

Practical Method for Qualitative Visual Evaluation of Storm Drains Using a Visible Fluorescent Dye Tracer

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Abstract:

This paper discusses the use of a visible fluorescent dye for conducting qualitative visual inspections of outfalls, storm drains, and sanitary sewer source points. This method may be used to satisfy provisions of industrial multi-sector general storm water permits (MSGP) for non-storm water discharge assessment and certification. The method is intended to be a visual qualitative verification of storm drain, storm sewer, or sanitary sewer line flow path only. It is not intended to serve as an engineering evaluation or test method for structural integrity of drain lines or conveyances. The dye selected for development of this method was Rhodamine WT, produced by Crompton and Knowles.

The use of this method is recommended for industrial facilities located in urban areas or remote industrial sites in rural areas which do not directly discharge to receiving surface waters that are designated drinking water sources. When an industrial facility cannot verify the flow path of sanitary wastewater, process wastewater, or storm drains by site plan drawings or piping diagrams, this method can provide a reliable means to establish discharge flow patterns in a responsible manner with low adverse environmental impact.

Introduction

A recently developed practical method employs a systematic approach for conducting qualitative visual inspections of outfalls, storm drains, and sanitary sewer source points. The method uses a visible fluorescent dye tracer to verify that there are no illicit connections from sanitary sewer sources or other prohibited discharges. This method may be used to satisfy provisions of industrial multi-sector general storm water permits (MSGP) for non-storm water discharge assessment and certification. The method is intended to be a visual qualitative verification of storm drain, storm sewer, or sanitary sewer line flow path only. It is not intended to serve as an engineering evaluation or test method for structural integrity of drain lines or conveyances. The evaluation should be conducted as a dry weather event during daylight hours, with no previous storm event or run off occurring for a minimum of 72 hours (3 days). Information used for development of this dye test protocol comes in part from data furnished by the dye manufacturer, and from ASTM Method D5613, Open Channel Measurement of Time of Travel Using Dye Tracers.

Development of the Method

The dye selected for development of this method was Rhodamine WT, produced by Crompton and Knowles. The dye has good visibility in daylight down to low concentrations, is stable for a period up to five hours, degrades with little or no residual stain, and has negligible toxicity to receiving streams that are not drinking water sources. This dye is approved for use by the EPA, USGS, and other agencies for conducting dye tracer flow studies. Since evaluations conducted by this method are intended to produce qualitative visual observation data only, quantification of residual dye concentrations through measurement by fluorimeter or other instrumental analysis is not required to achieve satisfactory results.

The main steps for conducting the dye tracer evaluation by this method are summarized as follows:

- Selection of sanitary sewer and storm drain source entry points
- Selection of storm drain flow path exit points for observation
- Determination of minimum flush volume and clear water slug volumes to be employed
- Determination of minimum dye concentration in flush volume to ensure adequate visibility with the naked eye in daylight conditions
- Introduction of clear water slug volume to establish flow path
- Preparation and introduction of diluted dye solution into entry points
- Introduction of clear water slug volume
- Continuous stream of clear water flow
- Recording of visual observations at storm drain exit points
- Identification of potential illicit connections based on observations

Several sanitary sewer sources and/or storm drain entry points within a facility are selected for the evaluation to ensure an accurate representation of storm drain and/or sanitary sewer flow paths, and to verify that sanitary sewer sources are not illicitly discharged to the storm drains. The locations are cross referenced and identified on the site drainage map from the facility's storm water pollution prevention plan (SWP3). Potable water is used as the medium for diluting and dispensing the dye into the source points, and for the clear water "slug" volumes. The clear water slug and dye flush volumes to be used at each entry point are determined based on the location, configuration and size of the entry point, and the anticipated travel distance to the outfall exit observation point. The minimum concentration of dye to be used in the flush volume is determined based on anticipated dye decomposition factors in the flow stream. Decomposition factors include contact with suspended solids, loss of fluorescence with increased temperature, and chemical reaction with chlorine and other oxidizing compounds.

For sanitary sewer sources, use of chlorine bleach, brighteners, and other chemical cleaning compounds should be discontinued at least 48 hours prior to the evaluation to minimize potential dye degradation through the sewer lines. Each sanitary sewer source location should be checked with a portable black light just prior to dye introduction to verify that chlorine cleaning compound residues are not present.

The dye solution is batch prepared for each entry point. A "slug" of clear water of the same volume as the dye solution is introduced first to verify flow path. The dye solution volume is next introduced at once as quickly as possible. A second slug of clear water of at least the same volume as the dye solution immediately follows. A steady stream of clear water is then allowed to flow into the entry point for at least 15 minutes to ensure flow detection at the exit point (if it occurs). Upon introduction of the dye at an entry point, a stationed observer at the designated storm or sanitary sewer drain exits will begin to look for signs of dry weather flow and the presence of the fluorescent dye. Date, time, observation location, and visual observation parameters are documented. A minimum observation period of 15 minutes per event should be allowed to detect flow, the presence or absence of dye, and record observations. After recording observations for each source and drain exit point, the data is used to verify the presence or absence of potential illicit connections. The documentation of observations and results are suitable for archiving with the non-storm water discharge certification in the facility's SWP3.

Results

Results of the first trial study indicate that Rhodamine WT dye will begin to degrade in turbid shallow stagnant receiving waters in as little as 30 minutes in bright sunlight when the outside ambient temperature is 90°F or higher. Under these conditions it will disappear totally within approximately 3 hours. Based on observations made at the receiving waters during the first trial study, an initial dye flush volume concentration of up to 15 ppm had no visible adverse effects on plants or aquatic fauna when dispersed with at least a 5:1 volume of potable water. Indigenous minnows and turtles observed in the receiving stream appeared unaffected by the water containing the dye solution.

During the second field study, positive confirmation was made for point sources with flow paths along internal sanitary sewer lines. Higher initial concentrations of dye in the flush volume were needed to overcome anticipated interferences from suspended solids and other substances present in process wastewater and sanitary discharges. The dye concentrations employed were sufficient to plainly see the dye slug in the sanitary sewer manhole observation points, without contributing excess opacity to the flow stream.

Conclusion

The use of this method is recommended for industrial facilities located in urban areas or remote industrial sites in rural areas which do not directly discharge to receiving surface waters that are designated drinking water sources. When an industrial facility cannot verify the flow path of sanitary wastewater, process wastewater, or storm drains by site plan drawings or piping diagrams, this method can provide a reliable means to establish discharge flow patterns in a responsible manner with low adverse environmental impact.