A Rohrback Cosasco Systems White Paper

THE RDC-CI CHEMICAL INJECTION DATA LOGGER
A NEW SOLUTION TO AN OLD AND EXPENSIVE PROBLEM

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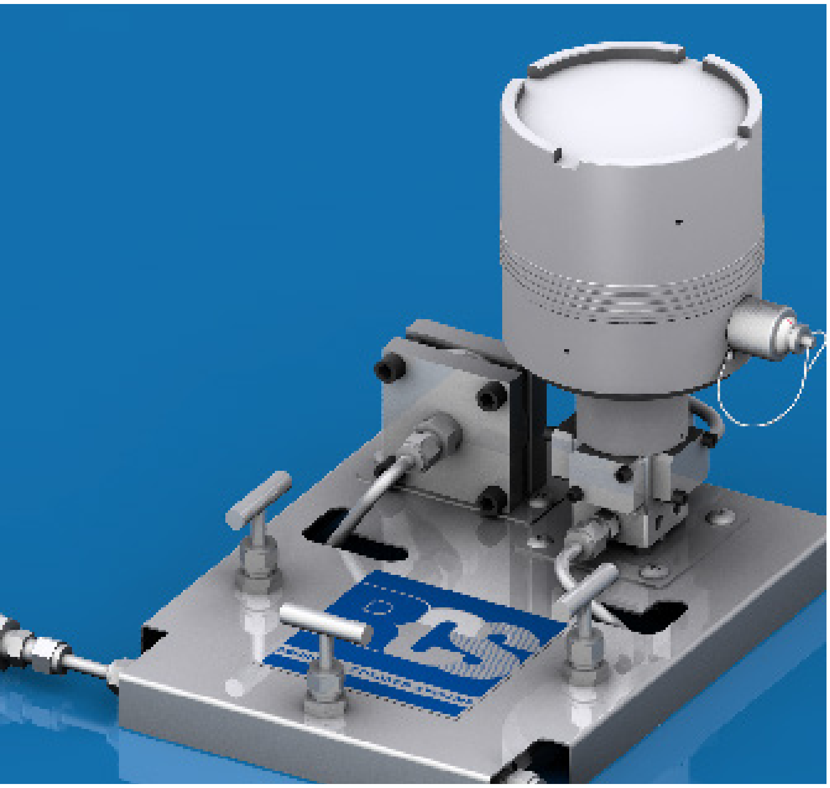
Injection Datalogger Concept



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Contents

Introduction

Accurate chemical injection monitoring, particularly in the oil and gas production industry, has been a problem for corrosion engineers and technicians since the first chemical additives were applied using a continuous injection pump. These chemical additives are expensive and over-injection can be costly, while under-injection can result in expensive system failures. For companies employing this continuous application methodology, a solution to accurate monitoring has been found, created and implemented.

Problem Statement

Accurate monitoring of continuous injection chemical additives, particularly in remote locations, has provided nebulous results at best. How and why to overcome this problem has been the topic of many panel discussions and technical papers in the oil and gas production industry.

Previous Options

Until now, the two primary ways of monitoring the amount of chemical additives used over any given period were:

1) to time the rate that a measured amount was introduced to the system, which provides only a momentary integral of the overall time and does not necessarily reflect the entire time since the last measurement; and

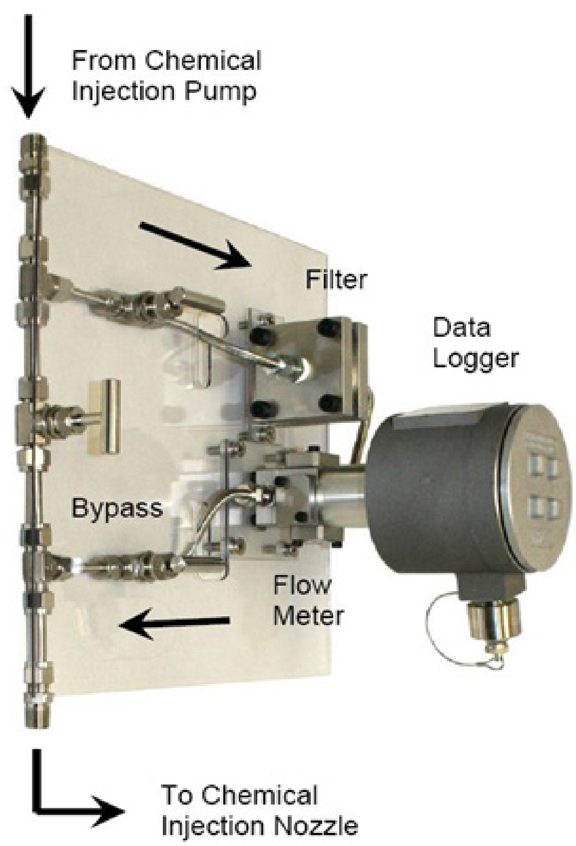
2) to take the cumulative amount of chemical injected, divide by the number of days or hours since the last measurement and assume that it was injected evenly during that period.

Rohrback Cosasco Solution

Rohrback Cosasco, after initial discussions with the author, developed the RDC-CI Chemical Data Logger, which when mounted on discharge side of the chemical injection pump, directly monitors the flow to the chemical injection quills or nozzles with its accurate positive displacement flowmeter designed to continuously check the actual amount of chemical leaving the pump and entering the system. The RDC-CI can be piped in permanently for continuous monitoring or piped in on a temporary basis, using an accessory kit of flexible 6 foot hoses and sealing quick-connect couplings. This option allows for occasional in-line testing.

Every 5/100,000th gallon (0.19 ml) volume increment is measured and totalized into selectable interval "buckets" between two minutes and one day over which the injection rate is computed. The battery life is typically six months. Collected data can be transferred directly to a laptop if located in a safe area, or with a Checkmate DL or Checkmate Plus in a hazardous area. Data is stored in a CSV file format and can be viewed graphically as flowrate and integrated flow on the supplied software. A hazardous area location version is currently in development.

Figure 1: RDC-CI Chemical Data Logger—Actual Device



Development History

After 25 years of chemical injection and corrosion monitoring experience with oil and gas production companies in Canada and Libya, the author set out to find a better way to more accurately determine the rate of chemical injection in oil and gas production facilities. With an annual corrosion chemical budget in excess of US$10 million per year, he estimated that wastage was costing the company at least 10–15% of that budget.

The author also determined, particularly in remote locations such as the Rocky Mountains and the Sahara, that daily temperature fluctuations often resulted in significantly varying injection rates between the cold of the night and the heat of the day, as well as with seasonal weather effects. This was determined by sitting at the wellhead for at least 24 hours, taking injection rate reading every 30–60 minutes, which was a tedious and difficult task to undertake.

After leaving his last oil and gas production company, the author set out to determine if any such product existed or could be developed. After doing the research, he found that although some forms of this equipment did exist, they were not necessarily compatible with high pressures and/or were not available for use in remote locations such as oil and gas wells.

Taking the concepts of various components, including the RCS Data Logger for Corrosion Monitoring, and marrying them, the author developed the conceptual design of this instrument and presented it to Rohrback Cosasco for evaluation. After much market and product research, Rohrback Cosasco started development of the prototype.
The two most important concepts of this design were portability and remote placement where no structured power supply system exists.

Benefit 1—Economics

The primary benefit of this instrument is better economic control of the chemical additives used, particularly with corrosion control chemicals. Some of these chemical additives can cost in excess of $50 per gallon ($13 per liter), with an average cost in excess of $30 per gallon ($8 per liter). Obviously at these costs, over-injection of chemicals can be extremely expensive; and under-injection will eventually result in equipment failure.

In all actuality with corrosion inhibitors, under-injection is often worse than no injection at all. An incomplete film can result in small anode (unprotected) areas relative to large cathode (protected) areas, resulting in accelerated pitting corrosion. Therefore, accurate chemical injection rates are extremely important in cost control.

The chemical injection data logger's method of "bucket" sampling, combined with setting the "bucket" time frame results in the most accurate reading over any 24 hour day, with room in the data logger for up to 180 days of data.

Benefit 2—Remote Monitoring

The next most important benefit of this instrument is its ability to be used in remote locations where no power source exists. Many oil and gas wells have no power source on site, resulting in limited abilities for sophisticated monitoring equipment. However, the RDC-CI Chemical Data Logger comes fully contained with up to a six month battery life as its source of power.

In these remote locations, pneumatic pumps are usually the method of chemical injection with the power source being gas from the wellhead. As this gas passes through a regulator or a series of regulators, where moisture is removed and caught in a trap while the pressure is reduced. Once the trap is full, the gas can no longer pass through to the pneumatic pump. Standard Operationg Procedure (SOP) usually calls for the well operator to empty each of these traps on a daily basis, but as this is not always done, many times the pump stops for a day or two (or more) until the operator remembers to drain the trap and restart the pump. Of course, there is no way for the corrosion engineer or technician to know if, or how often, this occurs, resulting in skewed data readings.

With logging intervals of between 2 and 30 minutes, the exact time of the chemical pump failure, if it is occurring at all, and its restarting are automatically recorded. With the variable interval and the data logger storage, the engineer or technician can come to the site at any time and download the existing readings, reset the data logger and/or the "bucket" timer for the next set of readings.

Looking at a prolonged history of readings, which can vary from days to weeks, from the same injection pump will show if this is a regular, frequent or irregular occurrence; or whether or not it occurs at all. Once the frequency is determined, so can the cause, as well as the remedial solution to the pump operating problems.

Even if the battery should fail, the already accumulated data is stored in non-volatile memory that does not lose the data when the power is off. This is similar to a flash drive or similar data storage device.

Benefit 3—Portability

Provided with a weather resistant case, the RDC-CI Chemical Data Logger is designed for ease of installation with either a permanent or temporary time span. Because of the quick coupling attachments and hoses available with this unit, the user does not need to purchase a single device for every chemical injection location.

A single device can be set for any length of time at one location; then after the data is downloaded, moved to another location to check the accuracy of that chemical injection pump. However, in a field or area with a large number of wells or pipelines with chemical injection pumps, the user will still likely require multiple units to test every location on regular rotational basis, which is advised.

Additionally, because it is battery powered, it does not require any external electrical hookups making portability that much easier.

Accuracy

Because the device is installed on the discharge side of the pump, it accurately measures the amount of chemical that actually leave the pump to enter the process system. Previous methods of monitoring measured the amount taken from the suction side of the pump, which was not only less accurate, but held no guarantee that the chemical actually left the pump. The author has encountered more than one pump where the piston seals were leaking and the chemical left the pump onto the ground or into the sump.

Oil and gas field chemical injection rates can be as low as less than one gallon (four liters) per day and as high as tens of gallons (hundreds of liters) per day. Because the device measures in 5/100,000th of a gallon (0.19 ml) increments, the actual volume injected is accurately recorded, regardless of the intended injection rate. Each stroke of the pump moves the chemical through the flowmeter, spinning each increment past as recording device, which in turn runs a cumulative total of increments passing the reader location.
For example, 5/100,000th of a gallon (0.19 ml) passing through meter every two minutes is only 1.16 pints (18.6 fl oz) or 547 ml per day. This means that one incremental volume container in the meter is used every two minutes (the minimum time “bucket”); and this volume of output is far less than the normal minimum amount that any chemical metering pump can output, which makes this a highly accurate device.

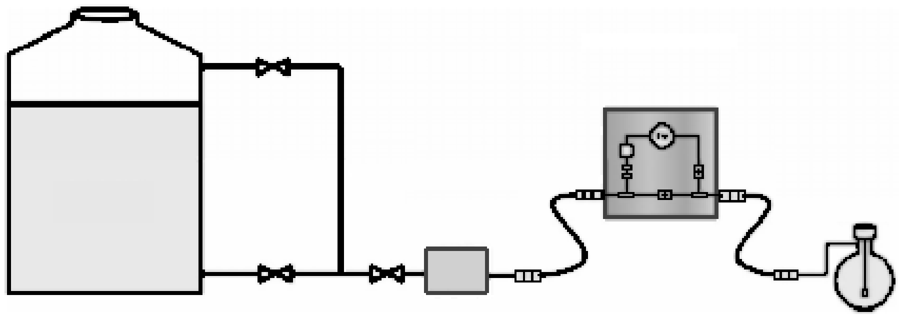
Implementation

Implementation of the RDC-CI solution starts when the corrosion technician or engineer realizes that chemical efficiency is part of the job description and that improper use of the chemical additives result in the company incurring unnecessary costs either from wasted product, or from equipment failures due lack of- or under-injection. The technician or engineer must also realize that whatever standard methods of monitoring they are currently using; they are likely to be highly inaccurate.

For example, the author has encountered operators who “couldn’t be bothered” with checking the pumps on a regular basis; so he would shut them off for most of the month and then over a day or two, operate the pump at a maximum rate and inject the amount of chemical required for the month over that short period of time. He has also encountered operators who could not leave the pump rate controls alone and were constantly adjusting them every time they went by the pump. In both cases the result was corrosion and/or scale related failures in the system.

After realizing these facts, the corrosion technician or engineer needs to find a method of accurately monitoring the chemical injection rate. This leads us to the RDC-CI Chemical Data Logger. As it is the only product of its type currently on the market, it remains the ONLY solution to accurate chemical injection monitoring that can be applied in any location, in any industry and by any type of chemical metering pump.

Figure 2: RDC-CI Chemical Data Logger—Typical Installation Setup



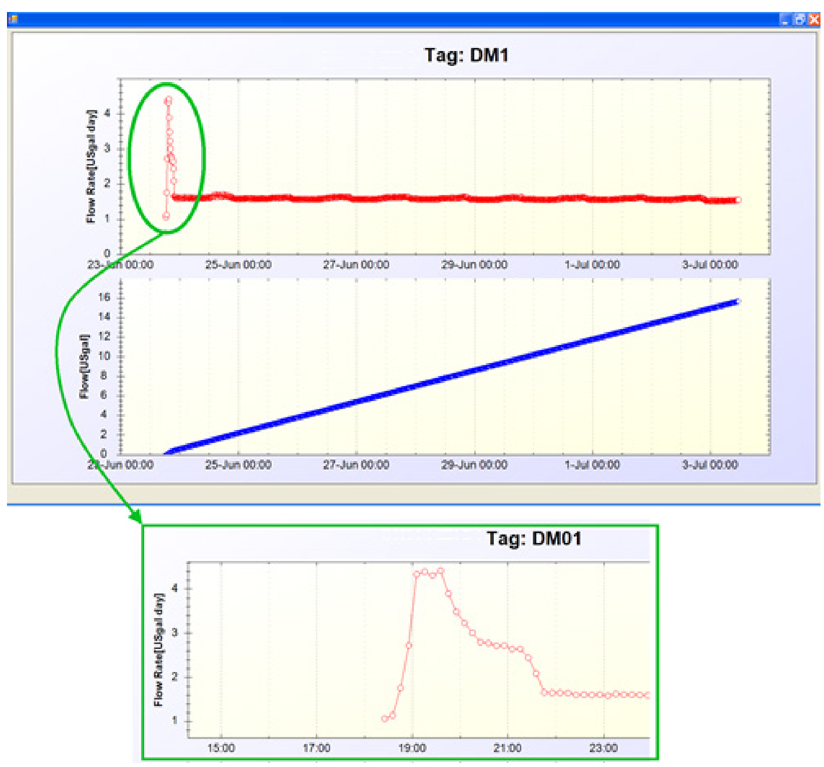
Field Trials

The RDC-CI Chemical Data Logger has undergone field trials in several locations around the world providing the results discussed in this section.

Field Trial Site 1

Field Trial Site 1 is located in California USA and was a trial of both oil based and water based chemicals
—Demulsifier

Figure 3: RDC-CI Chemical Data Logger—Demulsifier Field Trial Data



The rate fluctuated daily by about 0.15 gal/day (0.57 l/day). It tended to drift downward slightly over the test period by about 0.05 gallons per day. By comparison the estimated flowrate from to site glass tube was 1.75 gal/day (6.6 l/day) compared with a rate from the flowmeter of between 1.53 gal/day (5.8/ l/day)) and 1.67 gal/day (6.3 l/day). Readings were recorded on a 10 minute interval yielding about 190 counted pulses in the 10 minute window

On August 6 the flowrate was increased to approximately 2.5 gal/day (9.5 l/day) as estimated by the site glass. The flowmeter showed a flow that fluctuated between 2.33 and 2.4 gal/day (8.8 and 9.1 l/day).

—Corrosion & Scale Inhibitors

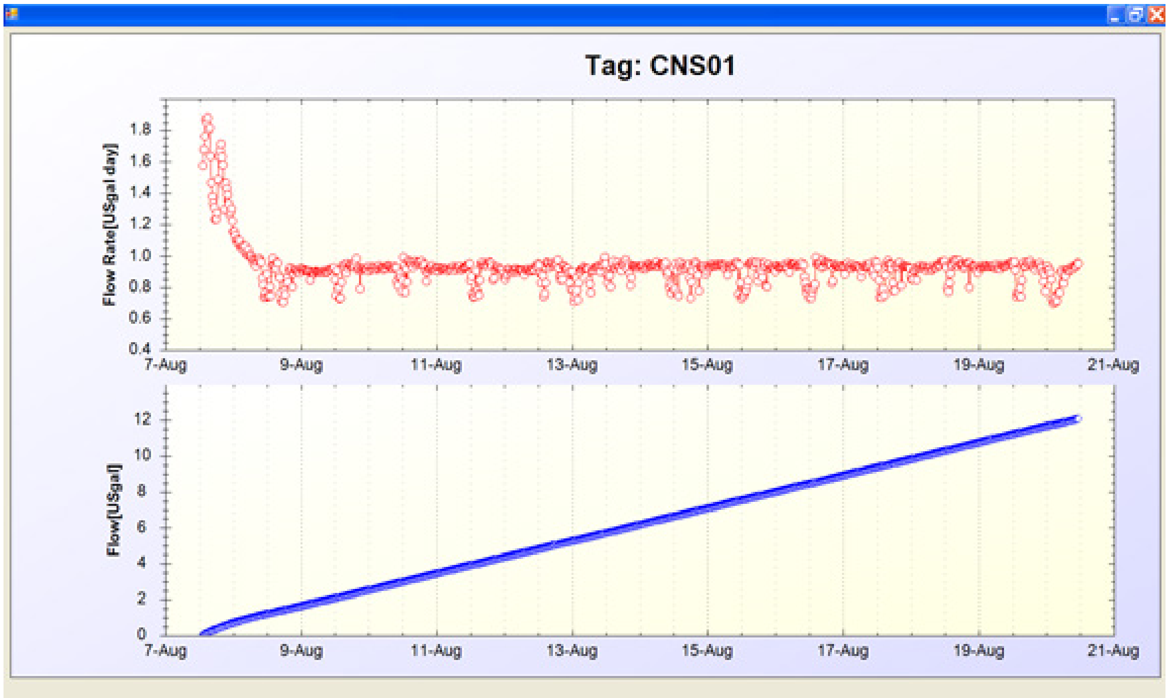
On August 7, the flowmeter was removed from the demulsifier. The filter was removed for later examination and the flowmeter head was disconnected and flushed out with isopropyl alcohol (IPA) using a plastic bottle and nozzle. The hoses and pipework were similarly removed and flushed with IPA, before re-assembling onto the water-based corrosion inhibitor and scale inhibitor mix. The injection fluid is about 80% scale inhibitor and 20% corrosion inhibitor. The average injection rate is approximately 0.5 gal/day (1.9 l/day). Because of the lower flowrate the interval for collecting pulses was increased to 20 minutes.

Some purging of air out of the pump and lines was required before getting steady pumping. At this rate the pump delivers one stroke about every 20 seconds, for a period of 1 to 2 seconds. This will mean that the instantaneous flowrate through the pump during the pump cycle may be much higher such as 10 to 20 times higher namely, 5 to 10 gallons per day.

The data from this site was downloaded on August 20 with a total of 932 readings taken at 20 minute intervals, to give approximately 200 pulses in each 20 minute “bucket” in order to compute flow. This gives an approximate 0.5% accuracy on the flowrate readings. The meter reading shows an initially high reading which exponentially decays over about one day to the steady state reading. We saw a similar effect previously on the demulsifier but for a shorter period. This may be an artifact rather than a true flowrate. It was noticed at the startup of the pump that the flow in the site glass goes back and forth until all the air is out of the system and the non-return valves operate properly. We measure flow irrespective of direction. So if the flow is oscillating back and forth through the pump, we will count the totalized flow from both directions, rather than the resultant flow in one direction In fact, leaky non-return valves, could give rise to this under the normal flow. It would be advisable to re-check the site glass under normal operation to check that there is no back flow occurring.

The mean flow appears to be about 0.9 gals/min (3.4 l/min) most of the time with fairly frequent drops to about 0.7 gals/min (2.65 l/min).

Figure 4: RDC-CI Chemical Data Logger—Corrosion/Scale Inhibitor Field Trial Data



Field Trial Site 2—Corrosion Inhibitor

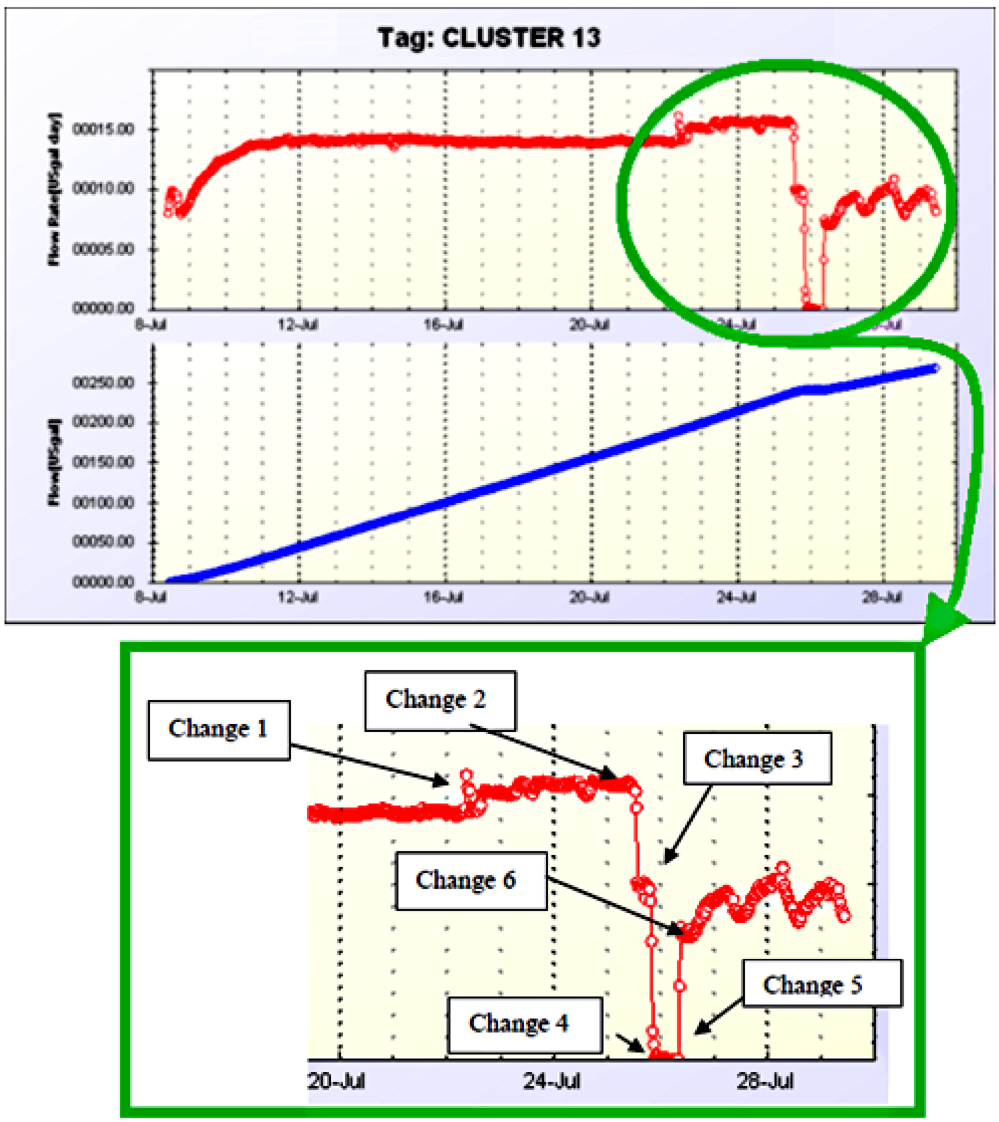
The RDC-CI injection monitoring instrument was installed for a field trial in the Middle East. The instrument was installed on an Inhibitor pump set at 4ppm, at a wellhead location. The instrument was left for approximately 4 weeks and then down loaded using the CheckMate instrument. The data recovered is presented in two segments below.

Figure 5: RDC-CI Chemical Data Logger—Retrieving Data with an RCS CheckMate

—Trial 1

The typical flowrate was 14.3 gal/day (54.1 l/day). It took two days to reach the typical flowrate. The injection rate changed at least six times. The final rate was 8 gal/day (30.3 l/day), but the injection rate was more erratic and swung between 7 and 11 gal/day (26.5 and 41.6 l/day).

Figure 6: RDC-CI Chemical Data Logger—Site 2 Results–Trial 1 Data



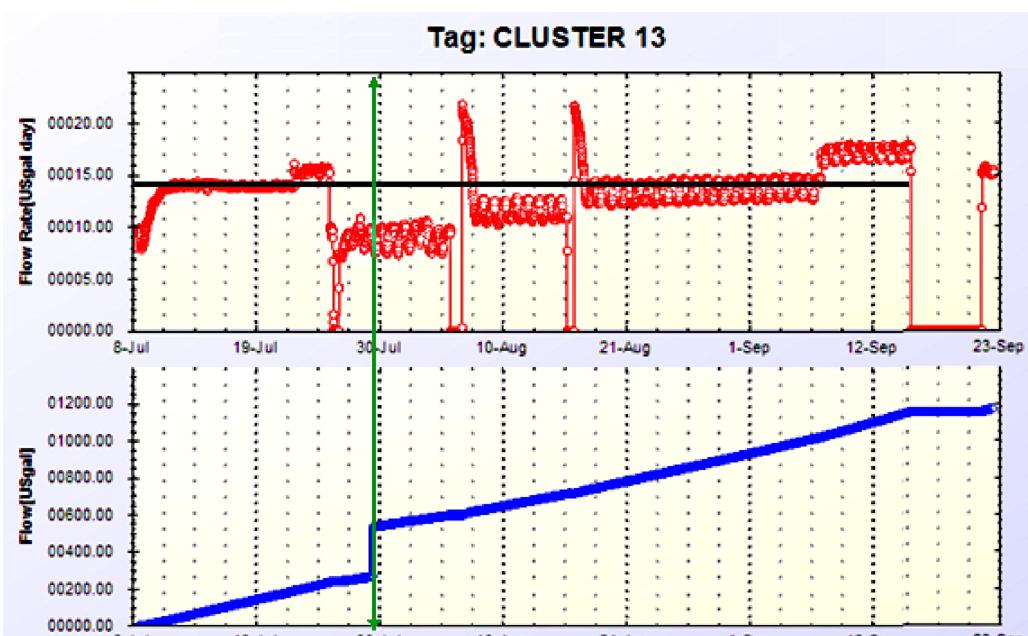
—Trial 2

This data was down loaded during the third visit of the technicians to the site, and also included the previous period's data. In Figure 7 the green line indicates the start of the new logging period and the black line is the approximate injection rate form the first period (as set).

The second set of data shows that the injection pump behavior has become more erratic during the past few months. The first week's data is fairly uneventful, but more erratic than previously. Then a series of up-sets occur, with the injection rate dropping on average by 30% and becoming very uneven. The pump is oscillating and has shut down completely several times over the next 2 months. Typically the shutdown is for a short period followed by a reset to a higher level, gradually reaching the original injection rate over a month long period, (about mid-august). During this time the pump is fairly erratic. A re-set occurs at the end of the first week in September, where the injection rate moves to a slightly higher rate. Finally, it stops altogether for about 1 week, before restarting and resetting to the original injection rate. All of these various re-sets make it hard to believe that there has been no external interference with the pump settings. The pump itself appears not to be functioning as well as over the first trial period, although the latter part of this also showed a similar pattern in the data. Whatever causes the oscillations in the pump, the total injection rate is not significantly affected. This probably means that the operational requirements of the chemical are still being met. More worryingly, the onset of oscillation points to the possibility of a problem with the pump and may presage the eventual failure of the pump over time. Pump shut downs seem to be coming more frequent and the periods out of operation are longer. Assuming that this is not an external event, it might well predict complete failure in the near future.

The total volume injected looks fairly consistent, except for the period when the pump was down completely at the end.

Figure 7: RDC-CI Chemical Data Logger—Site 2 Results–Trial 2 Data



Summary

In addition to being the most cost efficient method of chemical injection monitoring, the RDC-CI Chemical Data Logger is easy to install, set up and use. With its versatile “bucket” method of measuring it will produce timely and accurate data resulting in reduced chemical additive costs for your company, as well as improved efficiency of the chemicals themselves.

In fact, this device can also be used to find the optimum injection rate when combined with accurate and comprehensive corrosion monitoring techniques and equipment. Taking this one step further, the RDC-CI Chemical Data Logger could also be used to provide accurate data of the efficiencies of different chemicals from the same of different suppliers during evaluation periods.

Using this product at any location and over any time period makes portability one of its best assets. The option of being able to easily move the RDC-CI Chemical Data Logger from one location to another also minimizes capital investment by limiting the number of instruments required for any given company and/or field.