REPORT

to

CITY OF KISSIMMEE

DEPARTMENT OF WATER RESOURCES

for

Demonstration of On-Line Dissolved Oxygen and Suspended Solids Analyzers

at the

South Bermuda Water Reclamation Facility

December 9, 2002

Prepared by:

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INTRODUCTION

The planned expansion of the City of Kissimmee's South Bermuda and Sandhill Water Reclamation Facilities will require reliable on-line dissolved oxygen (D.O.) and mixed liquor suspended solids, (MLSS) measurements, since process control systems using these parameters as inputs are proposed. On-line D.O. probes have previously been used by the City, but were proven unreliable and maintenance intensive. To our knowledge, on-line MLSS meters have not been employed at any of the City's facilities.

Currently, D.O. and MLSS readings are taken manually by operators on a daily or per shift basis. The manpower requirements, both for sampling and associated instrument maintenance, can be reduced by incorporating on-line, low maintenance instruments.

The City also desires to have consistent instrumentation throughout the facilities it owns and operates. Considerable costs will be incurred to outfit all facilities with like instruments, therefore the instruments must be proven accurate and reliable.

For the above reasons, an on-site demonstration of two prospective instruments was conducted at the South Bermuda WRF. This Report summarizes the details pertaining to the instrumentation and their operation during the demonstration.

PRODUCTS

Two manufacturers provided their equipment for this demonstration, Insite and Cerlic. Insite provided both a D.O. and MLSS meter, while Cerlic provided only an MLSS meter. Cerlic also has a D.O. meter, however, it uses a traditional Clark style galvanic sensor, which is well known and therefore wasn't tested. The Insite D.O. sensor is optical and measures D.O. via fluorescence. Both MLSS sensors operate on the principle of infrared light absorption.

Each of the meters require an associated analyzer and mounting hardware. An automatic cleaning system for each sensor is also recommended. Information concerning the analyzers, sensors and hardware for each instrument are provided at the back of this Report. The manufacturers and Kissimmee's local representatives are listed below. The Insite meter is manufactured in Louisiana, while Cerlic's is manufactured in Sweden.

Insite IG

Manufacturer:
Insite Instrumentation Group, Inc.
1550 W. Lindberg Drive
Slidell, LA 70458
Phone: 985-639-0006
Fax: 985-639-0014
WEB: www.insiteig.com
Vice President: Rick Davis

Local Sales Representatives:
Southern Industrial Supply Corp. (SISCO)
2558 28th Avenue North
St. Petersburg, FL 38713
Phone: 727-323-1300 / 800-466-4629
Fax: 727-323-6905
Reps: Pete Vandersloot
Dean Brunette

Cerlic

U.S. Distributor:
Cerlic Environmental Controls, Inc.
P.O. Box 420097
Atlanta, GA 30342
Phone: 404-256-3097
Fax: 404-256-3094
WEB: www.cerlic.se
Contact: Jim Radney

Local Sales Representative:
Ellis K. Phelps & Company (EKP)
2152 Sprint Boulevard
Apopka, FL 32703
Phone: 407-880-2900
Fax: 407-880-2962
Reps: Ken Johnson (sales rep)
Tim Estep (field tech)

DEMONSTRATION

The demonstration time period for each of the instruments lasted approximately one month, from mid-October through late November 2002. Throughout, the readings from the instruments were logged on data sheets by South Bermuda WRF operators along with in-house measurements for comparison purposes. In early November the instruments were connected to BioChem's on-line data acquisition system, located in the operations building, and continuous data was logged in the system. Both sets of data are presented and discussed later in this Report.

The meters were each installed at the "end" of the eastern Carrousel basin, next to the effluent spillway. This location was chosen since variations in D.O. are typical here, and because of the proximity to Biochem's data acquisition system. The lower velocity in the Carrousel channel at this point was also a consideration.

The demonstration was overseen by Jim Goodley, P.E. of Biochem's King of Prussia, PA office. The logistics of the demonstration were largely handled by Iwona Staniszewska, of BioChem's Southeast Office. Iwona's observations concerning each of the instruments are detailed below.

CERLIC METER

The Cerlic MLSS meter was installed at the site on October 22nd, and was removed in late November. The EKP field technician handled all installation, calibration and maintenance during the demonstration. Installation of the probe and analyzer seemed effortless and the unit appeared well engineered. According to the field technician, the probe was initially calibrated in tap water at his office, however the initial on-site readings were set to those measured by the Insite meter, which was already operating.

Shortly after installation (roughly a couple of days) the MLSS readings began to drift upward, with readings higher than 10,000 mg/L in less than a week. The field technician often visited the site to maintain the instrument, mainly cleaning the probe. BioChem personnel were not notified of when or how often these visits took place. A good deal of debris (rags, hair, etc.) accumulated on the sensor, which necessitated frequent cleaning and caused erroneous readings, according to the representatives. Sometime during the demonstration, a cleaning system for the sensor was installed, which used the plant's non-potable water supply. Even with the cleaning system in place, the unit's MLSS readings remained inconsistent, with upward drift typical.

Twice during the demonstration, the Cerlic meter was not operational. The first period was 11/7 -11/8, and the other period was 11/12 -11/15. During the second period, the meter was physically removed from the site. No explanation for these problems was provided by the representative.

The Cerlic meter could never be successfully converted into the BioChem data acquisition software. The problem is believed to be with the 4-20 mA output settings for the analyzer and the associated range and offset.

INSITE METERS

SISCO personnel installed the Insite IG integrated D.O. and MLSS meter on October 17th and removed it November 25th. The meters were maintained by SISCO personnel during the demonstration. However, to our knowledge, only two other site visits were made besides the installation and removal.

The Insite meter was installed with a cleaning system that also used the Plant's non-potable water. Initial calibration was conducted in a bucket of tap water and with the Plant's most recent MLSS reading. During the first week of operation, a solenoid valve in the cleaning system broke and it was never repaired. Thus, the cleaning system was not functional for the remainder of the demonstration.

Some difficulty with sensor mounting system hardware was noticed when the sensors were removed for manual cleaning. This maintenance required two people and was somewhat cumbersome. The sensors required removal to remove debris that had accumulated on the assembly (see photo below).

Both Insite meters were connected to the on-line data collection system. This was not a smooth operation, as some misinformation related to 4-20 mA output settings for the instruments complicated matters. Once the problems were resolved, on-line data collection with the instruments was relatively trouble-free.

Overall, both of the Insite meters worked well. They each provided reliable operation with consistent and accurate readings despite operating without a cleaning system. The only problems with the unit were related to the probe mounting hardware and a failed solenoid valve.

DATA

Dissolved Oxygen

South Bermuda WRF operations staff kindly recorded D.O. readings from the Insite meter and their portable D.O. meter on a log sheet. Generally, three readings were made each day, coinciding with each shift at the Plant. The readings typically occurred at or around 7:00 AM, 3:00 PM and 11:00 PM, and were taken at the same location as the Insite meter. The raw data is provided in **Table 1** and the plotted data is shown in **Figure 1**. As seen in **Figure 1**, the data from the meters match up very well throughout the testing period. Some differences in the data are noticeable near the end of the demonstration, which may be the effect of not having an operable cleaning system. The majority of the readings are below 1.0 mg/L and a small difference between the meters is seen in this range. Typically, the Insite meter read lower than the South Bermuda WRF D.O. meter (0.572 mg/L vs. 0.886 mg/L averages for Insite and SBWRF meters, respectively), which is likely because of sensitivity differences between the meters. For instance, the lowest reading provided by the South Bermuda WRF was 0.2 mg/L as compared to frequent readings by the Insite meter below 0.2 mg/L. Statistical analysis of the data (**Table 1**) shows that the average difference between meter readings was 0.34 mg/L, with a standard deviation of 0.402.

The BioChem data acquisition system collected data from the instruments every 10 minutes for approximately two weeks. Readings from the Insite D.O. meter are shown in **Figure 2**. Much of the time, presumably during high loadings, the D.O. is very low, around 0.1 – 0.2 mg/L. The wide variation in D.O. at this location in Carrousel is evident in the figure as was also seen in **Figure 1**. The Insite meter appears to register these differences well.

MLSS

The MLSS data for grab samples and on-line monitoring are provided in **Figures 3** and **4**, respectively. Grab sample data for both the Cerlic and Insite meters are plotted along with South Bermuda's WRF's MLSS values as measured in their laboratory in **Figure 3**. Trendlines (continuous black lines) for the Insite and South Bermuda WRF data show that the changes in MLSS are tracked well by the Insite meter. However, the Insite readings are continually lower than the South Bermuda WRF data. This deviation is about 500 mg/L at the start of the demonstration and gradually increases to about 1,000 mg/L at the conclusion. An explanation for this difference could be that the South Bermuda WRF MLSS samples are taken from the clarifier splitter box where MLSS from both Carrousel trains has blended, while the Insite readings are only from the east train. The gradual increase in deviation may be due to buildup on the Insite MLSS probe, since the cleaning system wasn't operating. Overall, the average

difference between the Insite and SBWRF MLSS readings was about 600 mg/L, with a standard deviation of about 200 (see **Table 1**).

Data for the Cerlic meter varied widely throughout the demonstration and many points are omitted from **Figure 3** due to the MLSS scale on the graph. This wide variation also caused a trendline for this data to be omitted, since it skewed the graph. The average difference of the Cerlic and SBWRF readings was about 2,900 mg/L, with a standard deviation of 8,400, which emphasizes the meter's instability. As previously noted, it was observed that the Cerlic meter values drifted upward soon after the probe was cleaned. When the probe was clean, the meter appeared to be reasonably accurate.

On-line data for the Insite MLSS meter is shown in **Figure 4**. The data is relatively stable and shows the MLSS trend well. Some spikes in the data are evident but reasons for these are not known. Potential reasons may be loss of communication, electrical interference, power failure, cleaning / maintenance procedures, or membrane fouling. As previously mentioned, the Cerlic meter data could not be successfully converted into the data acquisition software.

COSTS

Purchase and estimated annual O & M costs for each of the meters and their associated accessories are listed below.

Insite IG - Purchase

Equipment	**Cost**
Dual (or single) Channel D.O./MLSS Analyzer	$2,215 ($1,815)
D.O. Sensor	$ 840
TSS Sensor	$ 840
Cleaning System	$ 685
Mounting Hardware	$ 200
TOTAL	$4,780

Insite IG - O & M

Item	**Annual Cost**
Operator Maintenance (0.5 hr/wk @ $50/hr)	$1,300
Replacement D.O. Sensor (1/yr)*	$ 840
Replacement MLSS Sensor (1/yr)*	$ 840
TOTAL	$2,980

**Manufacturer claims replacement will not be required – but realistically assume so.*

Cerlic - Purchase

Equipment	Cost
TSS Analyzer[1]	$2,700
TSS Sensor[2]	$3,800
TOTAL	$6,500

[1] Includes cleaning setup and mounting hardware

[2] Includes rail mounting kit

Cerlic – O & M

Item	Annual Costs
Operator Maintenance (0.5 hr/wk @ $50/hr)	$1,300
Replacement TSS Sensor (1/yr)	$3,000
TOTAL	$4,300

RECOMMENDATION

Although the Cerlic meter has a neater overall appearance and seems to be more user friendly, the Insite IG meter performed much better in terms of reliability and accuracy. With respect to purchase costs, the Insite IG TSS Meter is about $1,700 less than the Cerlic unit, even with the D.O. meter capabilities. Maintenance costs can be considered the same for each meter, but replacement sensors for the Cerlic unit are over triple the cost of the Insite sensors.

In consideration of the above, we recommend the Insite IG Dissolved Oxygen and Suspended Solids meters for use at the City of Kissimmee Water Reclamation Facilities.