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**Biaqua Ferritin validated for its adsorption capacity to remove > 99.95% of 32P (i.e. < 1 ppb)**

Biaqua Ferritin is the polishing step in removal of ortho-phosphate from aqueous environment to microbial limiting concentrations below 1 ppb of phosphate.

The state of the art technique used by Biaqua in collaboration with Reactor Institute Delft (RID) applied radio-isotope of phosphorus, $^{32}P$, under form of $^{32}P$-spiked $(PO_4)^{3-}$which has a detection limit below 1 ppt.

**Background**

Water contamination with oxyanions (arsenate and phosphate) and metal ions over a wide ranges of concentrations is a problem for water and related systems that clean water.

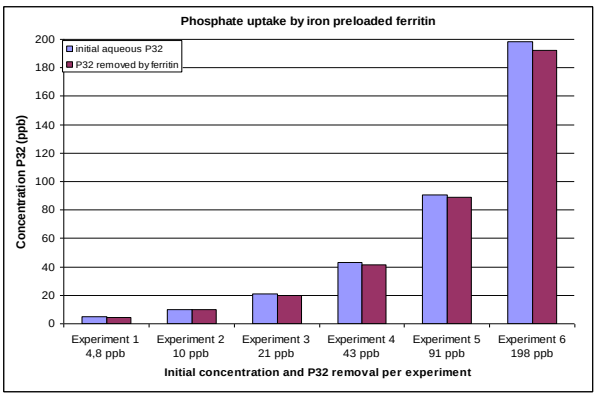
Eutrophication of surface water, caused by high level of phosphate, is an environmental issue. Further, arsenate ($HAsO_4^{2-}$/ $H_2AsO_4^-$) is a health and life threatening contaminant of drinking water in large areas of the world notably in Asia and also in parts of the USA and Europe.

There are numerous techniques available for the removal of the phosphate and arsenate from water. In general, all the available techniques suffer from a low affinity problem and therefore, are inefficient in the low concentration range (below 5 ppb). In addition, current water purification installations suffer from bio-fouling due to the accumulation of phosphate in the reverse osmosis systems at concentrations favourable for microbial growth.

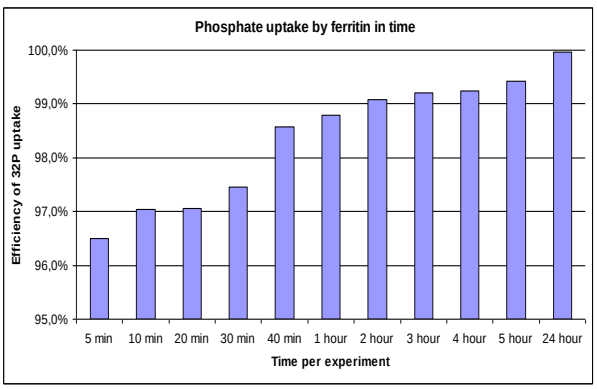
**Biaqua strategy**

Biaqua has addressed this problem by using a hyperthermophilic protein nano-cage, ferritin, which can form and hold an iron-based nanoparticle inside the protein. The nanoparticle thus formed is capable of adsorbing oxyanions with higher affinity even below 1 ppb.

**Results**




Uptake of ortho-phosphate by ferritin to occur to such an extent that the final equilibrium concentrations where below microbial limiting conditions, < 1 ppb.




The amount of phosphate removed from aqueous solution by ferritin as a function of time. When starting at higher liquid phosphate concentrations, the results show that already 96.5% of the total phosphate was taken up in the first 5 minutes.

*Calculations show the uptake of phosphate by preloaded ferritin under the given conditions is approx. 0.02 [mol/(mol.s)] (initial rate).*

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**Batch Equilibrium Experimental Setup**

The experimental program used a wide range of aqueous phosphate concentrations to monitor the phosphate removal by ferritin. Concentrations ranged from 5 to 200 ppb. The specific ferritin concentrations can also be varied.

The half-life of $^{32}P$ is 14.5 days.

The approach for the adsorption experiment is a standard batch liquid phase equilibration. Radioactively labeled phosphate solution was equilibrated with ferric iron loaded ferritin solution. The system was left overnight for equilibration. Aqueous phosphate solution and ferritin where separated using a column filter with a cut-off filter of 3 kDa. The $^{32}P$ concentration in the permeate was measured using a liquid scintillation counter, giving the final aqueous phase equilibrium concentration.

**About Biaqua**

Biaqua is established on the basis of pioneering work by Professor Dr. Fred Hagen (Enzymes) and Professor Dr. Marc van Loosdrecht (Water sector expertise). The team is currently based out of its offices in Delft and Badhoevedorp (Schiphol Airport) in the Netherlands.

Further information about the project and technology can be directed to

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