Flocculation

Design Considerations

The design and operation of a flocculation system should take into consideration the factors that determine optimum, cost-effective performance, while ensuring non-toxic discharges.

1. Product Evaluation

a. Treatment chemicals must be approved by EPA for potable water use.
b. Petroleum-based polymers are prohibited.
c. The approval of a treatment chemical shall be conditional, subject to monitoring of treated stormwater at the subject construction site.
d. Authorization to use a chemical in the field does not relieve the applicant from responsibility for meeting all discharge and receiving water criteria applicable to a site.

2. Planning Considerations

a. Flocculation systems should be designed as a part of the overall Sediment and Stormwater Management plan whenever problem soils are anticipated. Chemical treatment may be used to correct problem sites in some circumstances with formal written approval.
b. The right chemical must be used at the right dosage. A dosage that is either too low or too high will not produce the best results. There is an optimum dosage rate that must be determined based on the soil type.
c. Flocculants are most effective when applied to the soil surface in anticipation of a runoff event. They may also be installed in the form of "floc blocks" in conveyance system upstream from a sediment trapping practice. If applied directly to a pool of sediment-laden runoff, the coagulant must be mixed rapidly into the water to insure proper dispersion.
d. A flocculation step is important to increase the rate of settling, produce the lowest turbidity, and keep the dosage rate as low as possible.
e. Too little energy input into the water during the flocculation phase results in flocs that are too small and/or insufficiently dense. Too much energy can rapidly destroy floc as it is formed.
f. Since the volume of the basin is a determinant in the amount of energy per unit volume, the size of the energy input system could be too small relative to the size of the basin.
g. Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. The discharge should be directed through a physical filter such as a vegetated swale that would catch any unintended floc discharge.

3. Flocculation Materials

a. A variety of flocculent materials are available. Since trace amounts of flocculent will undoubtedly be discharged, the product used should be non-toxic and safe for both human and aquatic life and should not create Biochemical Oxygen Demand (BOD) problems in the downstream discharge waters.

b. One flocculent that has been commonly used for stormwater applications is Polyacrylamide (PAM). Two versions of PAM are available, cationic and anionic. Only anionic PAM should be used, as cationic PAM is considered highly toxic. Anionic PAM has been used for many years in the water and wastewater industry and is considered safe for humans and aquatic life when used at the recommended rates.
c. Chitosan is another flocculent that is derived from the exoskeletons of crustaceans. It is generally considered safe for use in stormwater and water bodies.
d. Selection of an appropriate flocculent is highly dependent on the soil particle type and concentration. Analysis of a sample of the contaminated water is usually required to select the proper product and application rate. Manufacturers of these products will normally assist in this process.

4. Flocculation System Design

a. Flocculation procedures shall be designed in accordance with the manufacturer's recommendations. Ponds or portable tanks are typically used for treatment. Flow-through systems with no means to trap or filter the flocculant are not permitted.
b. A typical flocculation system may contain various components, including but not limited to a stormwater conveyance system, a storage pond, filter, pumps, a chemical feed system, treatment cells, and interconnecting piping.
c. It is recommended that storage ponds or other holding areas have a capacity of 1.5 times the volume to be treated. Bypass should be provided around the system to accommodate extreme storm events.
d. Primary settling should be encouraged in the storage pond. A forebay is helpful.
e. Treatment cell sizing should consider the discharge flow rate and the desired drawdown time.
f. Discharge rates off site must meet all applicable requirements.

5. Monitoring

a. Operational monitoring should include pH, conductivity (as a surrogate for alkalinity), turbidity and temperature of untreated stormwater. Other important quantities include total volume treated, amount of polymer used for treatment and settling time.
b. Discharge monitoring should include pH, turbidity and toxicity of treated stormwater, as well as discharge rates.
c. Any other monitoring necessary to meet federal, state and local water quality standards.

6. Education

a. Each contractor who intends to use chemical treatment should be extensively trained by experienced personnel.
b. If a different contractor is used for chemical stormwater treatment than the general construction site contractor, regular coordination meetings should be held between all responsible parties.

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7. Maintenance:

Pretreatment and treatment ponds and cells should be cleaned out periodically, and sediment or floc properly disposed of. Pumps and feed systems must be maintained in good working order. Conveyance systems need to be inspected and maintained in order to function as designed. Check discharge points to ensure that no erosion is occurring from the release of treated runoff.

8. Limitations:

If approval of the chemical treatment system is not received during the application phase of the project, an addendum will be necessary and may result in project delays. Extensive monitoring may be necessary to ensure not only that turbidity reduction goals are being met, but that toxicity of the treated discharge is not an issue. The space necessary for pumps, treatment cells and chemical feed systems can be a problem on smaller sites.