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Application of aragonite shells for the removal of aqueous metals in polluted soils and wastewaters.

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In the present study the use of coupled precipitation/dissolution processes for metal (Me) removal from polluted soils and waters by biogenic carbonate ($CaCO_3$) shell surfaces is proposed, according to the following overall reaction:

$$CaCO_3 + Me^{2+} = MeCO_3 + Ca^{2+}$$

This reaction has been investigated at fixed experimental conditions using synthetic model systems consisting in columns, batch, and reactors (e.g. lead, zinc, and cadmium artificial solutions mixed with aragonite shells) that allowed quantifying the kinetics of the process of metal carbonate formation.

The above mentioned process has the potential of being used in three different areas of water treatment: a) use of shells as a cheap and effective geologic barrier for contaminated ground or surface waters, b) use as a material in filter beds or fluidized bed for selective cleaning of waste water with the potential of partial metal recovery and c) use as seed crystals during the elimination of metals through precipitation with soda (Na_2CO_3).

Acidic wastewaters containing several pollutants, including heavy and trace metals, are created during production of pesticides, paper, lubricating oil, batteries, acid/alkali, or in ship repair manufacturing, mines drainage systems, metalworking and metal plating industries.

Biogenic shells are a waste product in many coastal countries and may thus be more favorable than other solid phases such as clays or zeolithes from an economic viewpoint. Our metal elimination study aims at setting up a low-cost effective elimination system for various types of metal rich waste waters.

A number of experimental techniques such as batch, column and flow through reactors were used to optimize the metal removal efficiency in both synthetic and waste waters from the metal finishing industry. Solid liquid ratio, initial and final pH, metal concentration and combination of metals have been varied. Measurements of pH, metal concentration, conductivity and alkalinity were recorded over the time. Metal content of Fe, Zn and other heavy metals of the precipitate from the different reactors systems were characterized using FT-IR spectroscopy, X-ray diffraction, scanning electron microscopy (SEM) and Raman Spectroscopy. The most important factors that influence metal removal efficiency, experimental setup, the total iron content, reaction pH, metal to shell ratio will be discussed.