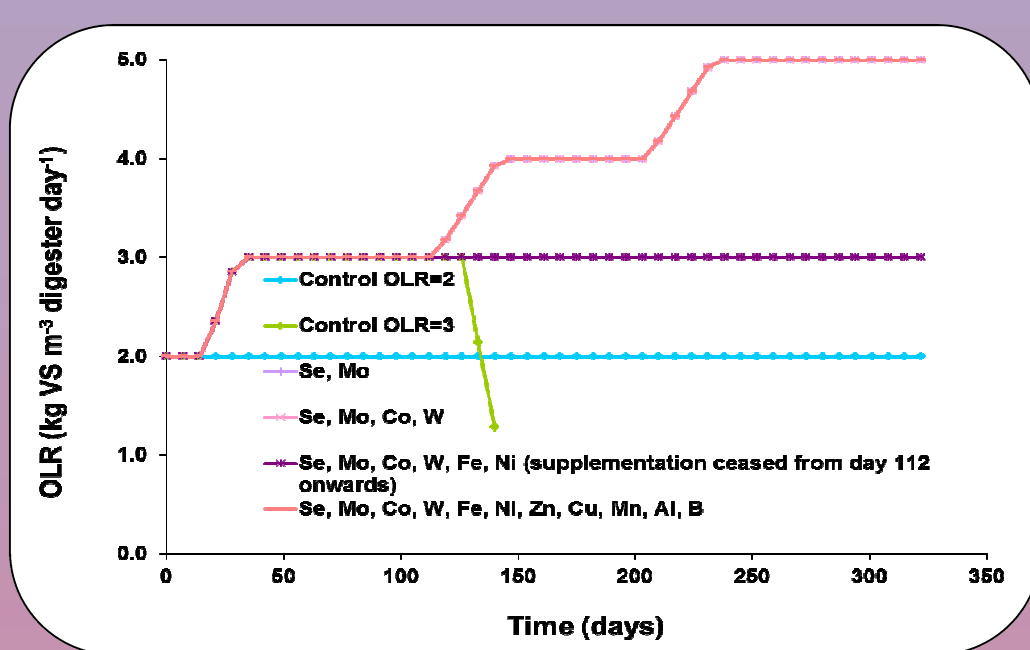
## Valorisation of food waste to biogas

### Trace element supplementation for process stability



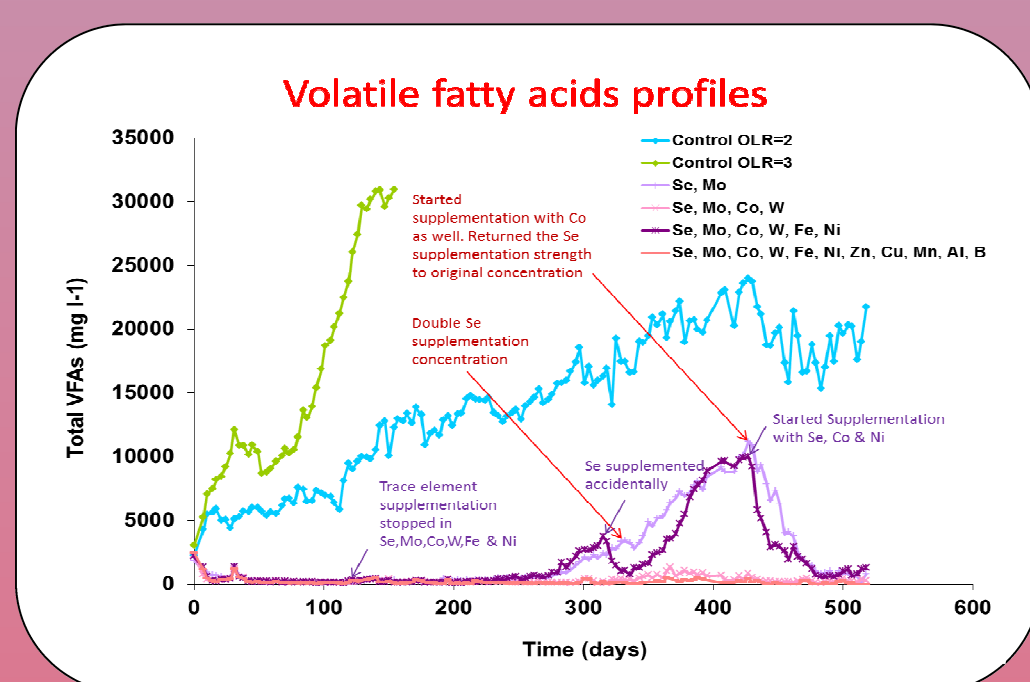
#### Laboratory study to optimise trace element additions for stable digestion

- Early studies showed food waste digesters accumulate volatile fatty acids (VFA)
- Proposed that this was a result of high ammonia concentrations and the loss of acetoclastic methanogens
- A solution could be to stimulate the growth of ammonia-tolerant hydrogenotrophic methanogens by selective trace element addition



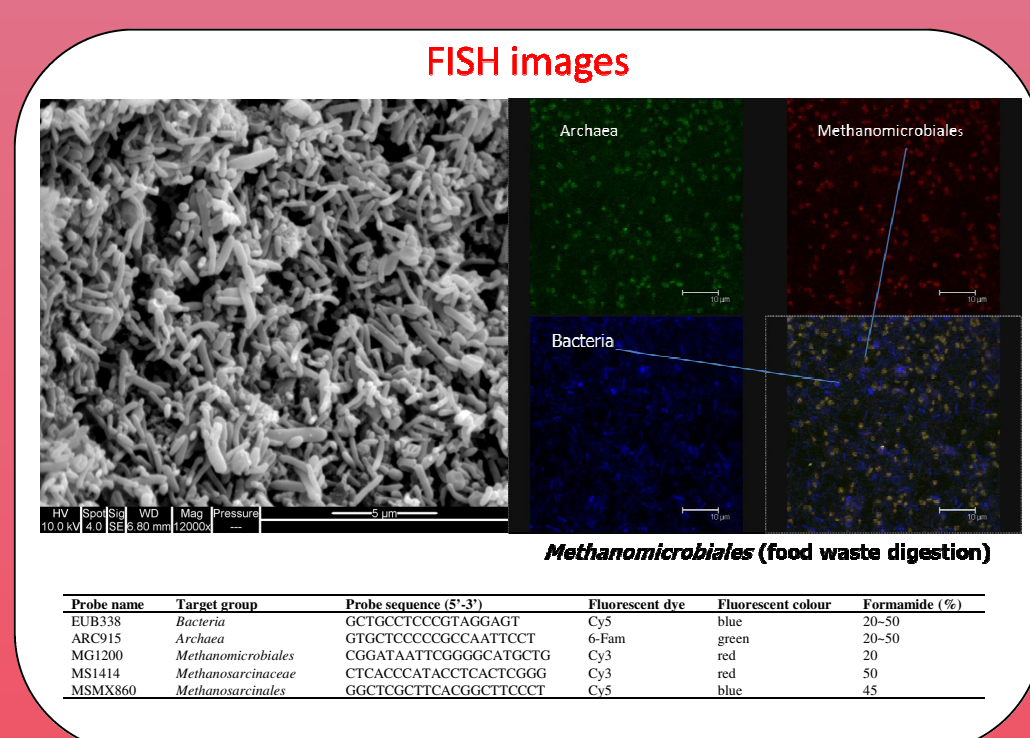
#### Experimental design

- Batch tests to confirm trace elements can stimulate VFA removal
- Continuous fed digestion trial at increasing organic loading with different trace elements
- Controls included with no trace element addition
- Trace element supplementation removed to observe the effect of washout



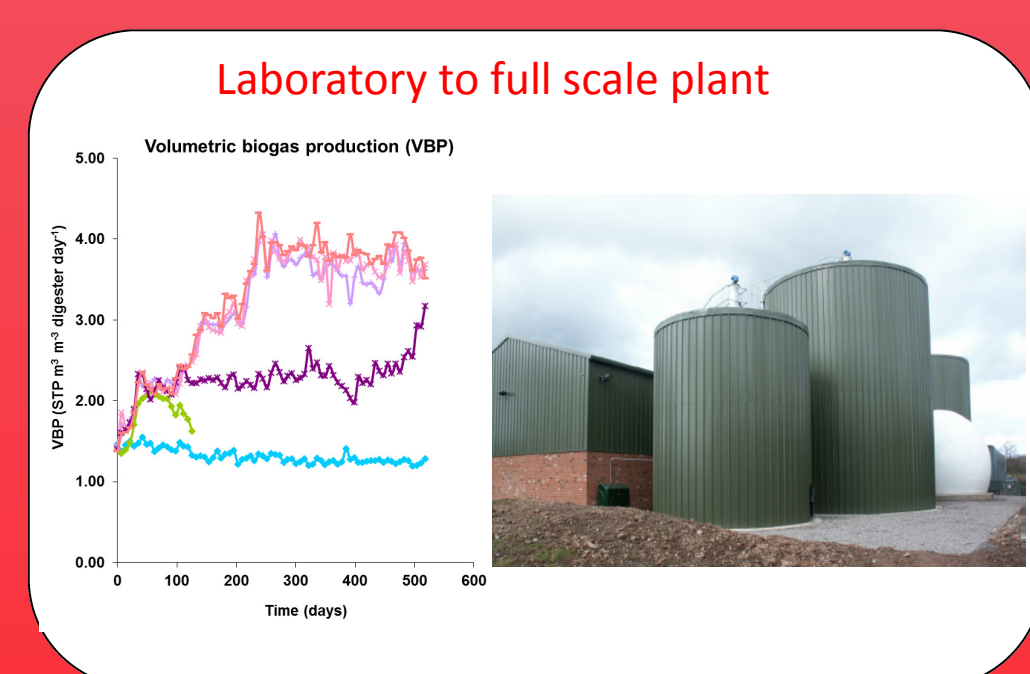
#### Analytical results

- Control digesters without trace element addition showed VFA accumulation and increasing the loading led to digestion failure
- The inclusion of Selenium in the trace element mix was crucial in preventing VFA build-up
- Removal of trace elements resulted in VFA build-up
- At high organic loadings Cobalt was also found to be required at concentrations higher than naturally present in food waste



#### Matching results to theory

- Methanogenic population structure analysed using fluorescent in-situ hybridisation
- The only methanogens belonged to the family Methanomicrobiales indicating that acetoclastic methanogenesis was absent
- The starting hypothesis was shown to be correct as the addition of Selenium was shown to be essential. This trace element is required for the enzyme systems that allow propionic acid to be degraded through the hydrogenotrophic methanogenic route



#### Improved digester performance

- Trace element supplementation allows digesters to operate on food waste at much higher organic loadings than was possible in the past
- This improves the economic and energetic performance of the plant
- The results of the work are now being used in large scale digesters and are showing themselves to be beneficial