FLUORESCENT-TAGGED TREATMENT POLYMERS

Field

[0001] Embodiments relate to fluorescent-tagged treatment polymers, a method of making fluorescent-tagged treatment polymers, and a method of using fluorescent-tagged treatment polymers in water systems.

Introduction

[0002] Various methods have been adopted to reduce the amount of water used in industrial water systems such as cooling water systems and boiler water systems. However, such methods may lead to unfavorable events such as corrosion and/or the formation of scale as the quality of the water in the system progressively deteriorates. As such, the use of polymeric treatment agents in such water systems has been proposed. The treatment agent may be used at specific concentrations in the water system, which concentrations are an important factor for performance of the desired function with good efficiency. However, during operation the treatment polymer may be consumed by various causes, such that the concentration may not remain consistent. With consumption, the amount of the treatment polymer dissolved in the cooling water does not remain the same as the amount added to the cooling water. Therefore, practical methods to determine the concentration of treatment polymers in the industrial water systems are sought.

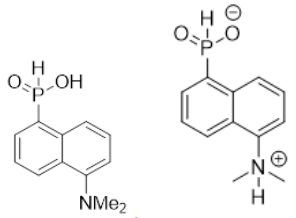
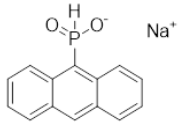
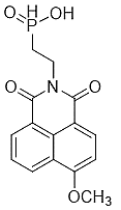
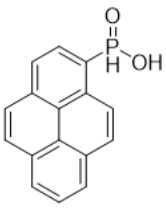
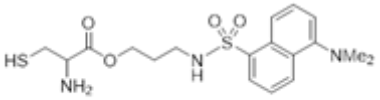
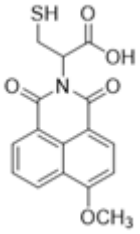
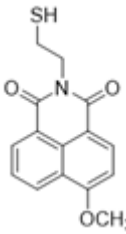
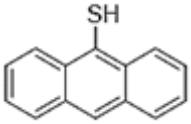
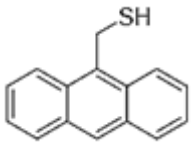
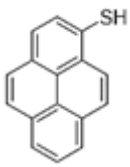
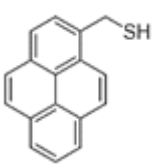
[0003] The use of fluorescent polymers prepared with reactive fluorescent compounds is proposed for monitoring concentrations of treatment agents in industrial water systems in International Publication Nos. WO 2019/027608 and WO 2019/027611. Further, methods for maintaining the desired amount of such fluorescent polymers in industrial water systems are proposed in International Publication Nos. WO 2019/027609 and WO 2019/027610. However, further cost advantaged fluorescent polymers are sought for use in monitoring concentrations of treatment agents.

Summary

[0004] ~~Embodiments may be realized by~~ The present disclosure relates to a method of treating a water system that includes providing to the water system a fluorescent-tagged treatment polymer that is the reaction product of a mixture that includes at least one unsaturated monomer, at least one initiator with at least one reactive terminal group for reacting with the unsaturated monomer, and at least one fluorescent chain transfer agent. The at least one fluorescent chain transfer agent has a phosphorus-hydrogen or sulfur-hydrogen group connected to a

polyaromatic hydrocarbon group having from two to ten rings. The at least one fluorescent chain transfer agent is a chain transfer agent that controls final polymer molecular weight of the fluorescent-tagged treatment polymer and a fluorescent tag for the fluorescent-tagged treatment polymer.

[0004a] In one aspect, there is provided a method of treating a water system, the method comprising: providing to the water system a fluorescent-tagged treatment polymer that is the reaction product of a mixture that includes at least one unsaturated monomer, at least one initiator with at least one reactive terminal group for reacting with the unsaturated monomer, and at least one fluorescent chain transfer agent, the at least one fluorescent chain transfer agent having a phosphorus-hydrogen or sulfur-hydrogen group directly connected to a polyaromatic hydrocarbon group having from two to ten rings, and the at least one fluorescent chain transfer agent being a chain transfer agent that controls final polymer molecular weight of the fluorescent-tagged treatment polymer and a fluorescent tag for the fluorescent-tagged treatment polymer.

[0004b] In another aspect, there is provided a method of treating a water system, the method comprising: providing to the water system a fluorescent-tagged treatment polymer that is the reaction product of a mixture that includes at least one unsaturated monomer, at least one initiator with at least one reactive terminal group for reacting with the unsaturated monomer, and at least one fluorescent chain transfer agent, the at least one fluorescent chain transfer agent selected from the group consisting of: , , , , , , , , , ,  and .

Brief Description of the Drawings

[0005] Features of the embodiments will become more apparent to those of ordinary skill in the art by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0006] FIG. 1 illustrates emission data for Example 3 and Comparative Example D; and

[0007] FIG. 2 illustrates a quantification of concentration and emission response for Example 3.

Detailed Description

[0008] The fluorescent polymers may be used as an fluorescent tracer that is added to water systems such as industrial water systems. The water systems may be cooling water systems and/or boiler water systems. During use the amount of the fluorescent tracer present correlates with the amount of a specific treatment polymer present. For example, the fluorescent tracer and the treatment polymer may be added to the water system in known proportions and the measured amount of fluorescent tracer present is correlated with the amount of treatment polymer present. According to exemplary embodiments, the treatment agent is tagged with a reactive fluorescent compound. A fluorimeter may be used to measure the fluorescence signal of the fluorescent tracer and the amount of the fluorescent tracer can be determined by using a calibration curve to relate the amount of fluorescence signal detected to the amount of the fluorescent tracer present. Monitoring of the fluorescent tracer can be conducted on-line in real time so that any changes in the amount of treatment polymer can determined.

[0009] When the polymeric treatment agent is tagged with the fluorescent tracer, the amount of the fluorescent compound incorporated should be sufficient enough such that the fluorescence of the polymer may be adequately measured. For example, fluorescently-tagged treatment polymer may be detectable by fluorimetric techniques known in the industry. Further, it should not be so high that the performance of the polymer as a treatment agent for the water is decreased. Also, when the treatment agent is tagged, a better quantification is possible as the measure of consumption of the treatment agent and

Listing of the Claims:

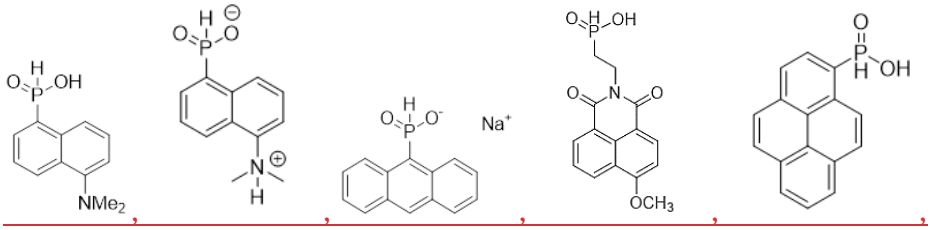
1. A method of treating a water system, the method comprising:

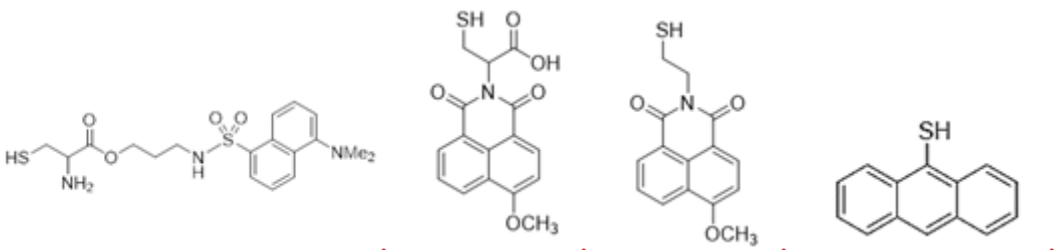
providing to the water system a fluorescent-tagged treatment polymer that is the reaction product of a mixture that includes at least one unsaturated monomer, at least one initiator with at least one reactive terminal group for reacting with the unsaturated monomer, and at least one fluorescent chain transfer agent, the at least one fluorescent chain transfer agent having a phosphorus-hydrogen or sulfur-hydrogen group directly connected to a polyaromatic hydrocarbon group having from two to ten rings, and the at least one fluorescent chain transfer agent being a chain transfer agent that controls final polymer molecular weight of the fluorescent-tagged treatment polymer and a fluorescent tag for the fluorescent-tagged treatment polymer.

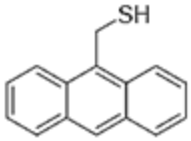
~~2. The method of claim 1, wherein the one or more fluorescent chain transfer agent is a phosphinic or a thiol based compound.~~

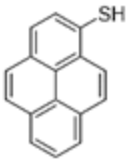
2. A method of treating a water system, the method comprising:

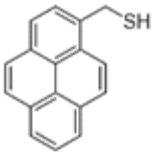
providing to the water system a fluorescent-tagged treatment polymer that is the reaction product of a mixture that includes at least one unsaturated monomer, at least one initiator with at least one reactive terminal group for reacting with the unsaturated monomer, and at least one fluorescent chain transfer agent, the at least one fluorescent chain transfer agent selected from the group consisting of:







, 

and 

.

3. The method of claim 1 ~~or claim 2~~, wherein the polyaromatic hydrocarbon group has two to five rings.

4. The method of ~~any one of~~ claim~~s~~ 1 ~~to~~or 3, wherein at least one of the one or more unsaturated monomer is a monoethylenically unsaturated monomer further having one to five carbonyl groups.

5. The method of any one of claims 1 to 4, wherein the fluorescent-tagged treatment polymer is provided in an amount from 0.1 ppm to 100 ppm ~~per liter~~ of water in the water system.

6. The method of any one of claims 1 to 5, further comprising preparing the fluorescent-tagged treatment polymer in a reactor by feeding the one or more monomer, the one or more initiator, and the one or more fluorescent chain transfer agent to the reactor.

7. The method of any one of claims 1 to 6, further comprising using a fluorimeter to detect a fluorescence signal of the fluorescent-tagged treatment polymer.

8. The method of claim 7, further comprising:

correlating the fluorescence signal from the fluorimeter to a concentration of the fluorescent-tagged treatment polymer in the water system; and

adding an additional amount of the fluorescent-tagged treatment polymer to the water system to adjust the concentration of the fluorescent-tagged treatment polymer in the water system.