Encapsulator's Hypothesis

Through the application of polyurethane as a sequestering agent, we can reduce the re-introduction of phosphorus into freshwater ecosystems. Increases in phosphorus concentrations can result in eutrophic conditions. The change results in an increase in algal blooms, and decrease in water levels; thus, affecting the availability of fresh water.

Encapsulator's Plan and Design

Stage One (November2012-March 2013): As a team, an evaluation of different methods was executed. The team considered a method "the best" when it was presumed that it was able to capture and immobilize the migration of heavy metals into nearby environments and ecosystems. The following methods outline different means of sequestration.

Sequestration methods include:

A. Encapsulation

B. Dredging

C. Cementing

D. Encasing

The group decided what materials were best to capture and immobilize heavy metals through researching, selecting, and screening possible media. The initial assessment included a pH measurement of the substance and the way it affects the water's pH level. The substance was placed in a beaker of water, and the pH value was tested every other day. The pH level was tested using a pH scale (Hanna) HI 208 (inspection #9777AL). The substances that were capable of passing the pH test then went onto other preliminary tests. The preliminary tests included the way the group works with the substance, the cost, and the way it will affect the surrounding ecosystem. Total organic compounds (TOC) were also measured. The results were found to be normal based on criteria for river water.

Materials screened for sequestering:

A. Polyurethane

B. Silicon

C. Paraffin wax

Last year, the team decided to assess paraffin wax. At a 1:2 ratio (1 part paraffin, 2 parts sediment/slurry), wax was successful in encapsulating a total of 587.055 mg/k, which calculated to 91.5% of the original metals' concentration in the spiked sample.

This year the team decided to assess polyurethane as sequestering and encapsulating agent. The goal was to examine the encapsulation of phosphorus and phosphorus compounds. Phosphorus plays a major role in the succession of lakes and ponds towards more eutrophic conditions. This may result in increases in algal blooms and plant growth, diminishing or depleting the dissolved oxygen in water necessary for fish species to survive. The succession of lakes and ponds towards more eutrophic conditions may also reduce the fresh water supply on planet Earth.

Stage Two (A) (September 2013): After polyurethane was selected for immobilizing phosphorus, the group decided which delivery method was best. A. Gavina and S. Moreno determined the optimal ratio of encapsulate to sludge by conducting trial and error experiments.

Results of Stages 1 & 2

Method of Study: As a team, encapsulation was selected since the group realized it was the best and most realistic type of method to test.

Selected Media: Polyurethane was selected because the team concluded polyurethane would be able to sequester and immobilize phosphorus in lakes and ponds. Lake DePue is showing initial signs of pond succession and eutrophication. Over the past year, TOC levels have increased 72%, therefore, this bears monitoring. Also, keep in mind TOC levels can and do change with seasons. Being able to stop the process will be able to save the lake and the business it brings to the small community. Likewise, it could be

used in other areas around the world that have similar environmental problems.

Delivery Method/ Optimal Ratio: We examined different applications with polyurethane, and decided on injection/ slurry mixing method. The selected ratio was 1:5 (1 part polyurethane, 5 parts sludge).

Trial #1 with polyurethane

Stage Three (A) (November 12, 2013)(Micro-Trial): The experiment will be conducted on sludge dosed with a prepared solution containing phosphoric acid. A. Villalobos will be dosing the solution with the acid. Then the treated sludge will be mixed with polyurethane by S.Moreno. The polyurethane will be able reduce the re-introduction or migration of the phosphorous. Pre-treatment and post-treatment samples will be taken by A. Gavina and later will be submitted for total phosphorous analysis to determine the viability of polyurethane as a sequestering/immobilizing agent to the phosphorus. The polyurethane to sediment loading ratio will be 1:5 (one part polyurethane to five parts sediment/slurry).

Team Mentor's role

Throughout the whole process, Mr. Garcia will be supervising all the activities done by the students. He will also contact the press to spread the knowledge of the possible solution to stop the process of eutrophication of lakes and ponds.

Other help

Other community members have helped the Encapsulators by sharing it to the public. For example, Anna McKee helped the team by featuring the team's work on the school website. Eric Bryant also helped by allowing us to post our project on the community websites. Hugo Heredia kindly was able to post our project on to various websites. Additionally, Dr. Kevin Garcia was contacted to publish our finding in Sonoran News. Tina Garcia also helped the group with technical procedures.

The Encapsulators Members

Team Advisor/Mentor: Dr. Keith Garcia

Team Leader: Servando Moreno

Adilene Gaviña

Alejandro Villalobos