

Water Application of Additives for Sediment Control (1051)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

The water application of products containing water-soluble *additives*¹ to remove suspended solids in *sediment control structures* (water clarification). Products include additives such as *polyacrylamide (PAM)* and other *polymers*.

II. Purpose

The purpose of this practice is to clarify water prior to discharge by settling suspended *sediment* within sediment control structures for construction or post-construction process systems.

III. Conditions Where Practice Applies

This practice is to be used with self-contained sediment control structures, on a temporary basis for construction sites, in an emergency for post-construction sites, and if needed, to improve the sediment removal efficiency of a structure. Sediment control structures shall not be within *surface waters of the state*. An *allowable application rate* is needed if treated storm / process water is discharged to surface waters of the state. Additives shall not be directly applied to surface waters of the state.

This practice is intended for water application of additives (with an established *allowable usage rate*) when water could enter surface waters of the state as defined by the Wisconsin Department of Natural Resources (WDNR) ch. NR 102, Wis. Adm. Code.

IV. Federal, State and Local Laws

Additive application shall comply with all federal, state, and local laws, rules or regulations governing additives. The operator is responsible for securing required permits, and additive allowable usage rates. This standard does not contain the text of the federal, state, or local laws governing additives.

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

V. Criteria

A. Toxicity Criteria

Where an additive could discharge to surface waters of the state, the WDNR reviews toxicity data for the *additive mixture* based on the guidance titled "[Water Quality Review Procedures for Additives](#)".

This guidance document outlines the toxicological analysis of water applied additive mixtures to arrive at an allowable usage rate (in mg/l or ppm) that is environmentally benign, harmless to fish, aquatic organisms, wildlife, and plants. This guidance lists the toxicity test results, parameters, and physical information needed to enable the WDNR to calculate the allowable usage rate for the specific product.

When additives could discharge to groundwater, polyacrylamide additives shall have < 0.05% free acrylamide monomer by weight as established by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA).

B. Application Criteria

1. Application rates shall not exceed manufacturer's written application rate recommendations and shall not exceed the WDNR allowable application rate
2. (expressed in lbs/acre-ft).
3. The allowable application rate (lbs/acre-ft) is determined by multiplying the allowable usage rate (mg/l) by (1.35 lbs/acre-ft)/(mg/l).
4. The manufacturer or supplier shall provide written instructions (including the *Material Safety Data Sheet* or the *Safety Data Sheet*) to ensure proper safety, storage, and mixing of their product. The manufacturer shall provide general written application methods.
5. Additive mixtures shall be applied in conjunction with other erosion control BMPs and under an erosion and sediment control or stormwater management plan.

6. Where additive mixtures are used with temporary sediment control structures for work in a stream, such as during bridge construction, the structure shall not be removed until the water is clarified. If the resulting sediment floc is more than 6 inches deep it shall be excavated or filtered.

7. The applicator of the additive mixture shall at the time of application, document the following:

- Name of applicator
- Application rate in lbs/(acre-ft) of storm water runoff
- Date applied
- pH in sediment control structure after application
- Product type
- Weather conditions during application
- Method of application

Copies of this documentation shall be entered into the contractor's monitoring log or a project diary and made available upon request.

8. The manufacturer or distributor shall provide the following for the applicator:

- Labels affixed to the additive mixture containers that indicate the recommended application rate and the allowable application rate based on the allowable usage rate.
- A product expiration date for the additive mixture based on product expiration dates of the polymer.
- General written application methods.
- Written instructions to provide proper safety, storage, and mixing of their product.

9. The application method shall ensure uniform distribution of the product in the sediment control structure and shall consist of either:

- Passive Applications: Additives applied by non-mechanically dosing the sediment-laden inflow prior to it entering the impoundment area of the sediment control structure. The manufacturer shall base

passive application rates on the dissolution rate and/or the dead storage volume of the sediment control structure.

OR

- Active or Mechanical Applications: Additive applied by mechanically or hydraulically mixing directly into a sediment control structure.

10. Unused additive mixtures shall be minimized. Excess material shall not be applied at a rate greater than the allowable application rate. Disposal shall not occur in storm water conveyance systems (i.e., storm sewer manholes, storm sewer inlets, ditches, or culverts).

C. Product Review Criteria

1. Where sediment control structures may discharge to surface waters of the state, toxicity test results shall be submitted to: Runoff Management Section – Additive Review, WDNR, 101 South Webster St., P.O. Box 7921, Madison, WI 53707, as a pre-qualification for field use. The WDNR will review the toxicity test results and will provide a written product allowable usage and application rate.

2. The additive mixture shall be resubmitted for toxicity testing if any portion of the mixture is altered subsequent to its established allowable application rate. Such alterations may include:

- The amendment of base additive and/or any other additives.
- The ratios of individual components.

3. Additives reviewed with regard to toxicity may still be subject to additional performance evaluation by end users.

VI. Considerations

The following are additional recommendations, which may enhance the use of, or avoid problems with, the practice.

- A. Additive mixtures should achieve $\geq 95\%$ sediment reduction as measured by the standpipe method outlined in Appendix I.

slippery and can pose a safety hazard.

- B. The performance of additive mixtures should be verified and field-tested in a body of water that is not discharging directly into the surface waters of the state. The body of water should be a minimum of 1/3-acre surface area and an average depth of at least 3 feet.
- C. The total suspended solids prior to the additive treatment should be tested and verified by an independent testing lab, and should have a minimum value of 800 ppm or equivalent *Nephelometric Turbidity Units (NTU)* and be visibly turbid. The relationship between total suspended solids (TSS) and NTU is site-specific and the derivation of a unique TSS-NTU relationship should be conducted for each sediment control structure. A minimum of two samples per acre-foot of water should be taken from random locations within the test site.
- D. Within 48 hours from the initial treatment of the water body, the total suspended solids should have a maximum of 80 ppm, or equivalent NTU.
- E. Testing sites should not be used for subsequent testing for a period of 3 months from the time of initial application.
- F. The WDNR should be notified at least 7 days prior to testing, and allowed to monitor any such testing.
- G. When using products in impoundments immediately adjacent to, or within waters of the state, consider using products for which the manufacturer's recommended application rate is considerably lower than the allowable application rate.
- H. The applicator should use the least amount of additive mixture needed to achieve optimal performance.
- I. Care should be taken to prevent spills of additive mixtures. Follow the manufacturer's recommended cleanup procedures in the event of a spill.
- J. Inhaling granular additive may cause choking or difficulty breathing. Persons handling and mixing additive should use personal protective equipment of a type recommended by the manufacturer.
- K. Additive mixtures combined with water are very

- L. Additive mixtures should be considered as an aid to removing solids from dredge slurries.

VII. Specifications

Erosion control and storm water management plans specifying additive mixtures for sediment control shall be consistent with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

VIII. Operation and Maintenance

Sediment levels on the bottom of the sediment control structure should be monitored to measure the loss of storage capacity over time due to enhanced sedimentation by the additive mixture.

Test the pH of the water in the sediment control structure and follow the manufacturer's recommended pH range for their additive mixture, as pH will impact the effectiveness of additive mixtures.

IX. References

Voluntary Use Of Polymers In DNR Programs (A Field Guide). For copies of this companion document, contact Mary Anne Lowndes, Runoff Management Section Chief, Bureau of Watershed Management, 101 S. Webster St., Box 7921, Madison, WI 53707-7921.

WDNR, "State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, Edition 1." Bureau of Watershed Management, Wisconsin Department of Natural Resources, Madison, 1996 (WI. PUBL-WW-033-96).

USEPA, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 3rd Edition." Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH, 1994 (EPA/600/4-91/002).

Roa-Espinosa, A., Bubenzer, G.D. and Miyashita, E., "Sediment and Runoff Control on Construction Sites Using Four Application Methods of Polyacrylamide Mix." National Conference on Tools for Urban Water Resource Management and Protection, Chicago, pp. 278, February 7-10, 2000.

Roa, A., "Are there Safety Concerns or Environmental Concerns with PAM?" Dane County Land Conservation Department, 1997.

Sojka, R.E. and Lentz, R.D., "A PAM Primer: A brief history of PAM and PAM related issues." Kimberly, ID: USDA-ARS Northwest Irrigation and Soils Research Lab, 1996. <http://kimberly.ars.usda.gov/pamprim.ssi>

Wirtz, J, R., "The Pros and Cons of the Use of Anionic Polyacrylamides to Control Erosion and Sedimentation in the Lake Mendota Priority Watershed". University of Wisconsin-Madison, MS Thesis, 2000.

X. Definitions

Additive (I): Substance, typically a commercial product (may include clay based products) that has the potential to be directly discharged to a surface water and may cause toxicity to fish and aquatic organisms.

Additive Mixture (V.A): Any reference to additive mixture refers to the whole manufactured product, including the additive and any components.

Allowable Application Rate (III) expressed in lbs/ (acre-foot) and is based on the product allowable usage rate.

Allowable Usage Rate (III): Identifies the concentration (expressed in mg/l) as calculated using the procedures described in the "[Water Quality Review Procedures for Additives](#)" guidance, below which a product is not expected to cause acute toxicity in the aquatic environment.

Material Safety Data Sheets or Safety Data Sheet (V.B.3): Provide basic information on a material or chemical product intended to help someone work safely with the material. This includes a brief synopsis of the hazards associated with using a material, how to use it safely, and what to do if there is an emergency. The retail distributor and/or manufacturer as per OSHA's Hazard Communication Standard, 29 CFR 1910.1200, must provide MSDS, with the purchase of potentially hazardous products.

Nephelometric Turbidity Units (NTU) (VI.C.): A measure of the amount of light scattered by suspended and dissolved materials in the sample.

Polyacrylamide (I): A generic term for polymers made up of many repeating units of the monomer acrylamide (a simple organic compound).

Polymer (I): Polymers are materials that are either natural

or synthetic and that have a chain of carbon molecules that are identical, repeating units. Polymers can be positively charged (cationic), negatively charged (anionic) or have no charge (non-ionic).

Sediment (II): Settleable soil, rock fragments and other solids suspended in runoff.

Sediment control structure (I): An impoundment or pond designed to intercept and detain sediment carried in runoff, or water from a process system, prior to reaching the main channel of a waterway or body of water. Placement of these structures must be outside of the main channel of a waterway and shall not span opposing stream banks in channelized flow. The sediment control structure must provide for dedicated sediment storage to at least a depth of two feet, such that the sediment will not be subject to re-suspension during high velocity flow conditions.

Impoundments may be created by a cofferdam, turbidity barrier, earthen berm, sheet piling, self-contained filtering systems or similar material. Examples include properly maintained construction or post-construction sediment ponds, discharging directly or eventually to a water body. They may also include surface water impoundments that are immediately adjacent to a waterway, whose function is to treat storm water or dredging material. Another potential application is to isolate localized areas surrounding bridge and culvert construction.

Surface Waters of the State (III.): "Surface" refers to the sub portion of the waters of the state that discharge at the surface. "Waters of the state", as defined by s. 283.01(20), Wis. Stats, means those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, water courses, drainage systems and other surface water or groundwater, natural or artificial, public or private within the state or under its jurisdiction, except those waters which are entirely confined and retained completely upon the property of the person.

APPENDIX I

LABORATORY STANDPIPE TEST METHODOLOGY

1. Place 40 grams of oven dried "soil" in 2 liters of distilled water within a 2 liter graduated cylinder with stopper. The 40 grams of "soil" represents a "realistic" runoff suspended solids load of 20,000 mg/L (20,000 mg/L x 2 L) according to data collected from commercial and residential construction sites (Owens, et. al. 2000). Repeat a minimum of four times so that there are a minimum of five replicates. The "soil" used in the standpipe test may be characterized by one of the following three options:

Clays A clay "soil" is characterized as having greater than 20% of its particles < 2 µm in size. This option is appropriate for those seeking approval* of a polymer for use in any soil condition (clay, silt, or other).

Silts A silt "soil" is characterized as having less than 20% of its particles < 2 µm in size AND greater than 20% of its particles 2-25 µm in size. This option is appropriate for those seeking approval* of a polymer for use only in silt soils. The 2-25 µm size is representative of fine to medium silt soils.

Site-Specific Use of a site-specific "soil" provides an alternative for those seeking approval* of a polymer that may be customized for optimum performance (in both terms of suspended sediment removal and amount of polymer used) at a particular site. The results of a mechanical soil analysis characterizing the site soil sample particle size composition must be provided. The results of this analysis should be submitted with the results of the standpipe test entered on the "Standpipe Test Data Sheet." This option is provided since each site will have at least slight differences, if not significant differences, in soil chemical and physical characteristics. These differences may influence the effectiveness of any given polymer.

Indicate which "soil" type is used in the standpipe test on the data sheet under "-V Soil Type Used."

* Note that final approval of a polymer is granted only after it is demonstrated through both the standpipe and field tests that the polymer is effective and can be effectively applied.

2. Mix the solutions by completely inverting each graduated cylinder 3 times.
3. Add polymer mixture to each graduated cylinder. The volume and concentration of polymer added is the manufacturer's or supplier's choice, but must include a set volume and a gradient of "low" to "high" concentrations. The volume and each polymer concentration must be recorded on the data sheet. The purpose is to determine the lowest polymer mixture concentration needed to achieve effective removal of suspended solids. Ultimately the least amount of polymer mixture needed to achieve optimal performance should be used in the field.

A minimum gradient of five polymer mixture concentrations is used to achieve the above stated purpose. The purpose of the five concentration gradient is to attempt to pinpoint the concentration that achieves optimal removal of suspended solids (i.e. least amount of polymer mixture required to remove a minimum of 95% of the suspended solids). This gradient should be sufficiently wide to show a range of effectiveness in removing suspended solids (with at least one, but preferably more, meeting the 95% removal level). A second goal of using a minimum of five concentrations is to avoid the occurrence of false negative outcomes in the polymer approval process. By having more concentrations across a gradient it is more likely to find truly effective concentrations that are less than the use restriction value. A polymer mixture will not be approved for field testing, and thus for inclusion on the PAL if its effective concentration (as determined in this laboratory stand pipe test) is greater than the use restriction value.

4. Mix the solutions by completely inverting each graduated cylinder 3 times.
5. Let the solution in each graduated cylinder settle for 5 minutes.

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6. Determine the percent suspended solids reduction in each graduated cylinder as follows:
 - a. Heat/dry one evaporating or drying dish at 103 – 105 °C for 1 hour for each graduated cylinder. Store the dishes in a desiccator until needed (steps b).
 - b. Weigh a dish out to at least one, and preferably more decimal points. Record this weight on the data sheet.
 - c. Collect 20 ml from within one of the graduated cylinders at the 1 liter mark and place in a pre-weighed evaporating or drying dish (from step a). Repeat steps b and c for each of the other graduated cylinders.
 - d. Evaporate and dry each of the 20 ml samples from step b at 98 °C for at least 1 hour.
 - e. Cool each dish with sample in a desiccator to balance temperature
 - f. Weigh each dish with sample. Record this weight on the data sheet.
 - g. Subtract the weight of the dried dish (from step b) to determine the weight of the solids from the sample.

Record this weight on the data sheet.

- These methods follow, with slight modification, those of Standard Methods 2540 B. (1989).

7. The polymer passes this effectiveness test if it achieves 95 % reduction of suspended solids. Thus, **95 % reduction is achieved if the weight of the solids from the sample is 0.2 mg.**

$$\frac{2000 \text{ ml}^1}{1000 \text{ mg/L}^2} = \frac{20 \text{ ml}^3}{X^4} \quad X = 10 \text{ mg/L}$$

¹ = volume of solution in the cylinder

² = suspended solids concentration in the cylinder at 95 % reduction

³ = volume of sample taken from 1 L mark of the cylinder

⁴ = sample solids concentration needed to achieve 95 % reduction

$$\frac{10 \text{ mg}}{\text{L}} \times \frac{\text{L}}{1000 \text{ mL}} \times 20 \text{ mL} = 0.2 \text{ mg}$$

8. A photocopy of the completed data sheet should be sent to the following address for WisDOT review: New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

STANDPIPE TEST DATA SHEET

Date(s): _____

Testing Laboratory: _____

Analyst(s) Initials: _____

Polymer Name: _____

Manufacturer Name: _____

Volume of Polymer Mixture Used: _____

-V Soil Type Used: ___Clay ___Silt ___Site-Specific Soil (mechanical analysis results enclosed)

Polymer Mixture Concentration (mg/L or % solution)	Weight of Evaporating/Drying Dish		Final Weight of Solids Sample
	Pre	With Sample	

Which polymer mixture concentration(s) achieved effective (? : 95%) reduction of suspended solids (i.e. final weight :: 0.2 mg solids)?

Notes/Comments:

Please send a photocopy of this completed data sheet to:
 New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

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