The Concept of Smart Water Discharge (SWD)™ , The Next Revolution in Produced Water Treatment

Authors: Frank A. Richerand, Frank Richerand II
Yoosef Peymani

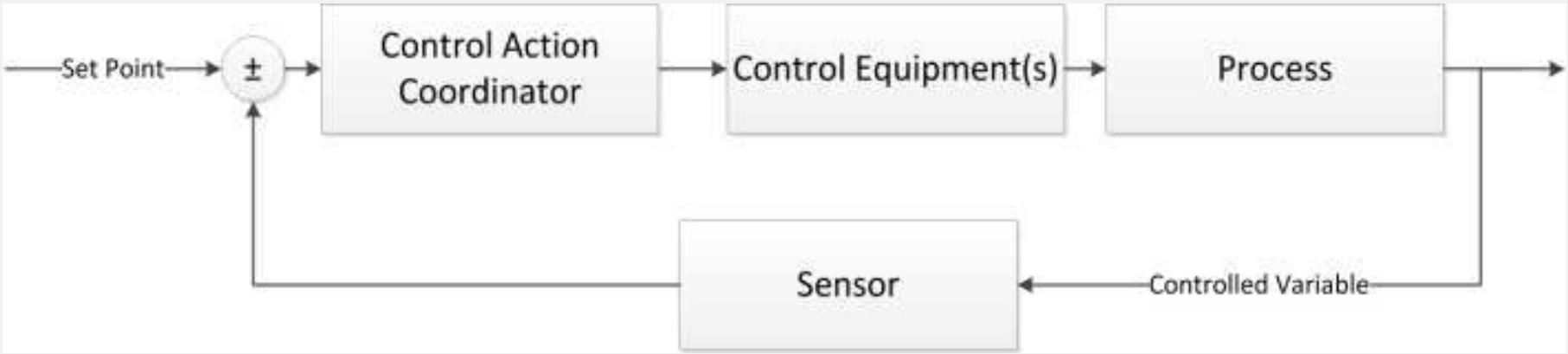
ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

www.envirotechsystems.com

Smart Water Discharge Definition

•Automation is the only method to eliminate or reduce the human error and synchronize the response with the upset by proper automation, continuous monitoring and Human-Machine Interaction

Control Logic Flow Chart

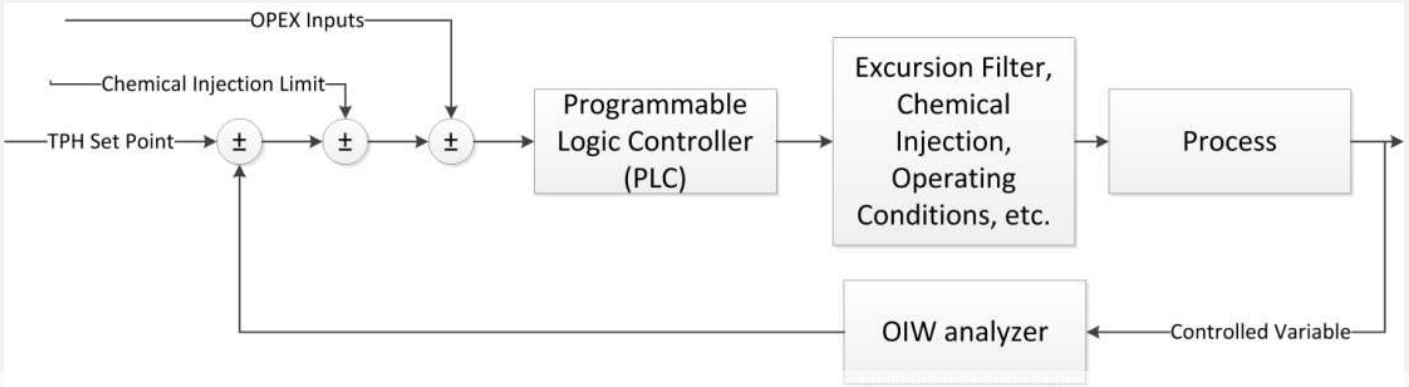


ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Smart Water Technology Components

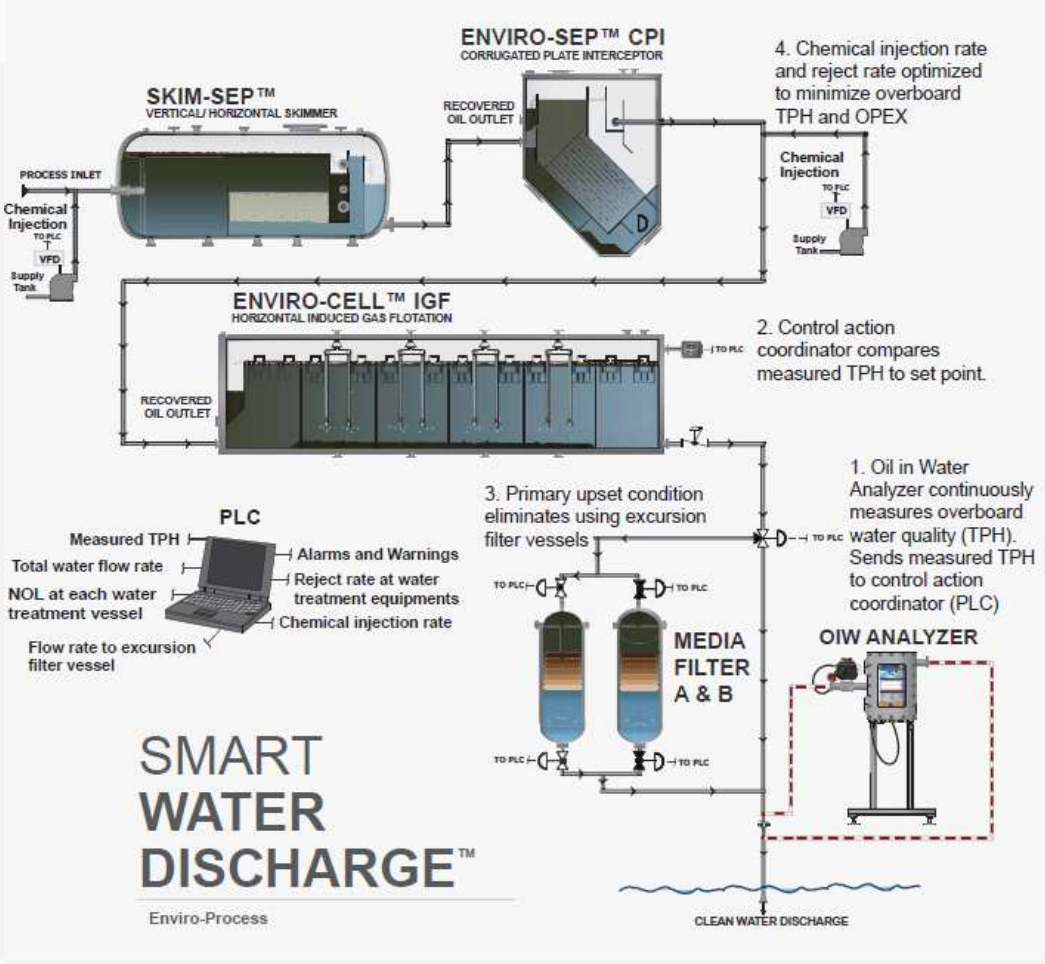
- Sensor: OIW Analyzer
- Error : Measured Variable – Set Point
- Control Action Coordinator (CAC): Decision Maker
- Controlling Equipments: Excursion Filter Skid, Chemical Injection Rate, Operating Conditions at Each Water treatment Component

Control Logic Flow Chart



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Smart Water Discharge Definition (SWD): Constantly maintain the output (overboard water quality) at a predetermined set point by means of monitoring and controlling the vital process parameters (such as chemical injection rate and excursion skid).



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Sensor (OIW analyzer)

- Proper Location to represent correct TPH of the overboard water;
- Accurate over the range of possible TPH;
- Calibrated to have maximum accuracy at set point;
- Continuous measurement;
- Free to low maintenance with reliable and repeatable output;
- Any fault in the sensor should be reportable with a proper code to CAC;
- The analyzer should be self-cleaning;

Controlling Equipment

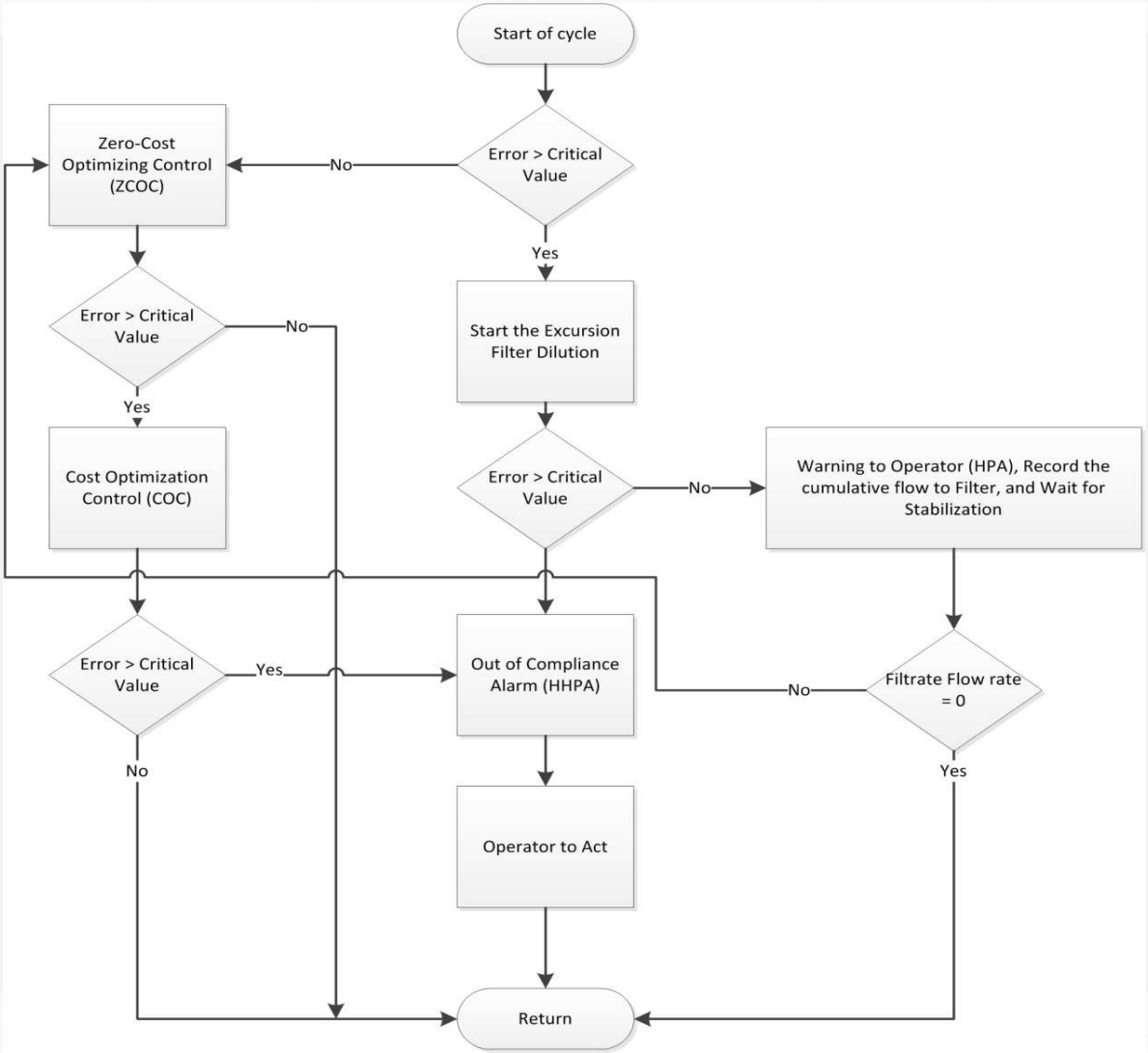
- Primary Controlling Equipment: Excursion Filter Vessel
    1. Adsorption: Nutshell filters
    2. Absorption: Activated Carbon, Organo-Clay, Organically Modified Silica
    3. Membrane: Ceramic Membrane, Micro/Nano Membrane

- Secondary Controlling Equipment/Parameters:
    1. Alter the water/oil interface at three phase separator
    2. Altering the reject rate of gravity and/or flotation separator
    3. Controlling the pressure differential ratio in hydro-cyclones
    4. ***Chemical Injection Rate***

Control Action Coordinator (CAC)

Control action coordinator receives the controlled variable and additional variables that might have an influence on the process. The processor utilizes a pre-loaded algorithm and select between pre-determined control actions to manage the upset condition and maintain the water quality in-compliance.

Smart Water Discharge (SWD) general operation algorithm



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

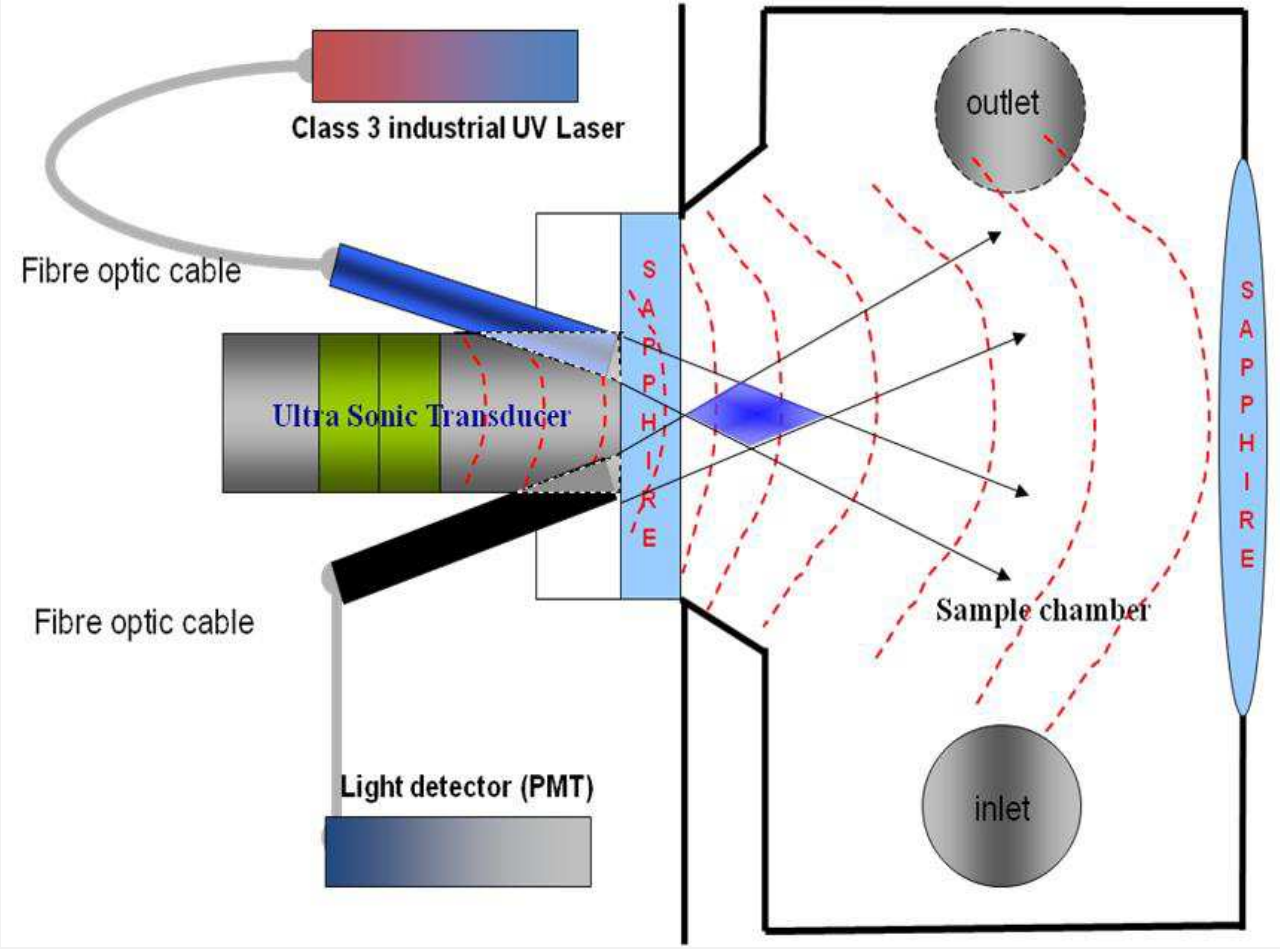
Field Tests

- Purpose: To determine the effect of harsh operating conditions on main SWD components:
  - Sensor (OIW analyzer): Advanced Sensors EX-100
  - Excursion Filter Vessel:
    - Granular Activated Carbon
    - Organically Modified Silica Media

Operating Conditions

- Understudied platform was located three miles off the coast of Hermosa Beach, California.
- Environmentally Critical Location
- The produced water contains high concentrations of asphaltines and paraffinic
- The high temperature of water (180-190° F)
- Abundance of Hydrogen Sulfide in the stream
- High TPH concentration (150-250 PPM)

OIW Analyzer (EX-100)



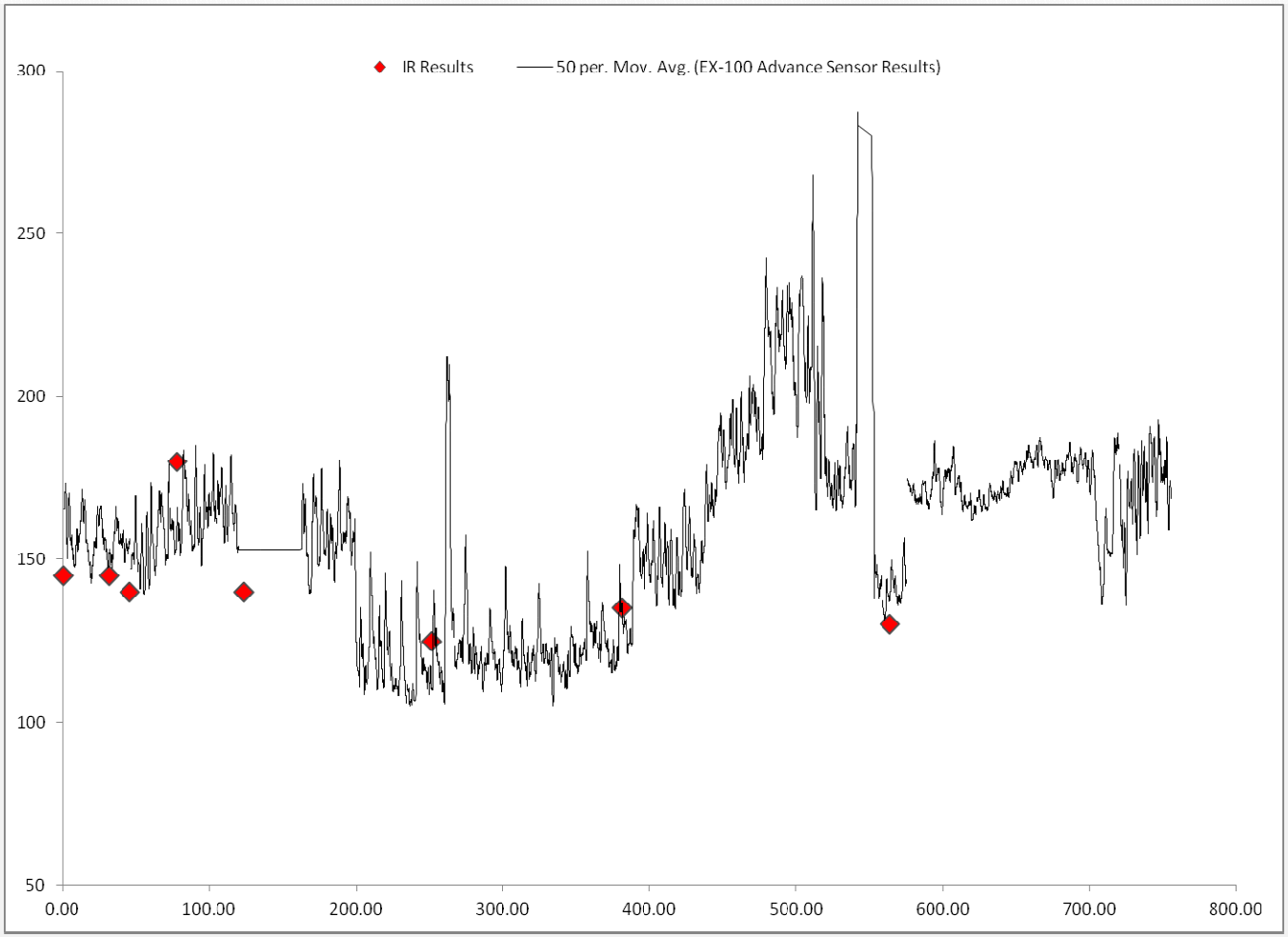
ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

OIW Analyzer (EX-100)

- Effective Cleaning at high asphaltines concentration
- Accurate Measurement (5% error)
- Maintenance Free in the 3 month trial period.

ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

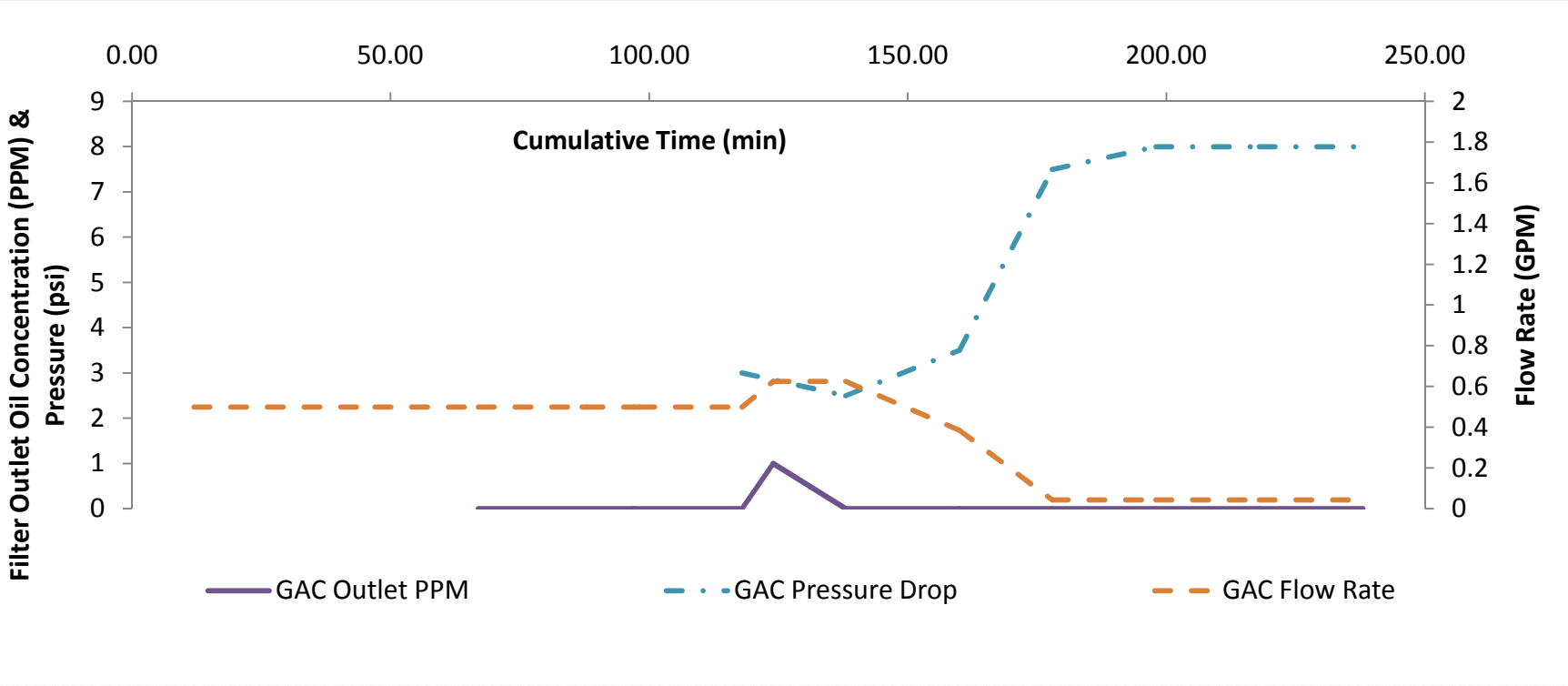
OIW Analyzer (EX-100)



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Granular Activated Carbon (GAC)

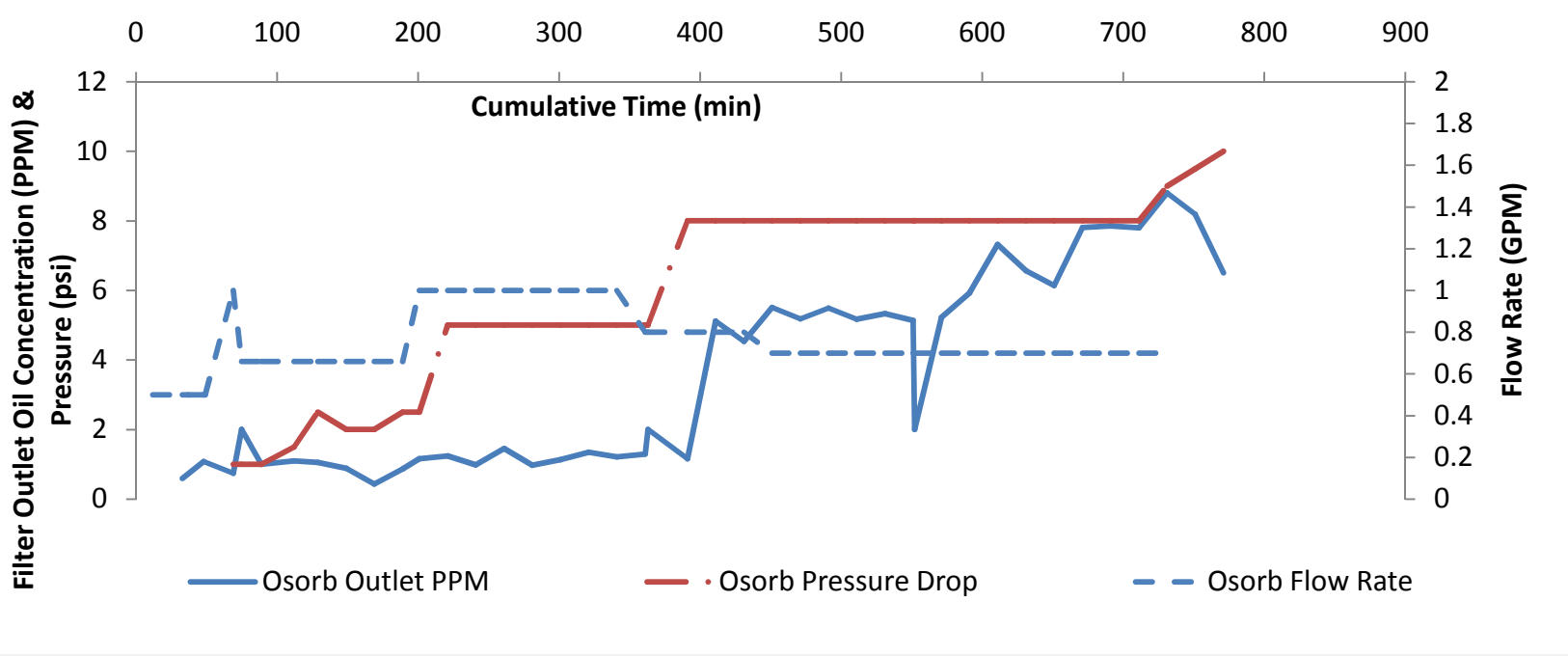
- Sorption Capacity: 1.6%
- Separation Efficiency: 99%-100%
- Media Fouling caused High Pressure Drop



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Organically Modified Silica Media

- Sorption Capacity: 12.8%
- Separation Efficiency: 98.7%-99.3%
- Saturation of Media and increase in PD



ENVIRO-TECH SYSTEMS
"PROCESS WATER SPECIALISTS"

Recent Smart Water Discharge Project

1. Oily Water Treatment Package on Platform X at Gulf of Mexico
2. Water Treatment System in Flow Station X in Nigeria
3. Produced water treatment package on platform X, Gulf of Mexico
4. Deck Drainage Treatment System on Four different Drill Ship, Three Different location on Each Ship
5. Hazardous Drain system (Drill Deck) on Four Different Drill Ship

Recent Smart Water Discharge Project: Oily Water Treatment Package on Platform X at Gulf of Mexico

Goals of Smart Water Discharge:

1. Divert the flow to storage tank in the case of upset
2. Optimize the dosage of two chemicals to relief the upset and minimize the chemical consumption.
3. Adjust the water level in the tanks to minimize the OIW and Chemical consumption

Recent Smart Water Discharge Project: Oily Water Treatment Package on Platform X at Gulf of Mexico

Recent Smart Water Discharge Project: Water Treatment System in Flow Station X in Nigeria

Goals of Smart Water Discharge:

1. Divert the flow to Bulk Media Filtration
2. Optimize the dosage of two chemicals to relief the upset and minimize the chemical consumption.
3. Minimize the usage of Filtration Units

Recent Smart Water Discharge Project: Produced water treatment package on platform X, Gulf of Mexico

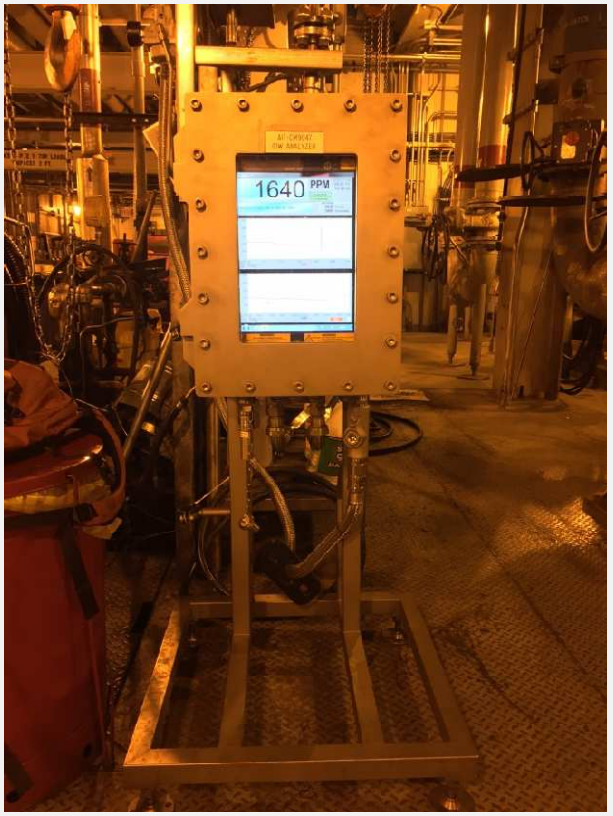
Goals of Smart Water Discharge:

1. Monitor and Alarm the Operators
2. Divert the flow to Media Filtration Units

Recent Smart Water Discharge Project: Deck Drainage Treatment System on Four different Drill Ship, Three Different location on Each Ship

Goals of Smart Water Discharge:

1. Monitor and Alarm the Operators
2. Divert the flow to Storage Tanks



Conclusions

•Upset condition and fluctuation in overboard water quality are results from dynamic nature of produced water treatment. Also, Start-up/Shut-in, Maintenance of equipment, Bringing a new well online, or human errors required proper control system and automation to prevent non-compliance.

•The initiation of the Smart Water Discharge technique is to compensate for these variables listed and most importantly control the sometimes uncontrollable factor of human error.

•A proper control algorithm was developed and a series of field and laboratory tests to investigate the best options for each component of Smart Water Discharge (SWD).

Acknowledgements

•The authors are grateful to the FreePort McMoRan for providing the opportunity to conduct the field test and permission to publish the data.

•We would like to thank all of our business partners, PWA-ProSep Inc., and Meidensha Corp., who helped us to fulfill all of the laboratory and field experiments.
•Authors are greatly thankful of SPE to provide the opportunity to release this information.

Questions