



STRUVITE OR TRADITIONAL CHEMICAL PHOSPHORUS PRECIPITATION – WHAT OPTION ROCKS?

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Project Description

Phosphorus removal from red meat industry wastewater is currently performed by chemical precipitation, but there is increasing interest in struvite crystallization, as it produces a useable fertilizer product rather than waste solids. This research project seeks to review current commercially available and proven full scale struvite crystallization systems and assess the economic and technical benefits of struvite crystallization against the benchmark conventional phosphorus precipitation processes.

Project Content

Four proprietary struvite technologies were selected from the 16 international vendors with full-scale installations. The four selected technologies, Multiform, Ostara Pearl, NuReSys and Phospaq covered a range of unique struvite crystallization designs and each had multiple full-scale installations with a long operational history. Each vendor received the same design specifications, based on the composition and flow of anaerobically-treated wastewater from a medium-sized red meat processing facility, as a basis for CAPEX and OPEX estimates and performance estimates.

A cost benefit analysis was conducted to compare the three phosphorus removal options: struvite crystallization, a stand-alone chemical precipitation plant and chemical co-precipitation in an existing BNR plant. Further scenarios also investigated the sensitivity of the outcome to struvite market value, cost of sludge disposal, meat processing facility size, initial phosphorus concentration and struvite CAPEX.

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Project Outcome

The major design considerations determining the most appropriate struvite crystallization technology for the red meat processor includes the initial and final phosphorus discharge concentrations, integration of the struvite process with the wastewater treatment plant without impacting negatively on downstream operations, and its cost competitiveness with alternate phosphorus removal technologies and especially precipitation. The appropriate choice is likely to differ for individual meat processing facilities given different existing infrastructure, location and facility size. It is critical to understand that struvite technology will achieve only moderate final effluent levels (typically 15 – 20 mgP/L) more suitable for discharge to irrigation and sewer than surface waters.

For the medium sized meat plant, a struvite crystallization installation would cost between A\$4.75 – 6.25 million to purchase and install with annual operating costs of A\$400,000 – 800,000. Despite the high upfront costs, the struvite process is still economically better than a stand-alone chemical phosphorus precipitation unit in most scenarios over 20 years. To the contrary, however, struvite is usually not competitive if the processing site has the option to chemically dose into an existing BNR system, which is often the case for the larger meat processing facilities in Australia.

Only under more optimistic scenarios is struvite crystallisation the most economical phosphorus treatment option. Under these scenarios the requirements are for large processing plants (5 ML/d or more wastewater flow), high sludge disposal costs (> \$130/tonne), a high initial phosphorus concentration (80 mg/L) and/or lower-cost struvite equipment and installation costs (< \$A 6,500,000).

The cost benefit analysis highlighted variables with the most impact on economic feasibility over a 20 year life. Interestingly, the value of the struvite had relatively little effect on the economic competitiveness of a struvite installation with only a 10% difference in Net Present Value (NPV) between a struvite value of \$0 and \$400 per tonne. The factors with greatest impact were the cost of chemical sludge disposal, meat processing facility size (larger is best) and feed phosphorus concentration (higher is better).

The intangible significant advantages in terms of environmental credentials attributed to the installation of struvite crystallization phosphorus recovery has not been accounted for in the economic viability but should also be considered.

