Effective Stormwater and Sediment Control During Pipeline Construction Using a New Filter Fence Concept

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Title: Effective Stormwater and Sediment Control During Pipeline Construction Using a New Filter Fence Concept
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Project Amount: $159,583
Research Category: Pollution Prevention and Waste Management

Description:

The overall objective of the project is to turn the currently unsuccessful silt fence technology into a highly effective sediment control system. Research is needed to replace current ineffective technology with a workable alternative that is effective at trapping sediment for the duration of the construction project and is cost effective as well. Year 1 efforts concluded with a preliminary design for such a system, to be known as Failure Avoidance and Effective Silt fence Technology (FAEST). The preliminary design successfully solved the problem of flow concentration and resulting undercutting and release of sediment at the toe of conventional silt fence; in addition, the inability of conventional silt fence to trap clays and fines due to inadequate detention time was greatly reduced. Year 2 efforts will result in a final structural design for FAEST and address installation issues.

Objective(s) of the Research Project Specified for Current Project Period:

The following is a brief summary of the objectives in the proposal to be addressed in the current project period.

Proposal Objective 3b. Increase trapping of fines and clays through addition of Polyacrylamide (PAM)
Proposal Objective 3c and 3d. Address failure of conventional silt fence due to fabric stretching and inadequate post strength.
Proposal Objective 4. Address economic and manufacturability issues.
Proposal Objective 5. Develop design aids and BMP guidelines.
Proposal Objective 6. Develop design requirements for a machine to install FAEST.

Progress Summary/ Accomplishments (since 10/11/05):

Proposal Objective 3. Results of Year 1 testing, as reported in the proceedings of the IPEC 2005 Annual Meeting showed that our preliminary design was far more effective with overall trapping

efficiency than conventional silt fence under similar conditions. In addition, we tested our design with steeper slopes (more severe conditions) than were possible with conventional silt fence.

This quarter's efforts toward Objective 3 have focused on addition of PAM to increase flocculation and decrease the detention time needed to settle clays and fines. We completed the first series of jar tests, the objective of which was to develop an experimental design for optimizing PAM type and concentration, along with optimizing addition of calcium chloride for a particular soil. While there are a wide variety of PAM formulations, we confined our testing to those anionic PAMs that have been used in agricultural and soil stabilization operations. A major part of the development involved determining and effective range of concentrations for PAM and the effects of adding calcium chloride. Results were evaluated based on reduction in turbidity and reduction in suspended solids concentration. The technique was then applied to a loamy clay soil which is very typical of soil found in Oklahoma. We discovered that, everything else being equal, PAM type was not much of a factor in sediment removal. We also found that, once a threshold concentration was reached, that sediment removal is consistent over a wide range of PAM concentrations. This result has very favorable implications for field applications where it would be difficult to attain an exact level of concentration in the runoff. Figure 1 shows the results and Figure 2 is a photo of the laboratory apparatus.

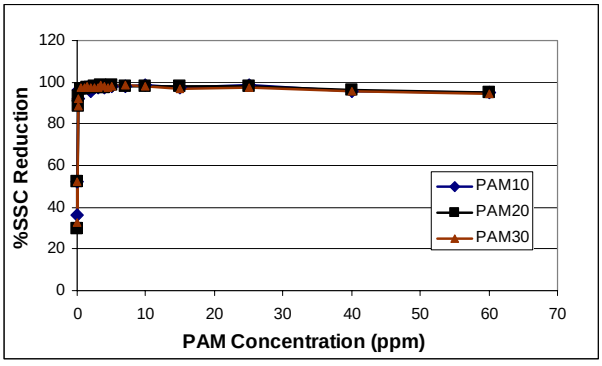

Figure 1. Sediment removal as a function of PAM concentration. The 10, 20, and 30 refer to the charge density of the PAM

Figure 2. Photo of laboratory jar test apparatus.

An additional element of Objective 3 is to determine the best means of introducing the PAM into the runoff. A variety of methods have been determined as feasible, and cover the range of

options from incorporating PAM into the fabric itself to spraying PAM onto the fabric and/or soil to placing PAM pellets in mesh containers for the runoff to flow through. To test these various options and also to verify that the laboratory experiments were a good representation of field conditions, a pilot scale model of one silt-fence impoundment was built in the Model Building at the USDA Hydraulics Lab. With this model, the amount of sediment, PAM, and water entering the impoundment can be measured. Also, the runoff passing through the fence can be measured and sampled. This piece of equipment has been built and tested and will be ready for data collection experiments as soon as the winter season is over and the siphons from Lake Carl Blackwell are opened. Figure 3 is a photo of the pilot scale model being tested.

Figure 3. Photo of pilot-scale model

Proposal Objective 5. A spreadsheet-based model to evaluate the performance of FAEST is currently being developed and the hydraulic and impoundment components are being verified based on the discharge and concentration data collected during the Year 1 Field Laboratory testing. In order to incorporate the impact of PAM application on the settling within the impoundments into the model, a large settling column was fabricated. Through video and human observation, this large settling column will be used to determine the settling velocity of sediment treated with PAM. Figure 4 is a photo of the settling column, which is 1 meter tall.

The information from the settling column experiment will be used to modify the impoundment settling components in the computer model to account for the greater settling velocities achieved through flocculation of the clays into aggregates.

Figure 4. Photo of settling column

Proposal Objective 6. We have had several meetings with industrial partner, Charles Machine Works ("Ditch Witch") and are moving toward production of a machine that will install FAEST.

Publications/ Presentations:

"FAEST, a New Silt Fence Technology That is Effective at Construction Sites," to be presented at the International Erosion Control Association meeting in San Diego, CA, February 2006

Future activities:

During the second quarter we plan to continue with the laboratory and pilot-scale tests. We are also in the planning stage with Greenville, SC to implement a field installation of FAEST at a construction site in their area. Full-scale field testing with addition of PAM is planned for spring and summer of 2006.

Supplemental Keywords: Soil, sediments, pollution prevention, sustainable development, engineering, hydrology, south central, Oklahoma, EPA Region 6, petroleum industry, construction industry.