

## Soil & Water Conservation Society of Metro Halifax ('SWCSMH')

(a volunteer scientific stakeholder-group)

310-4 Lakefront Road, Dartmouth, NS, Canada B2Y 3C4

Email: limnos@chebucto.ns.ca

Tel: (902) 463-7777

Homepage: <http://www.chebucto.ns.ca/Science/SWCS/SWCS.html>

---

**Ref.:** WAB01-06 (total= 3 pages)  
**To:** Chairman Dr. Wayne Stobo and Members,  
Halifax/Halifax County Watershed Advisory Board (WAB), HRM  
**From:** S. M. Mandaville (Professional Lake Manage.), Chairman & Exec. Director  
**Date:** March 04, 2001  
**Subject:** **All is not lost with large new subdivisions with onsite systems .....  
provided one spends the money and supports innovative systems and/or  
have greater setbacks from lakes than what NSDoE&L requires!**

---

As a formal board, the WAB has already addressed the need for larger setbacks from lakes/estuaries, hence I will not revisit that issue again here. This is about some innovative technologies a leading research institution in Canada is developing, i.e., the University of Waterloo Groundwater Research!

Further to the concerns on long-term migration of phosphorus via shallow/deep groundwater from onsite systems into our lakes, this submission is a brief overview on some emerging technologies which seem to hold considerable promise!!

Through the kind support of Prof. Dr. Will Robertson of the University of Waterloo, a leader in onsite system research, I am herewith pleased to provide the following info:

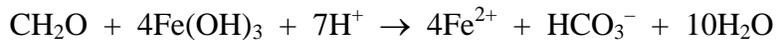
1. **Robertson, W.D., 2000**

A new method for the treatment of wastewater phosphate is presented here that relies on reductive iron dissolution (RID process). This technique may be attractive for use with smaller wastewater treatment systems such as septic systems, because it can be maintenance-free for long periods and it avoids sludge accumulation.

- 1.1. Background/Results: It is analogous to existing treatment methods that use iron salts (e.g., FeCl<sub>2</sub>) to precipitate P from wastewater, except that in this case ferrous iron is made available by the reductive dissolution of ferric iron solids that are contained in a reactive porous media. The ferric solids are minerals such as amorphous Fe(OH)<sub>3</sub> that occur naturally in soils and sediments. A laboratory column study and a pilot scale field trial demonstrated that these solids are susceptible to reductive dissolution

when mixed with sewage effluent, resulting in increased Fe(II) in solution. This promotes the precipitation of Fe(II)-P solids and then Fe(III)-P solids when the effluent is subsequently oxidized. Both experiments demonstrated the ability of the RID media to passively solubilize consistent, moderate concentrations of Fe (1-9 mg/l) over extended periods (2-3 yr.). In the column test, influent PO<sub>4</sub> of 9.0 ± 3.7 mg P/l was lowered to 2.1 ± 1.1 mg P/l. In the field trial, influent PO<sub>4</sub> of 10.2 ± 6.0 mg P/l was lowered to <0.05 mg P/l.

- 1.2. Theory: This is a new method for the passive removal of wastewater P, one that again relies on the use of an iron-rich porous media material. In this case however (unlike in Baker *et al.*, 1998), the media is placed in direct contact with the unoxidized sewage so that reducing conditions are maintained.



Ferrous iron in solution can then attenuate PO<sub>4</sub> in two ways; first by the precipitation of Fe(II)-P solids, for example vivianite:



and secondly, if the effluent is subsequently oxidized, by the precipitation of Fe(III)-P solids such as strengite:



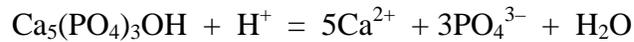
- 1.3. Recommendation: Longer-term trials should be undertaken with operating septic systems to assess the longevity of the RID media, further assess the amount of P removal that can be achieved, and examine potential operational problems that could result, such as permeability reductions from mineral accumulations or biomass buildup.

2. **Baker et al., 1998**

Permeable reactive mixtures can be placed in situ, as horizontal or vertical reactive barriers in sediments receiving wastewater discharge, or can be used in single pass, self-contained treatment modules in alternative treatment systems. Reactive mixtures composed of silica sand, high calcium crushed limestone, and readily available metal oxides were tested to evaluate phosphorus attenuation.

Iron/calcium oxides, produced from steel manufacturing, and fine-grained activated aluminum oxide outperformed other oxides tested during batch experiments. These materials removed greater than 99% of PO<sub>4</sub> from a 10 mg/l PO<sub>4</sub>-P solution within 1 h of contact.

2.1. The formation reaction and solubility product of hydroxyapatite are given by



$$K_{\text{sp}} = ([\text{Ca}^{2+}]^5 [\text{PO}_4^{3-}]^3) \div [\text{H}^+]$$

The mean value and 95% confidence interval of the solubility product, log  $K_{\text{sp}}$  for the microcrystalline phase formed in the column was  $-36.31 \pm 0.68$ . This value is 6-10 orders of magnitude greater than the literature log  $K_{\text{sp}}$  values for HAP (-44.20, -40.41).

**References:**

- Baker, M.J., Blowes, D.W., and Ptacek, C.J. 1998. Laboratory Development of Permeable Reactive Mixtures for the Removal of Phosphorus from Onsite Wastewater Disposal Systems. *Environ. Sci. Technol.* 32:2308-2316.
- Robertson, W.D. 2000. Treatment of Wastewater Phosphate by Reductive Dissolution of Iron. *J. Environ. Qual.* 29:1678-1685.