detect abnormal conditions and the information gleaned from those systems is of limited practical use.

In the context of corrosion prevention, three of the most useful data sets for a monitor to measure are pH, metal (especially iron) ion concentrations, and chloride ion concentrations. Ideally the monitored data is as close to real time as possible so remediation techniques for the causes of extreme concentrations can be applied before the causes effect corrosion or otherwise damage the facility. Unfortunately current monitoring technologies provide a large volume of false data so real time monitoring is usually difficult if not impossible. Moreover the false data can lead to the wasting of expensive remedial chemistries when their addition was not needed. As a result a truly automated remedial chemical feed system is not feasible and a human operator is typically required to prevent the addition of remediating chemicals in the face of a "false alarm" thereby increasing operation costs.

Thus there is a clear need for and utility in an improved method of monitoring the conditions within a chemical plant. The art described in this section is not intended to constitute an admission that any patent, publication or other information referred to herein is "prior art" with respect to this invention, unless specifically designated as such. In addition, this section should not be construed to mean that a search has been made or that no other pertinent information as defined in 37 C.F.R. § 1.56(a) exists.

Brief Summary of the Invention

At least one embodiment of the ~~invention~~ present disclosure is directed towards a method of

(e.g., determined empirically, automatically, fluorescently, electrochemically, colorimetrically, measured directly, calculated), temperature, pressure, process stream flow rate, dissolved solids and suspended solids.

There may be at least three sensors and each of the three sensors may pass on a raw measurement to the analyzer. The analyzer may use use the average of those raw measurements as the input in its calculations if at least one of the raw measurements fits within a pre-determined setpoint expected for the specific conditions under which measurement was taken, the analyzer a historically expected value as the input in its calculations if none of the the raw measurements fit within a pre-determined setpoint expected for the specific conditions under which measurement was taken,

The process variable may be iron concentration. The method may further comprise the steps of: disregarding all sensor readings that indicate zero iron concentration, and adjusting the measured iron concentrations using regression analysis over a 1 week time period. The remedial measure may involve adding a chemical whose effect is non-linear in nature. The analyzer may correct for the non-linear effects of the remedial chemical in its corrections. The remedial measure may involve adding a chemical subject to the constraints of deadtime and the analyzer corrects for those effects in its measurements. The process system may be one item selected from the list consisting of: a chemical plant, a refinery, an oil refinery, a food processing facility, a manufacturing plant, a chemical plant, a distillation column, a water filtration plant, a factory, a waste processing facility, a water treatment facility, and any combination thereof.

In an aspect, there is provided a method of controlling corrosion rate of a crude oil refinery process comprising: measuring iron concentration of the crude oil

refinery process to establish an initial corrosion rate of the crude oil refinery process; measuring pH of the crude oil refinery process; measuring chloride concentration of the crude oil refinery process; altering the initial corrosion rate of the crude oil refinery process according to the measured pH and the measured chloride concentration and correcting for dynamic state error, thereby determining an altered corrosion rate; comparing the altered corrosion rate to a pre-determined range of acceptable values; if the altered corrosion rate is outside of the pre-determined range of acceptable values, performing a remedial measure to change the altered corrosion rate to a value within the range of acceptable values; and repeating the steps.

In another aspect, there is provided a method of controlling corrosion rate of a crude oil refinery process comprising: measuring iron concentration of the crude oil refinery process to establish an initial corrosion rate of the crude oil refinery process; measuring pH of the crude oil refinery process; measuring chloride concentration of the crude oil refinery process; altering the initial corrosion rate of the crude oil refinery process according to the measured pH and the measured chloride concentration, and correcting for dynamic state error and steady state error, thereby determining an altered corrosion rate; comparing the altered corrosion rate to a pre-determined range of acceptable values; if the altered corrosion rate is outside of the pre-determined range of acceptable values, performing a remedial measure to change the altered corrosion rate to a value within the range of acceptable values; and repeating the steps.

Claims

What is claimed is:

1. A method of controlling corrosion rate of a crude oil refinery process comprising:

measuring iron concentration of the crude oil refinery process to establish an initial corrosion rate of the crude oil refinery process;

measuring pH of the crude oil refinery process;

measuring chloride concentration of the crude oil refinery process;

altering the initial corrosion rate of the crude oil refinery process according to the measured pH and the measured chloride concentration and correcting for dynamic state error, thereby determining an altered corrosion rate;

comparing the altered corrosion rate to a pre-determined range of acceptable values;

if the altered corrosion rate is outside of the pre-determined range of acceptable values, performing a remedial measure to change the altered corrosion rate to a value within the range of acceptable values; and

repeating the steps.

2. The method of claim 1, wherein the remedial measure comprises adding to the crude oil refinery process a chemical selected from the group consisting of: a neutralizer, a caustic agent, a filming inhibitor, and combinations thereof.

3. The method of claim 1, wherein the remedial measure comprises adding a neutralizer to the crude oil refinery process.

4. The method of claim 3, wherein the neutralizer is selected from the group consisting of: 3-methoxypropylamine, monoethanolamine, N,N-dimethylaminoethanol, methoxyisopropylamine, and combinations thereof.

5. The method of claim 1, wherein the remedial measure comprises adding a caustic agent to the crude oil refinery process.

6. The method of claim 5, wherein the caustic agent is 7.5° to 14° Baume sodium hydroxide solution.

7. The method of claim 1, wherein the remedial measure comprises adding a filming inhibitor to the crude oil refinery process.

8. The method of claim 7, wherein the filming inhibitor is selected from the group consisting of: an oil soluble blend of amides, an oil soluble blend of imidazolines, and an oil soluble blend of amides and imidazolines.

9. The method of claim 1, wherein the altering step comprises performing a regression analysis to determine the altered corrosion rate.

10. A method of controlling corrosion rate of a crude oil refinery process comprising:

measuring iron concentration of the crude oil refinery process to establish an initial corrosion rate of the crude oil refinery process;

measuring pH of the crude oil refinery process;

measuring chloride concentration of the crude oil refinery process;

altering the initial corrosion rate of the crude oil refinery process according to the measured pH and the measured chloride concentration, and correcting for dynamic state error and steady state error, thereby determining an altered corrosion rate;

comparing the altered corrosion rate to a pre-determined range of acceptable values;

if the altered corrosion rate is outside of the pre-determined range of acceptable values, performing a remedial measure to change the altered corrosion rate to a value within the range of acceptable values; and

repeating the steps.

11. The method of claim 10, wherein the remedial measure comprises adding to the crude oil refinery process a chemical selected from the group consisting of: a neutralizer, a caustic agent, a filming inhibitor, and combinations thereof.

12. The method of claim 10, wherein the altering step comprises performing a regression analysis to determine the altered corrosion rate.

Claims

What is claimed is:

1. A method of correcting an error in the measurement of a process variable taken sensor in a chemical process system characterized by properties which causes at least some of the measurements to be erroneous, the method comprising the steps of:

identifying the component of the error caused by dynamic state factors, this component of the error being determined by at least once obtaining a senor measurement in the system and noting how that measurement deviates from an objectively correct measurement of the process variable by varying amounts relative to time,

identifying the steady state factor component of the error, this component of the error being determined by at least once obtaining a senor measurements and noting that the measurement deviates from the objectively correct measurement of the process variable by a fixed amount relative to time,

identifying the component of the error caused by additional factors,

and altering the measurement to remove the errors caused by steady state factors, dynamic state factors, and unknown factors.

2. The method of claim 1 in which the sensor is in informational communication with an analyzer and the analyzer is in informational communication with a controller, the sensor constructed and arranged to obtain a raw measurement of the process variable, the analyzer correcting the error in the sensor's measurement, the controller taking the corrected measurement and if the corrected measurement is outside of a pre-determined

range of acceptable values, enacting a remedial measure to change the measured value to a value within the acceptable range.

3. The method of claim 2 in which the remedial measure is enacted before the steady state value of the measurement is detected by the sensor.

4. The method of claim 1 in which the process variable is a measurement of one item selected from the list consisting of: oxidation-reduction potential, pH, levels of certain chemicals or ions (e.g., determined empirically, automatically, fluorescently, electrochemically, colorimetrically, measured directly, calculated), temperature, pressure, process stream flow rate, dissolved solids and suspended solids.

5. The method of claim 2 in which there are at least three sensors, wherein each of the three sensors passes on a raw measurement to the analyzer, the analyzer using the average of those raw measurements as the input in its calculations if at least one of the raw measurements fit within a pre-determined setpoint expected for the specific conditions under which measurement was taken, the analyzer a historically expected value as the input in its calculations if none of the the raw measurements fit within a pre-determined setpoint expected for the specific conditions under which measurement was taken,

6. The method of claim 2 in which the process variable is iron concentration, the method further comprising the steps of: disregarding all sensor readings that indicate zero iron concentration, and adjusting the measured iron concentrations using regression analysis over a 1 week time period.

7. The method of claim 2 in which the remedial measure involves adding a chemical whose effect is non-linear in nature, the analyzer correcting for the non-linear effects of the remedial chemical in its corrections.

8. The method of claim 2 in which the remedial measure involves adding a chemical subject to the constraints of deadtime and the analyzer corrects for those effects in its measurements.

9. The method of claim 2 in which the process system is one item selected from the list consisting of: a chemical plant, a refinery, an oil refinery, a food processing facility, a manufacturing plant, a chemical plant, a distillation column, a water filtration plant, a factory, a waste processing facility, a water treatment facility, and any combination thereof.

10. The method of claim 2 in which the analyzer predicts the corrosion that will result from the formation of salt compounds, the method utilizing inputs from at least one of each of a: pH sensor, Chloride sensor, Fe sensor, Nitrogen sensor, total nitrogen sensor, ammonia sensor, total amine sensor, and an electrical resistance corrosion probe and in response the controller feeds into the system an appropriate amount of at least one of: Water, Sodium Hydroxide, potassium hydroxide, lithium hydroxide, methylamine, dimethylamine, trimethylamine, ethylamine , diethylamine, triethylamine, n-propylamine, isopropylamine, di-n-propylamine, di-isopropylamine, n-butylamine, sec-butylamine, 1-amino-2,2-dimethylpropane, 2-amino-2-methylbutane, 2-aminopentane, 3-aminopentane, morpholine, monoethanolamine, ethylenediamine, propylenediamine, N,N-dimethylethanolamine, N,N-diethylethanolamine, N,N-dimethylisopropanolamine, Methoxyethylamine, Piperidine, Piperazine, Cyclohexylamine, N-methylethanolamine,

N-propylethanolamine, N-ethylethanolamine, N,N-dimethylaminoethoxyethanol, N,N-diethylaminoethoxyethanol, N-methyldiethanolamine, N-propyldiethanolamine, N-ethyldiethanolamine, t-butylethanolamine, t-butyldiethanolamine, 2-(2-aminoethoxy)ethanol, di-n-butylamine, tri-n-butylamine, di-iso-butylamine, ethyl-n-butylamine, pentylamine, 2-amino-2,3-dimethylbutane, 3-amino-2,2-dimethylbutane, 2-amino-1-methoxypropane, dipropylamine, monoamylamine, n-butylamine, isobutylamine, 3-amino-1-methoxypropane and any combination thereof.

11. The method of claim 2 further comprising the steps of:

(a) introducing an opportunity crude oil into a crude unit that previously contained a different kind of crude oil, the properties of the opportunity crude differing such from the previous crude oil that it disrupts the steady state of the unit including causing a corrosion inducing spike in chloride concentration,

(b) the sensor measuring and/or predicting a property associated with the system parameter at one or more points in the crude unit;

(c) determining an optimum range associated with the measured and/or predicted property;

(d) if the measured and/or predicted property is outside of the optimum range associated with that property, causing a change in an influx of a composition into the process stream, the composition capable of adjusting the property associated with the system parameter in a manner to bring the measured and/or predicted property within said optimum range; provided that adjustments are limited to no more than one per 30 minutes and if there are either four overall adjustments or

the adjustment results in a change of at least 50% of added composition then further influx of composition is suspended for 4 hours; and

wherein the measuring/or predicting property comprises the steps of: collecting a sample of fluid from a process stream to form a sample stream; adding a sulfide scavenger obtained by reacting morpholine with formaldehyde to the sample stream; passing the sample stream through a membrane that prevents a reaction product of the sulfide scavenger and sulfide from flowing therethrough; and allowing the sample stream that flows through the membrane to contact a chloride specific electrode of a measurement cell to measure chloride content.

10