



ARMPhos Phosphorus Removal System

Problem

The removal of Phosphorous (P) from effluents prior to discharge back into the environment to prevent the eutrophication of receiving waters has been a challenge for many years for wastewater treatment engineers. The standard solution used by the Water Companies has been chemical dosing, with ferric, removing P through the co-precipitation and settlement of iron salts.

Tightening and more broadly applied P consents has increased the requirement for a P removal solution that does not require power, freshwater, chemicals, generate sludge or require sludge storage systems.

Solution

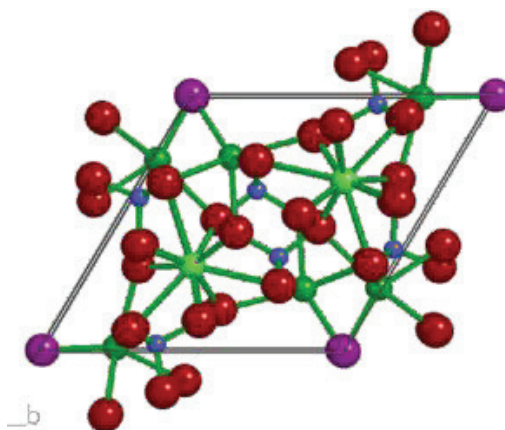
ARMPhos™, a reed bed engineering solution comprising a reactive media set within a wetland technology engineered framework is a very welcome step forward.

Mechanism of Action

The reactive media, based on apatite, offers two modes of action, an initial adsorption/crystallisation phase of phosphate on to the apatite which stimulates the second phase of crystallisation of calcium/phosphate complexes out of solution on to the adsorbed crystals.

History

French wetland Engineers could see the need for a low/no energy, low maintenance P removal system more than 15 years ago to match the characteristics of their highly successful full sewage treatment systems used widely in France. Using a reactive media in a wetland media setting was the obvious solution so a series of different reactive medias with P removal capacity were investigated including those based on iron, aluminium and calcium in the form of Zeolite, Expanded clays, LECA, Steel slag and Pozzolana to name a few. Apatite (rock phosphate) which comprises calcium phosphate with other salts and cations proved to have the highest P reduction capacity.



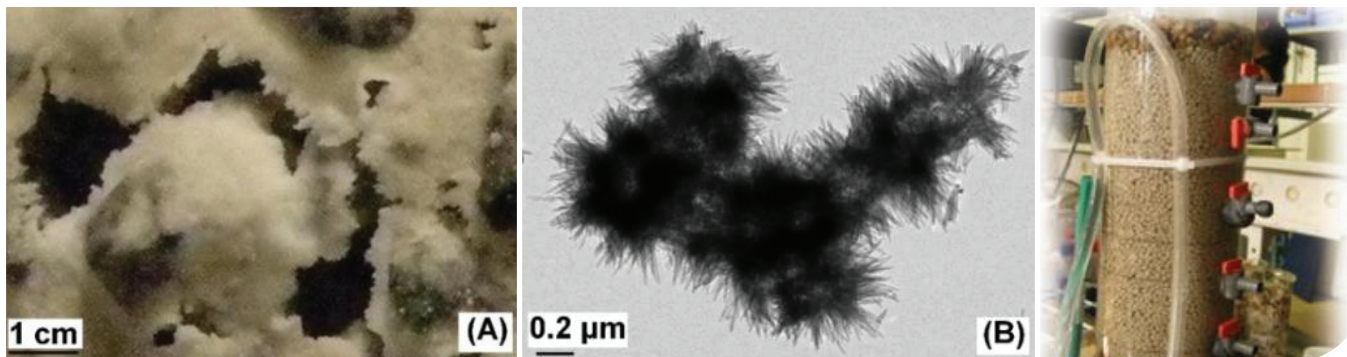
APATITE (Calcium Phosphate)
 $\text{Ca}_5(\text{PO}_4)_3 (\text{F}, \text{OH}, \text{Cl})$
Apatite rich in Fe, Al and Ca

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Pictures of the column trial equipment and electron micrographs of crystallised apatite

To the market

Initial attempts at bringing this to the market were with apatite beads formed with binders to increase the granularity of the media to improve hydraulic conductivity. A number of systems were constructed in this format but issues with the specific binder material affecting pH, and inhibiting the second crystallisation mechanism resulted in a reversion to the use of raw apatite, **ARMPhos™**, which if graded offered:

- Acceptable hydraulic conductivity
- Greater reactivity/binding sites
- Minimal pH effects

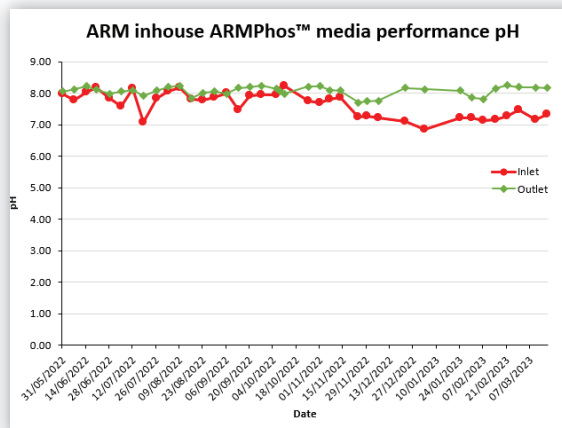
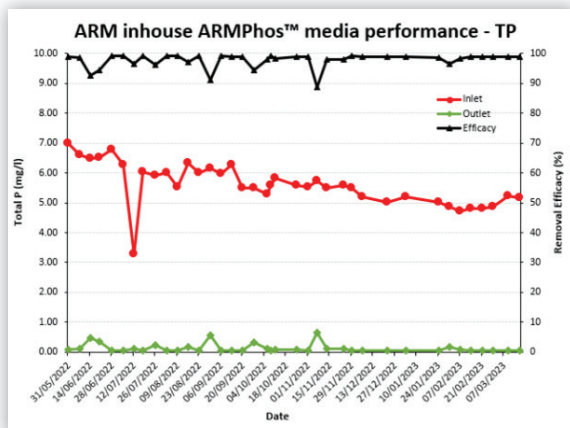
Initial column trials have seen

reductions comfortably below 1.0 mg/l Total P and as low as <0.1 mg/l.

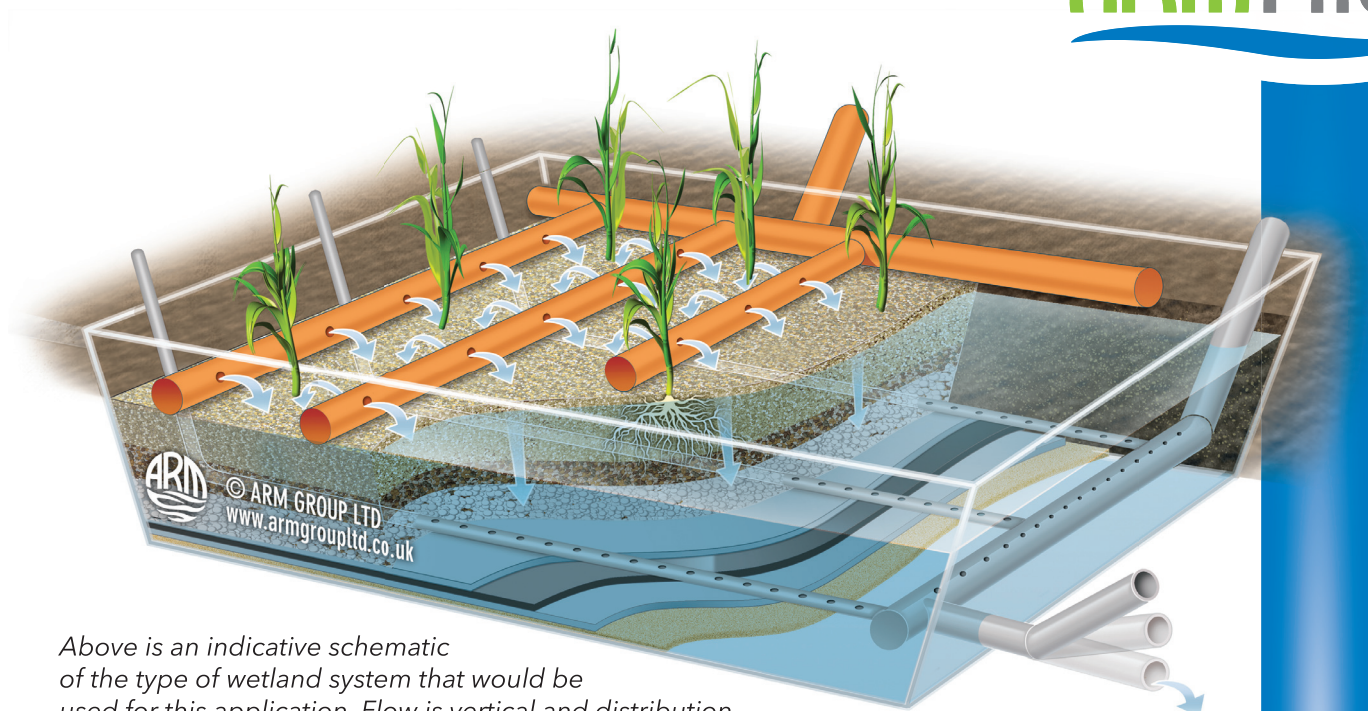
ARMPhos™

It was noted that the smaller particle sizes, finer grains, performed better in terms of P removal which may be influenced by increased surface area though there is thought to be a higher proportion of apatite within the finer grains also. The media supplied by ARM Ltd with the **ARMPhos™** solution is graded to an optimum balance of finer and larger particle sizes to provide excellent P removal capacity and good hydraulic loading capability also.

Research is ongoing looking at developments in the use of apatite in different formats, including new bead formulations to offer bespoke/broader treatment application capability.



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Above is an indicative schematic of the type of wetland system that would be used for this application. Flow is vertical and distribution is across the whole of the surface. The system would be in a tertiary position in the treatment process.

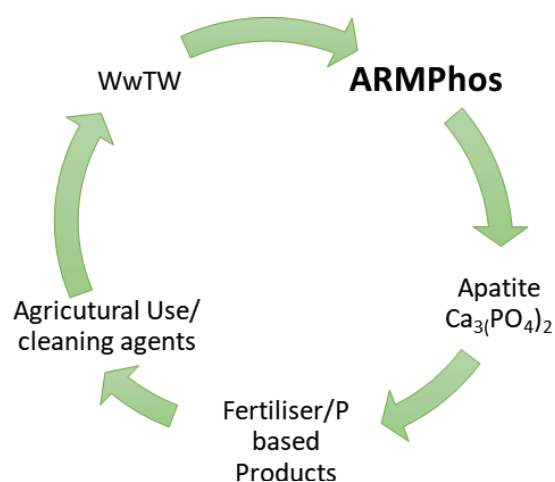
Recycling

The removal mechanisms result in the formation of more apatite through the complexing of calcium and phosphorous in solution and subsequent crystallisation. The time to refurbishment is based on reduction in permeability of the media, though results to date suggest this would be between 8 to 12 years or longer depending on the specific site. The resulting media could be removed as per any

refurbishment but could potentially be processed for reuse either in the same way or passed forward to other users of apatite such as fertiliser manufacturers. We have not reached this situation as yet so cannot confirm exactly how this might proceed but it is highly likely that the content of a fully charged system would be recyclable.

ARM Ltd offer **ARMPhos™** as the full P removal solution including:

- A bespoke designed solution for each site to achieve compliance
- Construction/Installation and commissioning
- Process guarantees where appropriate and depending on site requirements
- Consultancy, advice and recommendations based on performance
- Maintenance services
- Refurbishment services



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