and fouling mitigation include phosphorus, such as orthophosphates, polyphosphates, or organic phosphates commonly known as phosphonates. While there has been some success attributed to phosphorus containing corrosion and fouling inhibitor compositions, it has recently been discovered that phosphorus is not environmentally friendly and thus environmental agencies have either mandated a reduction in its use or banned its use altogether.

As such, there exists a need for corrosion and fouling mitigating compositions that do not include phosphorus, and methods for providing corrosion or fouling mitigation using such non-phosphorus containing compositions.

BRIEF SUMMARY OF THE INVENTION

Water treatment compositions useful for mitigating fouling and corrosion are disclosed. The water treatment compositions can include one or more azole compounds, one or more transition metals, and one or more dispersants. The water treatment compositions can exclude, or not comprise, phosphorus.

In one aspect, the present disclosure provides a water treatment composition comprising: an effective amount of one or more azole compounds, an effective amount of one or more transition metals, and an effective amount of one or more dispersants, wherein said water treatment composition does not comprise phosphorus.

Methods for mitigating corrosion and fouling of a surface in an aqueous system are also disclosed. The methods can include the steps of providing a housing having at least one metal surface, introducing an aqueous medium into the housing, and injecting a water treatment composition comprising an effective amount of one or more azole compounds, an effective amount of one or more transition metals, and an effective amount of one or more dispersants into the aqueous medium. The water treatment compositions can exclude, or not comprise, phosphorus.

The present disclosure provides an automated, on-line method of monitoring and controlling one or more properties of water. The method comprises:

(a) providing a storage device;

(b) introducing water into the storage device;

(c) providing a monitoring and controlling unit comprising a controller and a plurality of sensors in communication with the controller, wherein each of the plurality of sensors is operable to measure a property of the water;

(d) providing one or more pumps, which are in communication with the controller, wherein the one or more pumps can comprise one or more chemical injection pumps;

(e) inputting an acceptable range for each of the one or more properties of the water to be measured into the controller;

(f) providing a delivery conduit having a first end in communication with the water in the storage device and a second end connected to an inlet of the monitoring and controlling unit;

(g) pumping a sample of water from the storage device into the monitoring and controlling unit;

(h) measuring one or more properties of the sample of water with the plurality of sensors;

(i) adding a water treatment composition substantially free of phosphorus to the water in the storage device via a chemical injection pump;

(j) determining if the measured one or more properties of the sample of production water is within the acceptable range inputted into the controller in step (e); wherein

(k) if the measured one or more properties is outside of the acceptable range associated with that property inputted in step (e), causing a change in an influx of a chemical into the water from the one or more chemical injection pumps, the chemical being capable of adjusting the measured property associated with the water in a manner to bring the measured property within the acceptable range; and

(l) optionally repeating steps (a) to (k) to determine if the one or more properties has been brought within the acceptable range inputted in step (e).

Any of the methods recited herein can also include the step of pretreating the at least one metal surface with a water treatment composition excluding phosphorus, as disclosed herein.

The foregoing has outlined rather broadly the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter that form the subject of the claims of

the disclosure. It should be appreciated by those skilled in the art that the conception and the specific embodiments disclosed may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent embodiments do not depart from the spirit and scope of the disclosure as set forth in the appended claims.

BRIEF DESCRIPTON OF THE SEVERAL VIEWS OF THE DRAWINGS

A detailed description of the invention is hereinafter described with specific reference being made to the drawings in which:

Figure 1 shows a graph depicting a comparison of weight gain on a quartz crystal microbalance over time with a system incorporating a mixture of a polymaleic acid dispersant and a copolymer dispersant of acrylic acid and AMPS, compared to a control system that does not include these dispersants.

DETAILED DESCRIPTION OF THE INVENTION

The present disclosure provides a treatment including compositions and methods useful for mitigating corrosion and fouling in aqueous media. This treatment eliminates the need to use phosphorus containing compositions.

As used herein, "corrosion inhibitor" is intended to refer to at least one of, or any combination of, the disclosed corrosion inhibitors, corrosion inhibitor intermediates, and corrosion inhibitor product formulations. These compounds can also be referred to as water treatment compositions.

In an aspect, this disclosure provides water treatment compositions that are useful for inhibiting or mitigating corrosion and fouling of surfaces contacting, containing, or housing a water-based or aqueous system.

In certain aspects, the water treatment compositions are substantially free of phosphorus. In the present application, the term "phosphorus" is intended to include not only phosphorus, but also phosphorus bearing additives, phosphorus derivatives, etc. In other aspects, the compositions do not include any phosphorus.

CLAIMS

What is claimed is:

1. A water treatment composition comprising:

an effective amount of one or more azole compounds, an effective amount of one or more transition metals, and an effective amount of one or more dispersants, wherein said water treatment composition does not comprise phosphorus.

2. The water treatment composition of Claim 1, wherein said one or more dispersants are present in an amount ranging from about 2 ppm to about 50 ppm, optionally wherein said one or more dispersants are present in an amount of about 3 ppm.

3. The water treatment composition of Claim 1, wherein said one or more azole compounds are present in an amount ranging from about 1 ppm to about 50 ppm.

4. The water treatment composition of Claim 1, wherein said one or more azole compounds are present in an amount ranging from about 3 ppm to about 20 ppm.

5. The water treatment composition of Claim 1, wherein said one or more transition metals are present in an amount ranging from about 2 ppm to about 4 ppm.

6. The water treatment composition of Claim 1, wherein said one or more transition metals comprises zinc.

7. The water treatment composition of Claim 1, wherein said one or more azole compounds is selected from the group consisting of tolytriazole, and a mixture of tolyltriazole with a butylbenzotriazole.

8. The water treatment composition of Claim 1, wherein said one or more dispersants comprise a polymer, a copolymer, or a terpolymer, wherein said