'Bacterial shock' to recapture essential phosphate

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Bacteria could be exploited to recapture dwindling phosphate reserves from wastewater according to research presented at the Society for General Microbiology's Spring Conference in Dublin this week.

Phosphorus – in the form of phosphate - is essential for all living things as a component of DNA and RNA and its role in cellular metabolism. Around 38 million tonnes of phosphorus are extracted each year from rock. Most of this extracted phosphorus goes into the production of fertilizers to replace the phosphates that plants remove from the soil. However, it is a scare natural resource and current estimates suggest that reserves of phosphate rock may only last for the next 45-100 years.

Researchers at Queen's University Belfast (QUB) are developing a novel biological process to remove extracted phosphate from wastewater – where it ultimately ends up after manufacturing. Dr John McGrath who is leading the project explained, "Phosphate in wastewater is a pollutant that causes increased growth of algae and plants, reducing the oxygen available for aquatic organisms. This is known as eutrophication and poses the single biggest threat to water quality in Northern Ireland and indeed globally."

The work at QUB has focused on microorganisms that capture and store phosphate from wastewater, and how this process varies under different nutritional and environmental conditions. "A variety of microbes in wastewater accumulate phosphorus inside their cells and store it as a biopolymer known as polyphosphate. In some cases, this can represent

up to 20% of the dry weight of the microorganism!" explained Dr McGrath. "If we can harness this process we have a feasible biotechnological route to remove and recycle phosphate from wastewater."

The team have recently discovered a physiological 'shock' treatment which significantly increases microbial uptake of phosphorus and its accumulation inside cells. "It's similar to jumping into the sea on a winter's day – the first thing you do is take a sharp intake of breath. When we shock the microorganisms, their response is to take in phosphorus," explained Dr McGrath. "We've demonstrated this using activated sludge, containing a variety of microbes, from wastewater treatment works and shown this shock treatment is effective at producing a phosphorus-rich biomass suitable for phosphorus recycling."

Dr McGrath believes that developing such biotechnological processes is essential for regenerating valuable mineral resources. "No alternative to phosphorus exists – we urgently need to find ways of recovering and recycling phosphates. It's a pollutant we can't live without." he said. "Phosphates are currently removed from wastewater by chemical methods, however this is expensive and results in the production of large volumes of sludge. In contrast, the process we are developing is sustainable and efficient."

Provided by Society for General Microbiology