

BMP C250: Construction Stormwater Chemical Treatment

Purpose

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sedimentation ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Chemical treatment may be used to reduce the turbidity of stormwater runoff.

Conditions of Use

Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants. Very high turbidities can be reduced to levels comparable to what is found in streams during dry weather. Traditional BMPs used to control soil erosion and sediment loss from sites under development may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Chemical treatment may be required to protect streams from the impact of turbid stormwater discharges, especially when construction is to proceed through the wet season.

Formal written approval from Ecology and the City is required for the use of chemical treatment regardless of site size. The intention to use Chemical Treatment shall be indicated on the Notice of Intent for coverage under the General Construction Permit. Chemical treatment systems should be designed as part of the CSWPPP, not after the fact. Chemical treatment may be used to correct problem sites in limited circumstances with formal written approval from Ecology and the City.

The SEPA review authority must be notified at the application phase of the project review (or the time that the SEPA determination on the project is performed) that chemical treatment is proposed. If it is added after this stage, an addendum will be necessary and may result in project approval delay.

Design and Installation Specifications

See Appendix II-B for background information on chemical treatment.

Criteria for Chemical Treatment Product Use: Chemically treated stormwater discharged from construction sites must be nontoxic to aquatic organisms. The following protocol shall be used to evaluate chemicals proposed for stormwater treatment at construction sites. Authorization to use a chemical in the field based on this protocol does not relieve the applicant from responsibility for meeting all discharge and receiving water criteria applicable to a site.

- Treatment chemicals must be approved by EPA for potable water use.
- Petroleum-based polymers are prohibited.

- Prior to authorization for field use, jar tests shall be conducted to demonstrate that turbidity reduction necessary to meet the receiving water criteria can be achieved. Test conditions, including but not limited to raw water quality and jar test procedures, should be indicative of field conditions. Although these small-scale tests cannot be expected to reproduce performance under field conditions, they are indicative of treatment capability.
- Prior to authorization for field use, the chemically treated stormwater shall be tested for aquatic toxicity. Applicable procedures defined in Chapter 173-205 WAC, Whole Effluent Toxicity Testing and Limits, shall be used. Testing shall use stormwater from the construction site at which the treatment chemical is proposed for use or a water solution using soil from the proposed site.
- The proposed maximum dosage shall be at least a factor of five lower than the no observed effects concentration (NOEC).
- The approval of a proposed treatment chemical shall be conditional, subject to full-scale bioassay monitoring of treated stormwater at the construction site where the proposed treatment chemical is to be used.
- Treatment chemicals that have already passed the above testing protocol do not need to be reevaluated. Contact the Department of Ecology Regional Office for a list of treatment chemicals that have been evaluated and are currently approved for use.

Treatment System Design Considerations: The design and operation of a chemical treatment system should take into consideration the factors that determine optimum, cost-effective performance. It may not be possible to fully incorporate all of the classic concepts into the design because of practical limitations at construction sites. Nonetheless, it is important to recognize the following:

- The right chemical must be used at the right dosage. A dosage that is either too low or too high will not produce the lowest turbidity. There is an optimum dosage rate. This is a situation where the adage “adding more is always better” is not the case.
- The coagulant must be mixed rapidly into the water to insure proper dispersion.
- A flocculation step is important to increase the rate of settling, to produce the lowest turbidity, and to keep the dosage rate as low as possible.
- 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.

- Since the volume of the basin is a determinant in the amount of energy per unit volume, the size of the energy input system can be too small relative to the volume of the basin.
- 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.

Treatment System Design: Chemical treatment systems shall be designed as batch treatment systems using either ponds or portable trailer-mounted tanks. Flow-through continuous treatment systems are not allowed at this time.

A chemical treatment system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), a storage pond, pumps, a chemical feed system, treatment cells, and interconnecting piping.

The treatment system shall use a minimum of two lined treatment cells. Multiple treatment cells allow for clarification of treated water while other cells are being filled or emptied. Treatment cells may be ponds or tanks. Ponds with constructed earthen embankments greater than six feet high require special engineering analyses. Portable tanks may also be suitable for some sites.

The following equipment should be located in an operations shed:

- the chemical injector;
- secondary containment for acid, caustic, buffering compound, and treatment chemical;
- emergency shower and eyewash, and
- monitoring equipment which consists of a pH meter and a turbidimeter.

Sizing Criteria: The combination of the storage pond or other holding area and treatment capacity should be large enough to treat stormwater during multiple day storm events. It is recommended that at a minimum the storage pond or other holding area should be sized to hold 1.5 times the runoff volume of the 10-year, 24-hour storm event. Bypass should be provided around the chemical treatment system to accommodate extreme storm events. Runoff volume shall be calculated using the methods presented in Volume 3, Chapter 2. If no hydrologic analysis is required for the site, the Rational Method may be used.

Primary settling should be encouraged in the storage pond. A forebay with access for maintenance may be beneficial.

There are two opposing considerations in sizing the treatment cells. A larger cell is able to treat a larger volume of water each time a batch is processed. However, the larger the cell the longer the time required to empty the cell. A larger cell may also be less effective at flocculation and therefore require a longer settling time. The simplest approach to sizing

the treatment cell is to multiply the allowable discharge flow rate times the desired drawdown time. A 4-hour drawdown time allows one batch per cell per 8-hour work period, given 1 hour of flocculation followed by two hours of settling.

The permissible discharge rate governed by potential downstream effect can be used to calculate the recommended size of the treatment cells. The following discharge flow rate limits shall apply:

- If the discharge is directly or indirectly to a stream, the discharge flow rate shall not exceed 50 percent of the peak flow rate of the 2-year, 24-hour event for all storm events up to the 10-year, 24-hour event.
- If discharge is occurring during a storm event equal to or greater than the 10-year, 24-hour event, the allowable discharge rate is the peak flow rate of the 10-year, 24-hour event.
- Discharge to a stream should not increase the stream flow rate by more than 10 percent.
- If the discharge is directly to a lake, a major receiving water listed in Appendix C of Volume I, or to an infiltration system, there is no discharge flow limit.
- If the discharge is to a municipal storm drainage system, the allowable discharge rate may be limited by the capacity of the public system. It may be necessary to clean the municipal storm drainage system prior to the start of the discharge to prevent scouring solids from the drainage system.
- Runoff rates shall be calculated using the methods presented in Volume 3, Chapter 2 for the predeveloped condition. If no hydrologic analysis is required for the site, the Rational Method may be used.

Maintenance Standards

Monitoring: The following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site:

Operational Monitoring

- pH, conductivity (as a surrogate for alkalinity), turbidity and temperature of the untreated stormwater
- Total volume treated and discharged
- Discharge time and flow rate
- Type and amount of chemical used for pH adjustment
- Amount of polymer used for treatment
- Settling time

Compliance Monitoring

- pH and turbidity of the treated stormwater
- pH and turbidity of the receiving water

Biomonitoring

Treated stormwater shall be tested for acute (lethal) toxicity. Bioassays shall be conducted by a laboratory accredited by Ecology, unless otherwise approved by Ecology. **The performance standard for acute toxicity is no statistically significant difference in survival between the control and 100 percent chemically treated stormwater.**

Acute toxicity tests shall be conducted with the following species and protocols:

- Fathead minnow, *Pimephales promelas* (96 hour static-renewal test, method: EPA/600/4-90/027F). Rainbow trout, *Oncorhynchus mykiss* (96 hour static-renewal test, method: EPA/600/4-90/027F) may be used as a substitute for fathead minnow.
- Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48 hour static test, method: EPA/600/4-90/027F).

All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA test method and Ecology Publication # WQ-R-95-80, Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria.

Bioassays shall be performed on the first five batches and on every tenth batch thereafter, or as otherwise approved by Ecology. Failure to meet the performance standard shall be immediately reported to Ecology.

Discharge Compliance: Prior to discharge, each batch of treated stormwater must be sampled and tested for compliance with pH and turbidity limits. These limits may be established by the water quality standards or a site-specific discharge permit. Sampling and testing for other pollutants may also be necessary at some sites. Turbidity must be within 5 NTUs of the background turbidity. Background is measured in the receiving water, upstream from the treatment process discharge point. pH must be within the range of 6.5 to 8.5 standard units and not cause a change in the pH of the receiving water of more than 0.2 standard units. It is often possible to discharge treated stormwater that has a lower turbidity than the receiving water and that matches the pH.

Treated stormwater samples and measurements shall be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water shall not be taken from the treatment pond prior to decanting. Compliance with the water quality standards is determined in the receiving water.

Operator Training: Each contractor who intends to use chemical treatment shall be trained by an experienced contractor on an active site for at least 40 hours.

Standard BMPs: Surface stabilization BMPs should be implemented on site to prevent significant erosion. All sites shall use a truck wheel wash to prevent tracking of sediment off site.

Sediment Removal And Disposal:

- Sediment shall be removed from the storage or treatment cells as necessary. Typically, sediment removal is required at least once during a wet season and at the decommissioning of the cells. Sediment remaining in the cells between batches may enhance the settling process and reduce the required chemical dosage.
- Sediment may be incorporated into the site away from drainages.