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1. Introduction

The Phos4You I6 work package tasked Munster Technological University (MTU) and Veolia with establishing, commissioning, and optimising a phosphorus recovery plant at an Irish Municipal Wastewater Treatment Plant (WWTP), with a design range of 500-50,000 population equivalent (PE). After extensive investigation Macroom WWTP (Figure 1) was selected as it is:

- Representative of a typical Irish WWTP (population served, influent type, treatment processes etc.)
- A design load of 5,230 PE.
- Standard treatment process comprised of primary screening, extended aeration tank and sedimentation.
- Chemical or biological P removal not practiced.

The fully automated Struvia™ Demonstrator with fluidised bed P-recovery plant and designed for struvite precipitation was modified to recover calcium phosphate from Macroom WWTP effluent (Figures 2, 3 and 5).

2. P-Recovery Methodology

Laboratory jar tests undertaken indicated that P removal from Macroom WWTP effluent occurred at or above pH 10.0 with the most efficient removal (< 1 mg/l PO₄³⁻) at pH of 10.8. The pilot plant was commissioned as follows:

- pH maintained at 10.8
- Hydraulic retention time of 30 minutes
- 0.4mg/l of cationic polymer dosed to improve flocculation
- Chemical sludge recirculated as seed material.
- Pilot plant operation at pH of 10.6, 10.4 and 10.0.



Figure 3: Struvia™ Pilot plant unit at Macroom WWTP (2)

3. P-Rich Product Results

The process produced recovered Calcium Phosphate (Figure 4) with the following characteristics:

- 4.9% P₂O₅
- 0.10% K₂O
- 3.5% MgO
- 45% C₃O
- 0.6% Total N

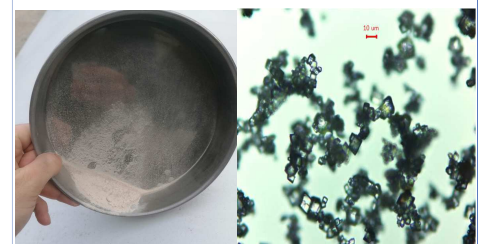


Figure 4: Recovered P product ((2) and own illustration)

5. Conclusions

- The Struvia™ pilot plant was commissioned and operated successfully at Macroom WWTP for 12 weeks.
- The Pilot Plant operated most effectively at a pH level of 10.8 with a P-removal efficiency of 60%; a simultaneous reduction in Total Nitrogen and COD was found.
- The effluent from the pilot plant had an elevated pH and alkalinity which requires further investigation.
- Approximately 60 kg of dry recycled calcium phosphate was recovered; some was used for growth trials on the MTU Campus and more for the Phos4You quality assessment work package.

4. Discussion

- Satisfactory removal rates were achieved for P, TN, COD and TSS (for pH of 10.8), see Table 1.
- Laboratory jar test results were not fully transferred to the pilot plant, with consistent PO₄³⁻ removal patterns only achieved at pH of 10.8.
- The long-term sustainability of lime precipitation for large scale treatment plant use requires further study – issues include elevated effluent pH levels and a high carbon footprint for lime usage.

	Units	ELV	Pilot Plant Influent (at pH 10.8)	Pilot Plant Effluent
pH	pH units	6-9	6.81	10.37
COD	mg/l	125	88.10	53.98
TSS	mg/l	25	32.38	24.49
PO ₄ -P	mg/l	1	1.53	0.61
Ammonia (as N)	mg/l	2	N/A	N/A

Table 1: Pilot plant influent/effluent removal rates (pH of 10.8) with WWTP Emission Limit Value (ELV) (own illustration)



Figure 5: Internal View of Struvia™ Pilot plant (© Veolia)

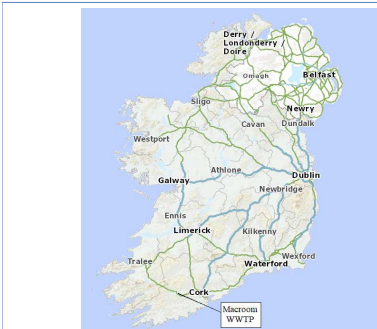


Figure 1: Location of Pilot Plant Unit at Macroom WWTP, Ireland (1)

- Prior to pilot plant commissioning, all health and safety, environmental and legal requirements were completed.

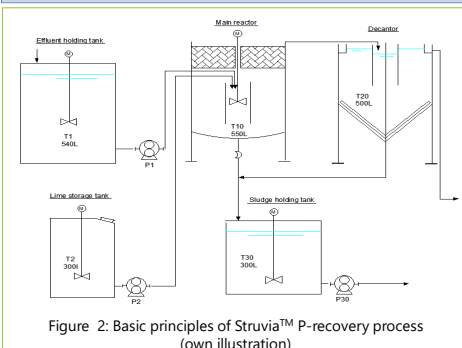


Figure 2: Basic principles of Struvia™ P-recovery process (own illustration)