Online Oil-In-Water (OIW) Monitoring

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B8/32

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Advanced sensors

Agenda

- Background
- Measurement Technique
- Installation
- Performance and Challenges
- Summary
- Q&A

OIW Monitoring - Background

- **Tantawan Explorer:** Two units of oil-in-water monitoring (ODME) installed at the outlet of Hydrocyclone and Produced Water Discharge since 1997. In 2004, only one unit was functioning, but the reading was incorrect.

- **Benchamas Explorer:** Two units of oil-in-water monitoring (Rivertrace) installed at the outlet of Oily Water Separator and Nutshell Filter/MRU (Produced Water Discharge) . In 2004, both units were functioning but the readings were, form time to time, incorrect, and needed special care such as sensor cleaning/replacing.

- **Benchamas Processing Platform:** One unit of oil-in-water monitoring (Rivertrace) installed at the outlet of IGF. In 2004, the unit was functioning but required special care such as sensor cleaning/replacement.

OIW Monitoring - Background

- At that time, technology of detecting ppm of oil in water has not fully arrived yet (within Chevron and Unocal organization).

- We were looking for a continuous Oil-In-Water (OIW) monitoring that were easier to maintain and operate (less maintenance, cleaning, and calibrating). And can provide an accurate and reliable Oil in Water monitoring for effluent discharge, re-injection and process management.

- OIW monitoring system from four suppliers were taken into consideration. **Advanced Sensors** product EX-100/EX-1000 was finally selected.

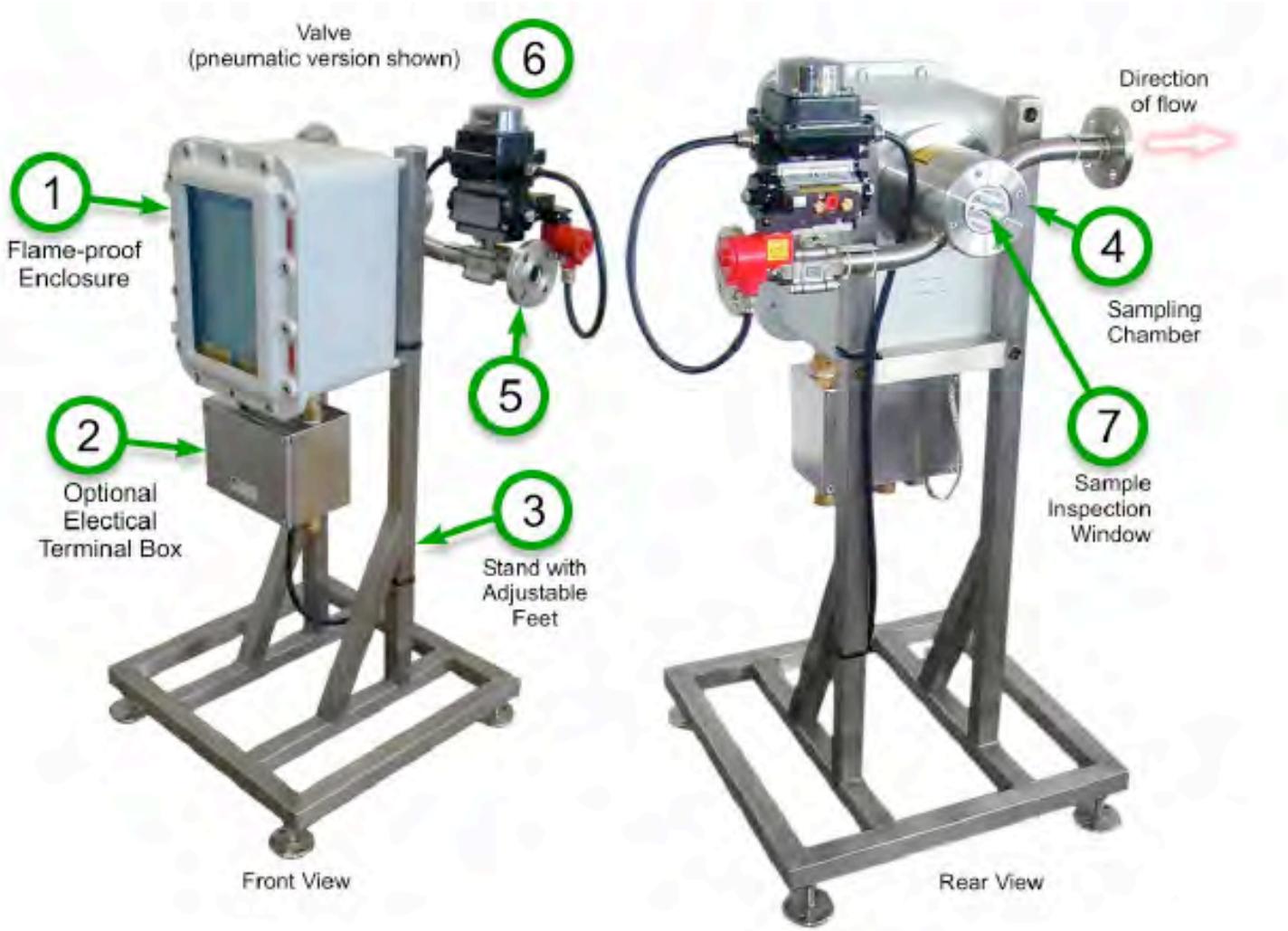
OIW Monitoring - Background

- On Benchamas Explorer and Tantawan Explorer, EX-100 were installed and commissioned in December 2006. The unit on Benchamas Explorer was later upgraded to EX-1000 in 2007.

- On Benchamas Processing Platform, EX-1000 was installed and commissioned in early 2008.

Measurement Technique

- Equipment



Measurement Technique

Measurement

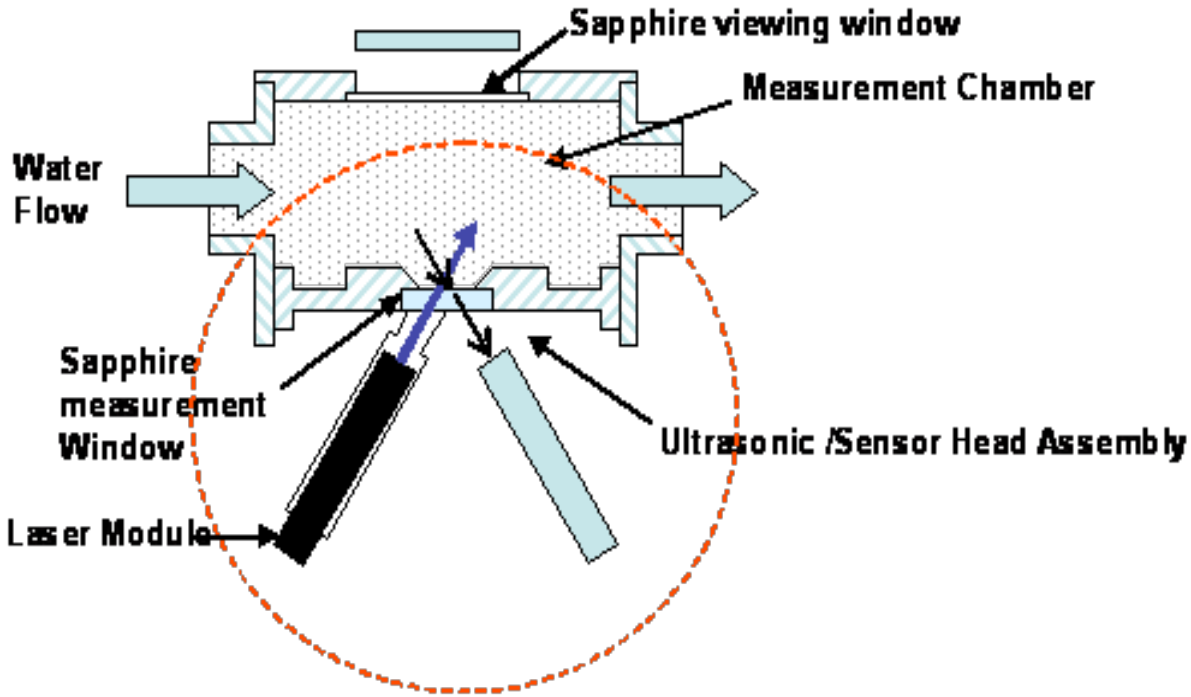
- The measurement technique incorporated in the Advanced Sensor's monitors is laser induced fluorescence.

- "Ultra Violet Optical Fluorescence" is used to measure oil content. Fluorescence is the preferred method for measuring low oil levels (0-1000ppm)

- The transducer sensor head is a combined Optical and Ultrasonic component. The laser passes through a smaller sapphire window to excite the water sample, the fluorescent properties are captured via Optical fiber light guides and taken to :
  - An optical filter and photo multiplier tube (PMT), the optical filter selected depends on the wavelength properties in the water.
  - And an optical UV spectrometer (for the EX1000)

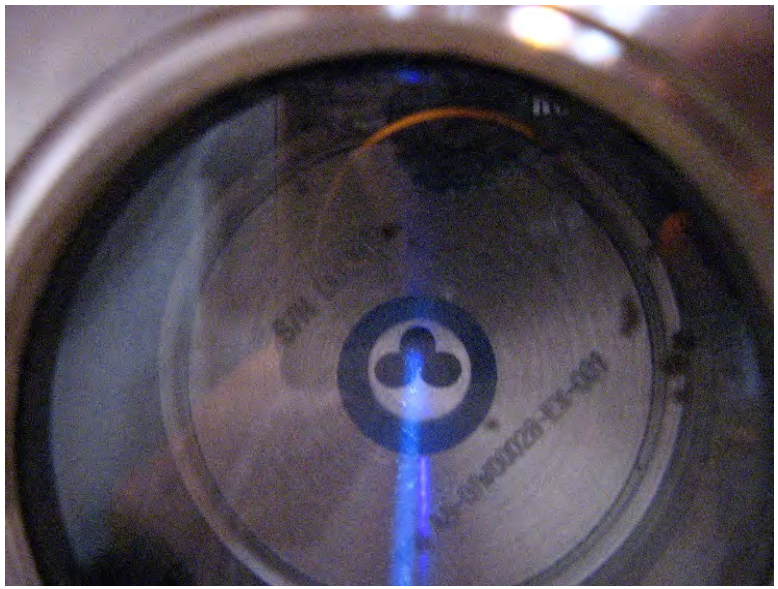
Measurement Technique

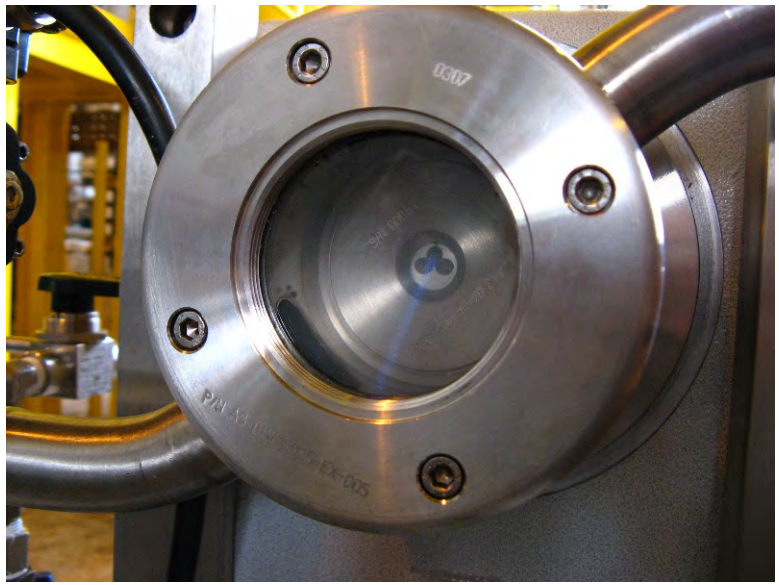
- a simplified schematic of the OIW monitor.



Measurement Technique

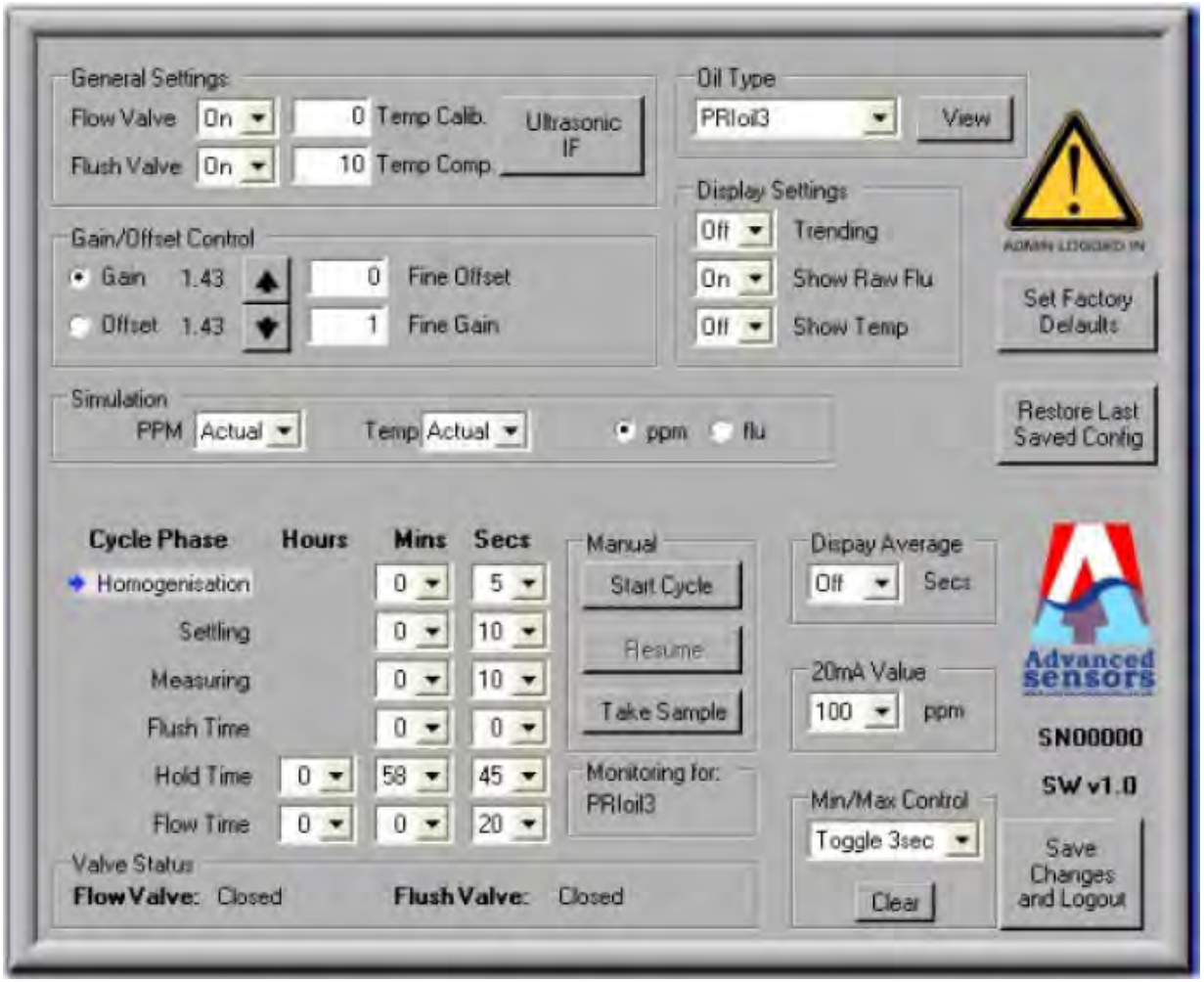
- Sampling Chamber





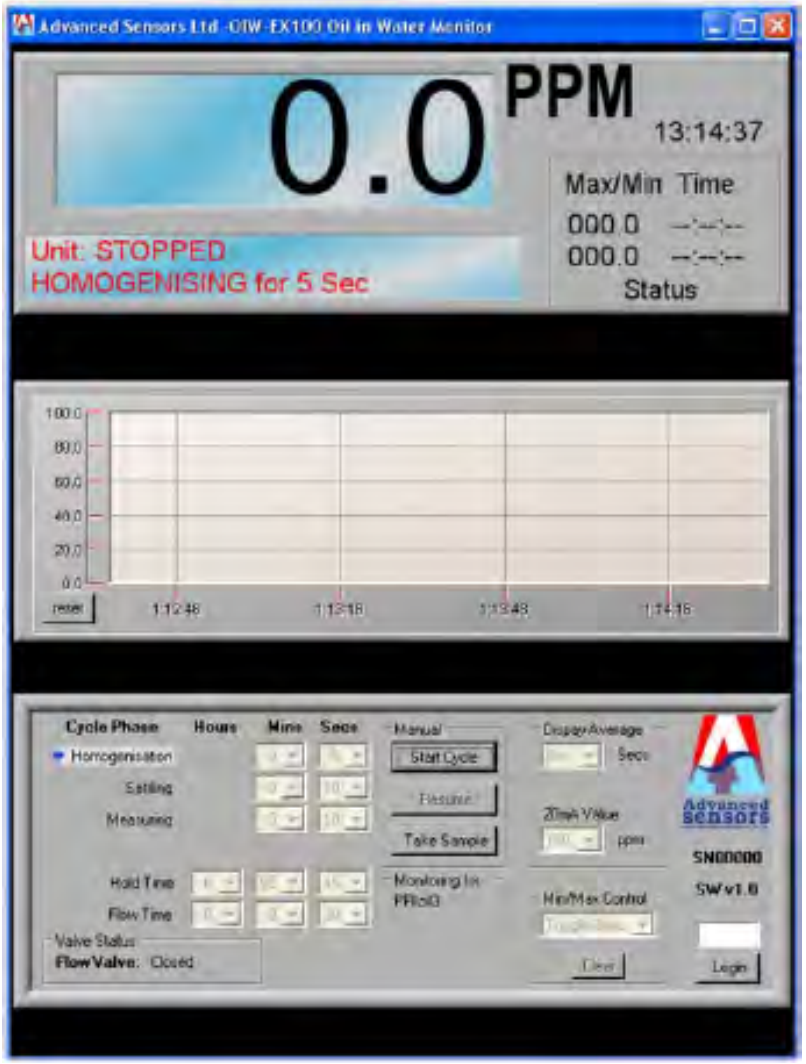
Measurement Technique

- Parameter Setting and Configuration



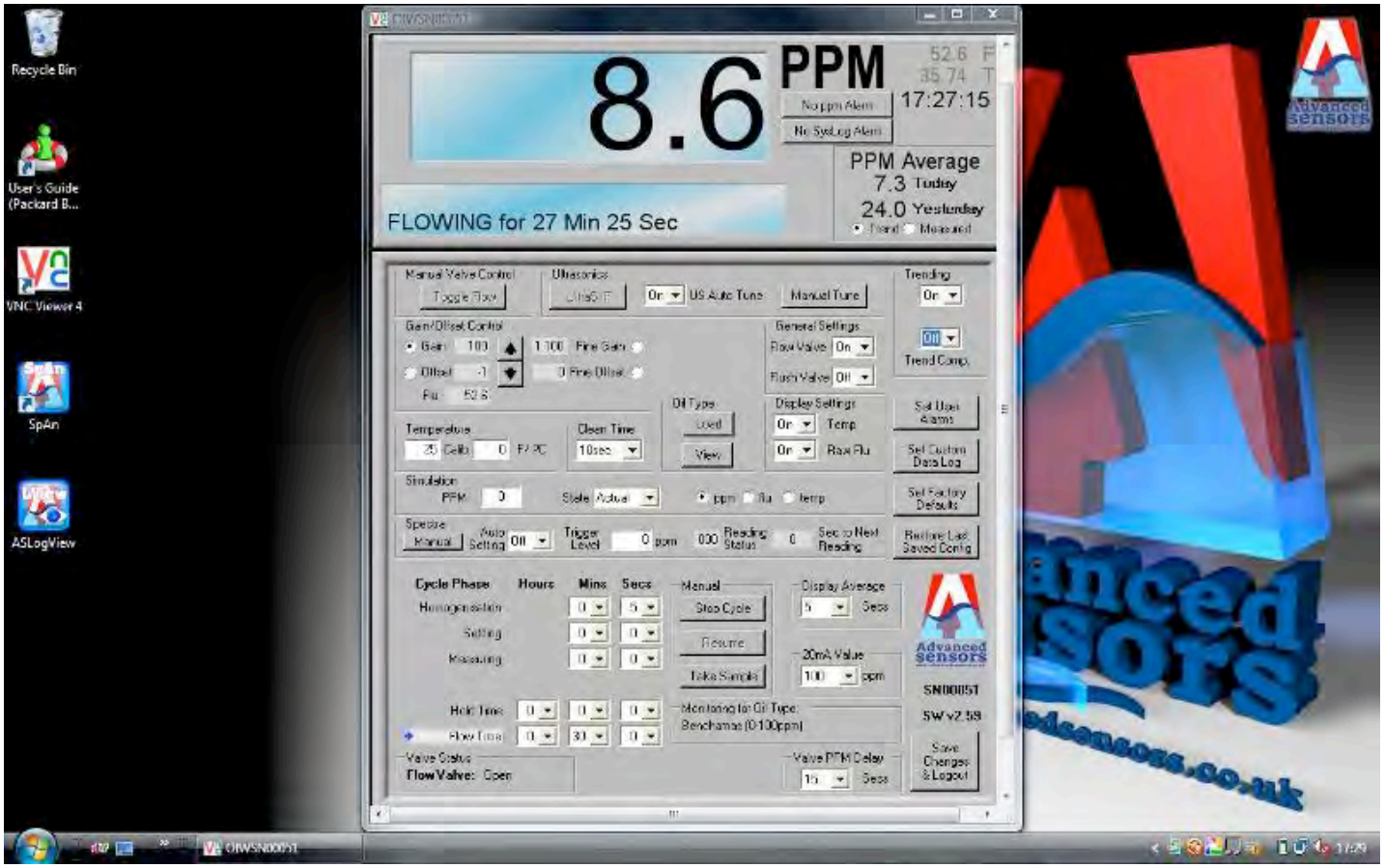
Measurement Technique

- Monitor Screen



Measurement Technique

- Remote Access



Installation

- **Tantawan Explorer:** EX-100 was installed at the Produced Water discharge in December 2006.

Installation

- **Benchamas Explorer:** EX-100 was installed at the outlet of Nutshell Filter in December 2006. It was later upgraded to EX-1000 in 2007.

Installation

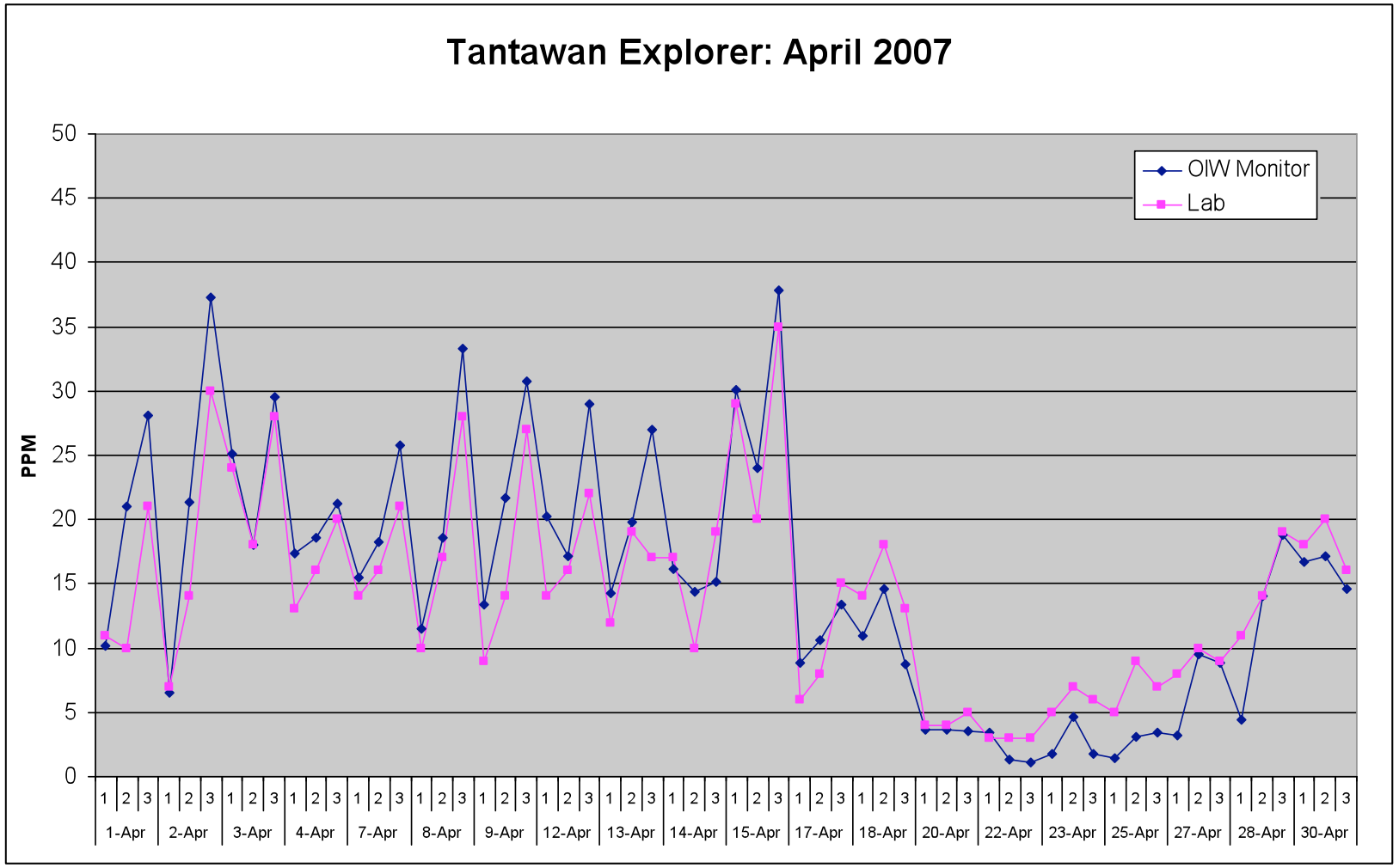
- **Benchamas Processing Platform:** EX-1000 was installed at the outlet of IGF on in January 2008.

Performance and Challenges

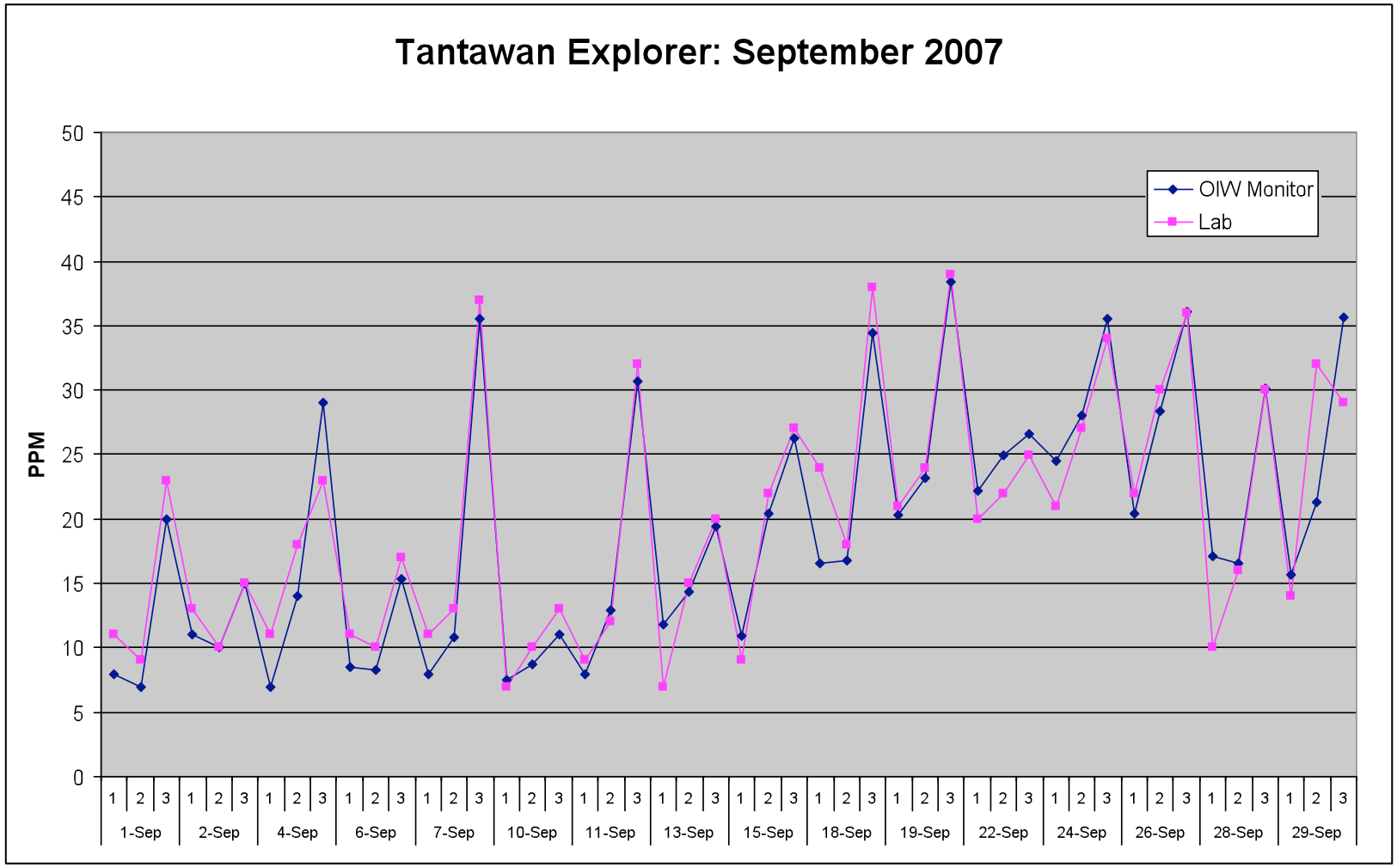
Tantawan Explorer

- The unit on Tantawan has been performing well since early December 2006 without the need of any human intervention, maintenance or cleaning.

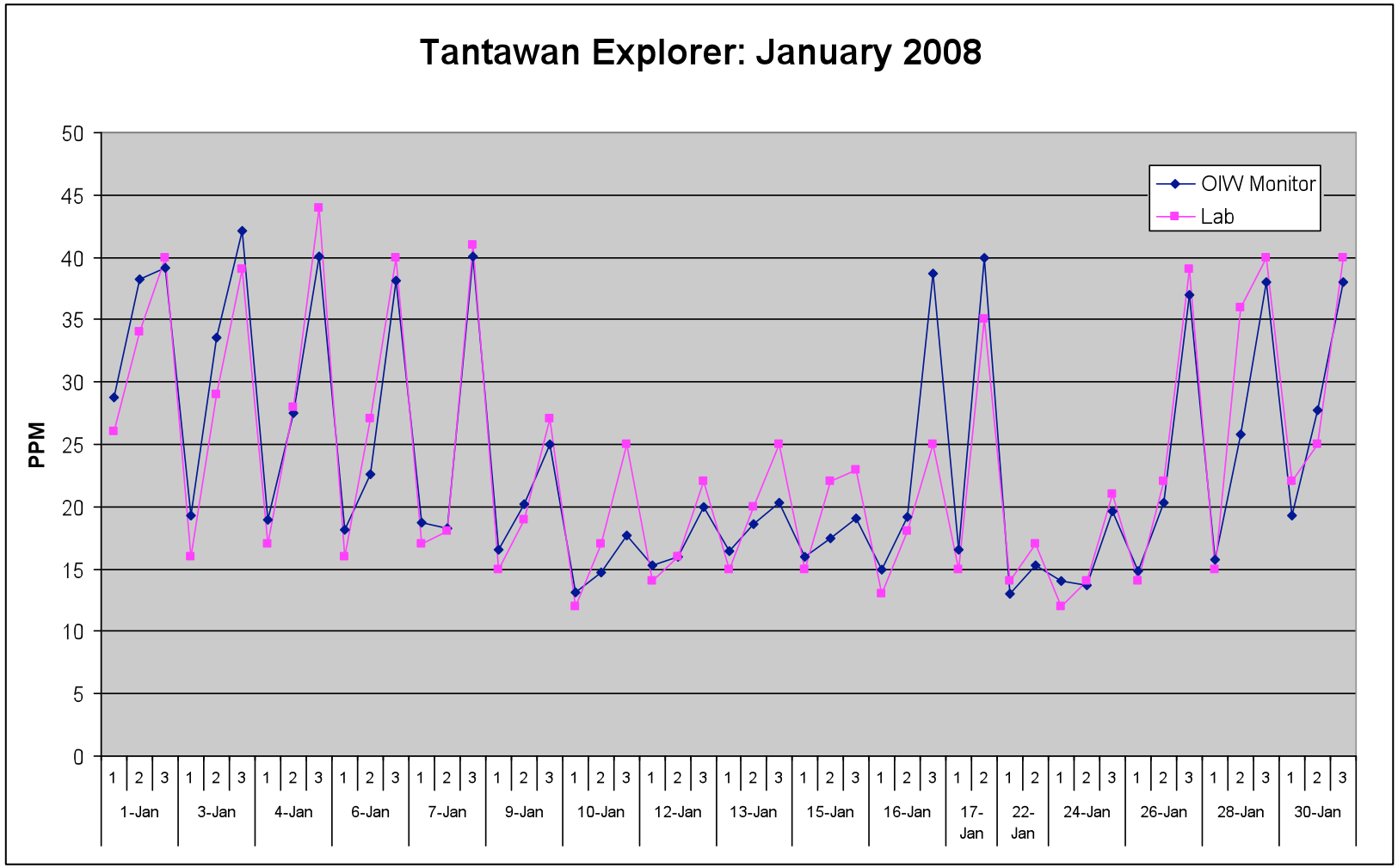
Performance and Challenges



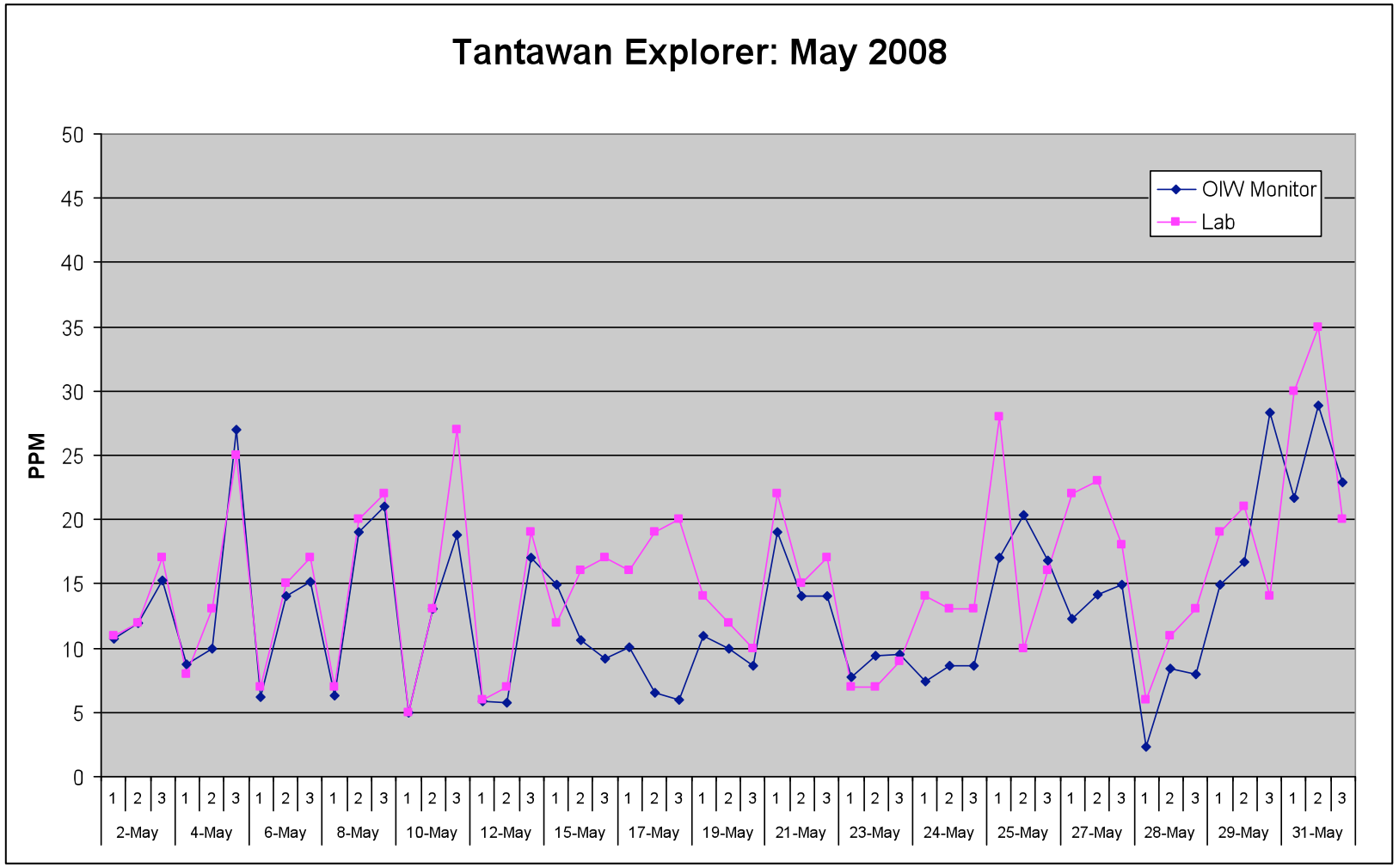
Performance and Challenges



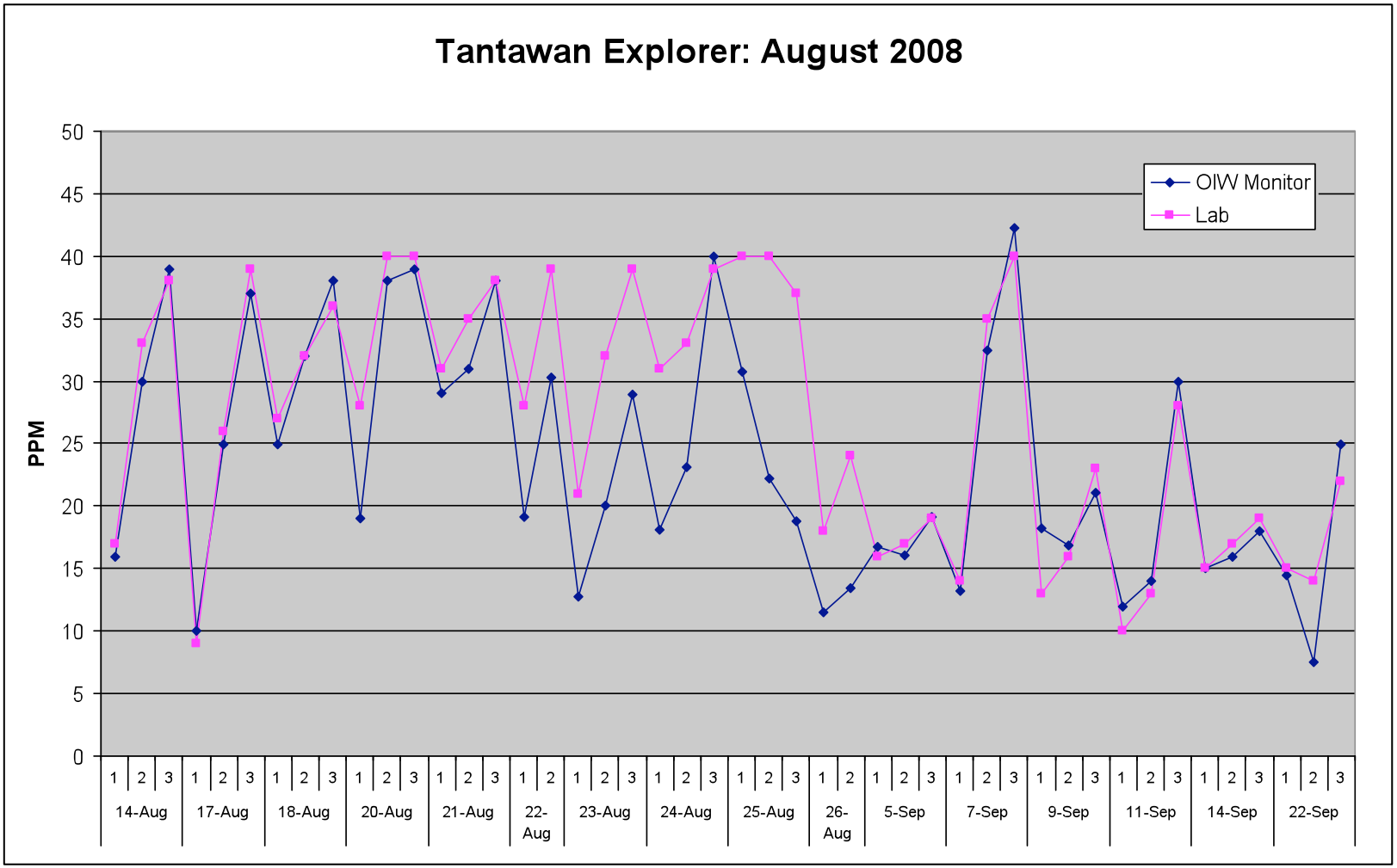
Performance and Challenges



Performance and Challenges



Performance and Challenges

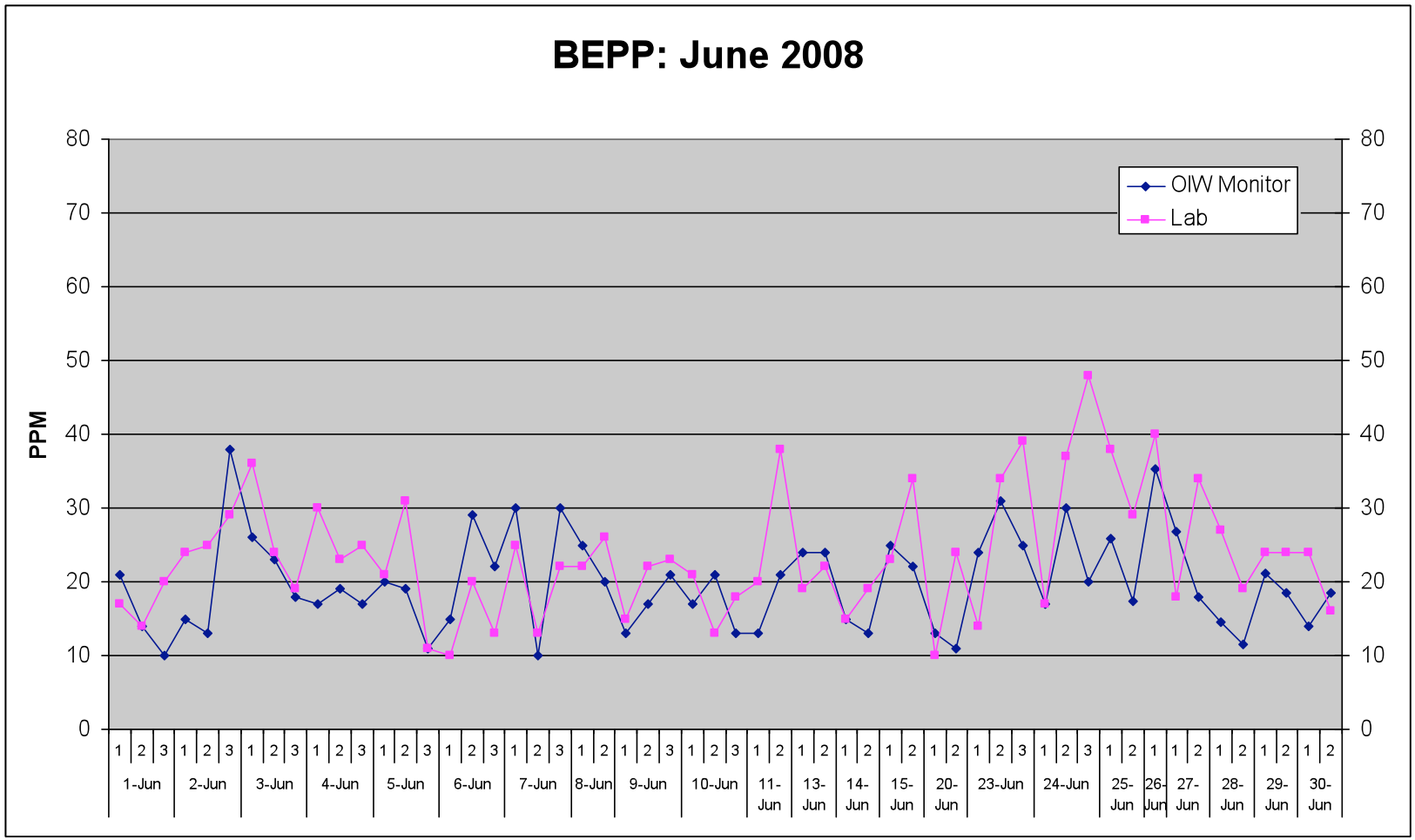


Performance and Challenges

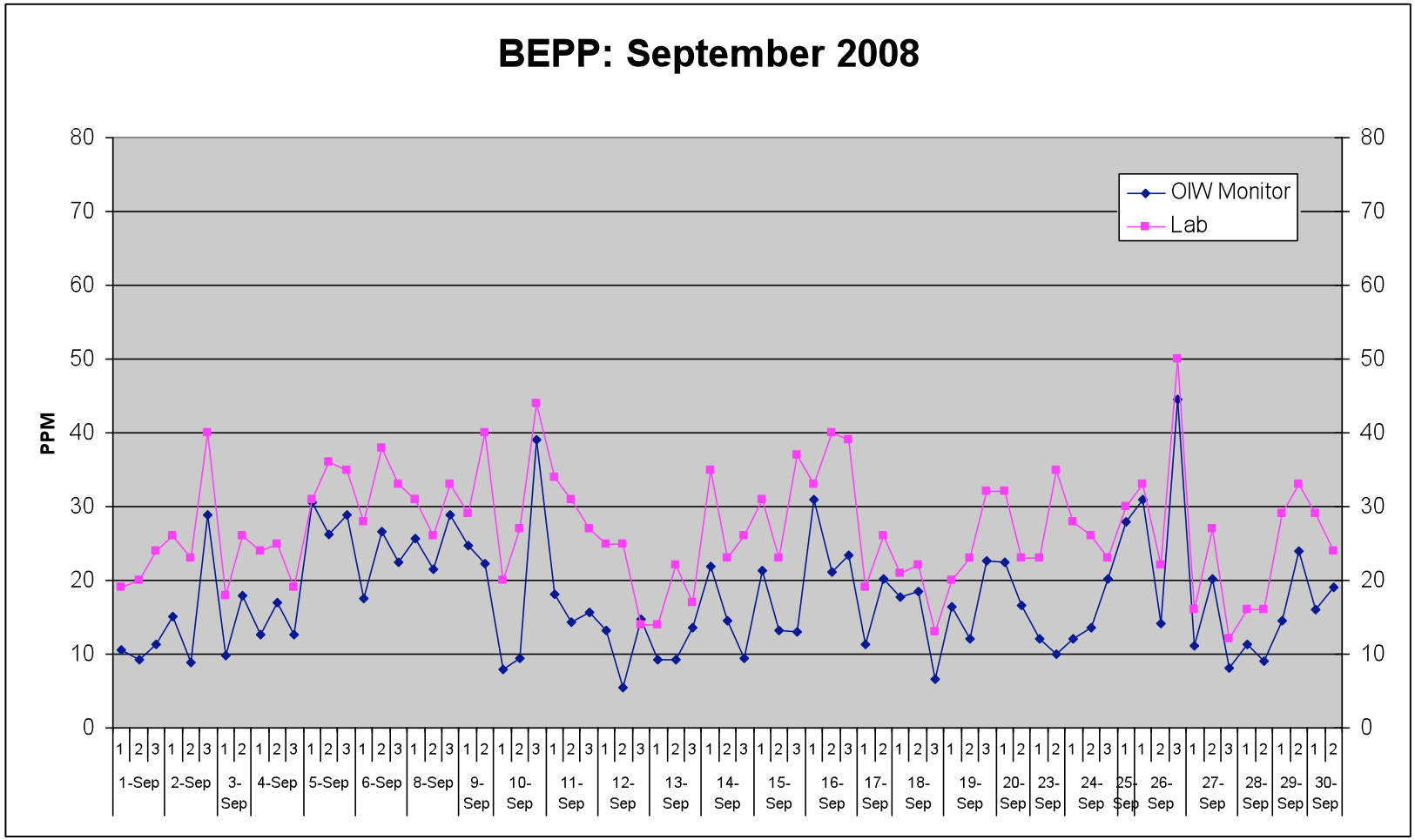
Benchamas Processing Platform

- After the commissioning in early 2007, the result from OIW Monitor has been satisfying.
- OIW ppm reading is linked to the Control Room HMI system to provide an immediate warning to the operators when the water treatment system is upset.
- The recent data show that the agreement with laboratory results can be better by adjusting Gain and Offset value.

Performance and Challenges



Performance and Challenges



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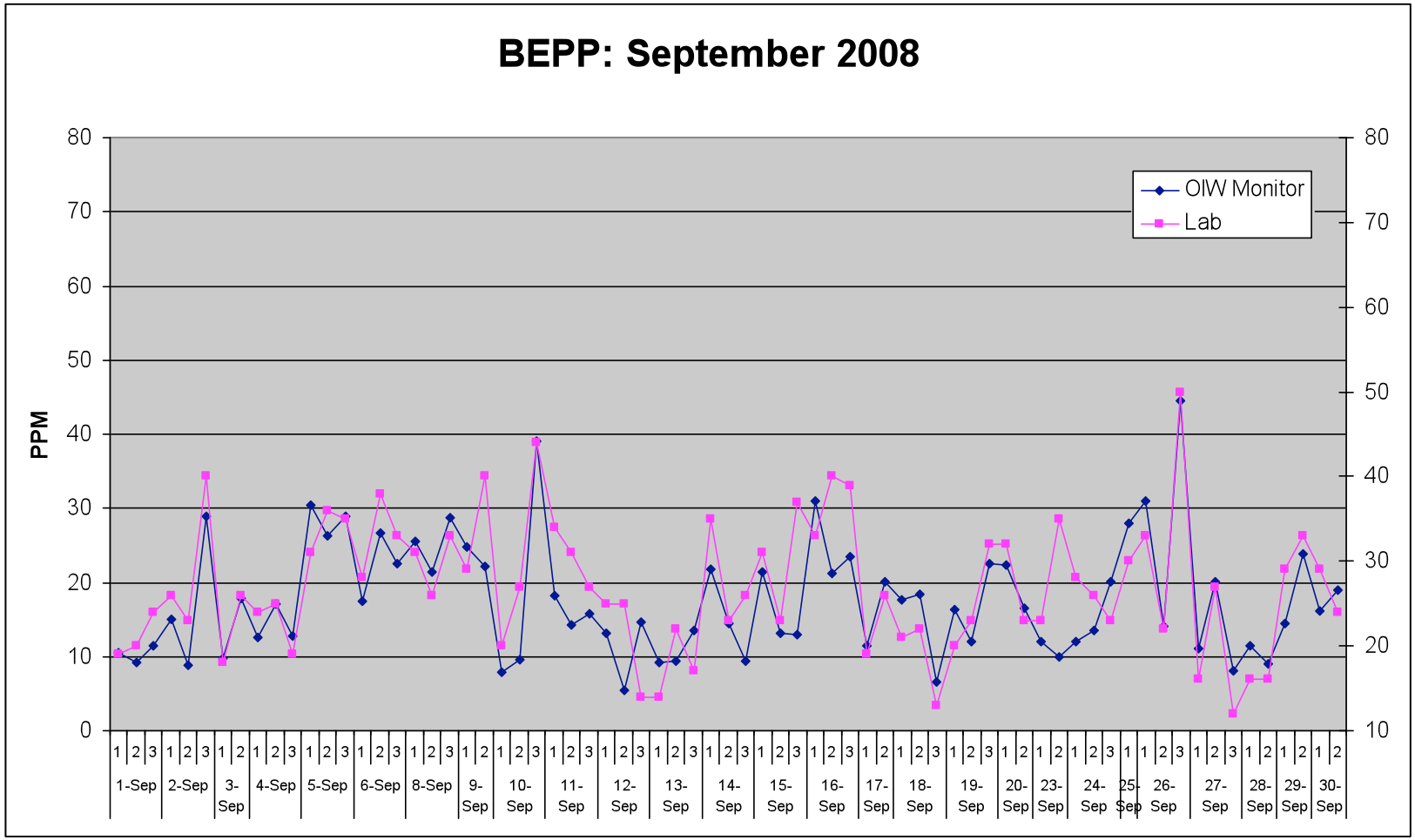


Performance and Challenges

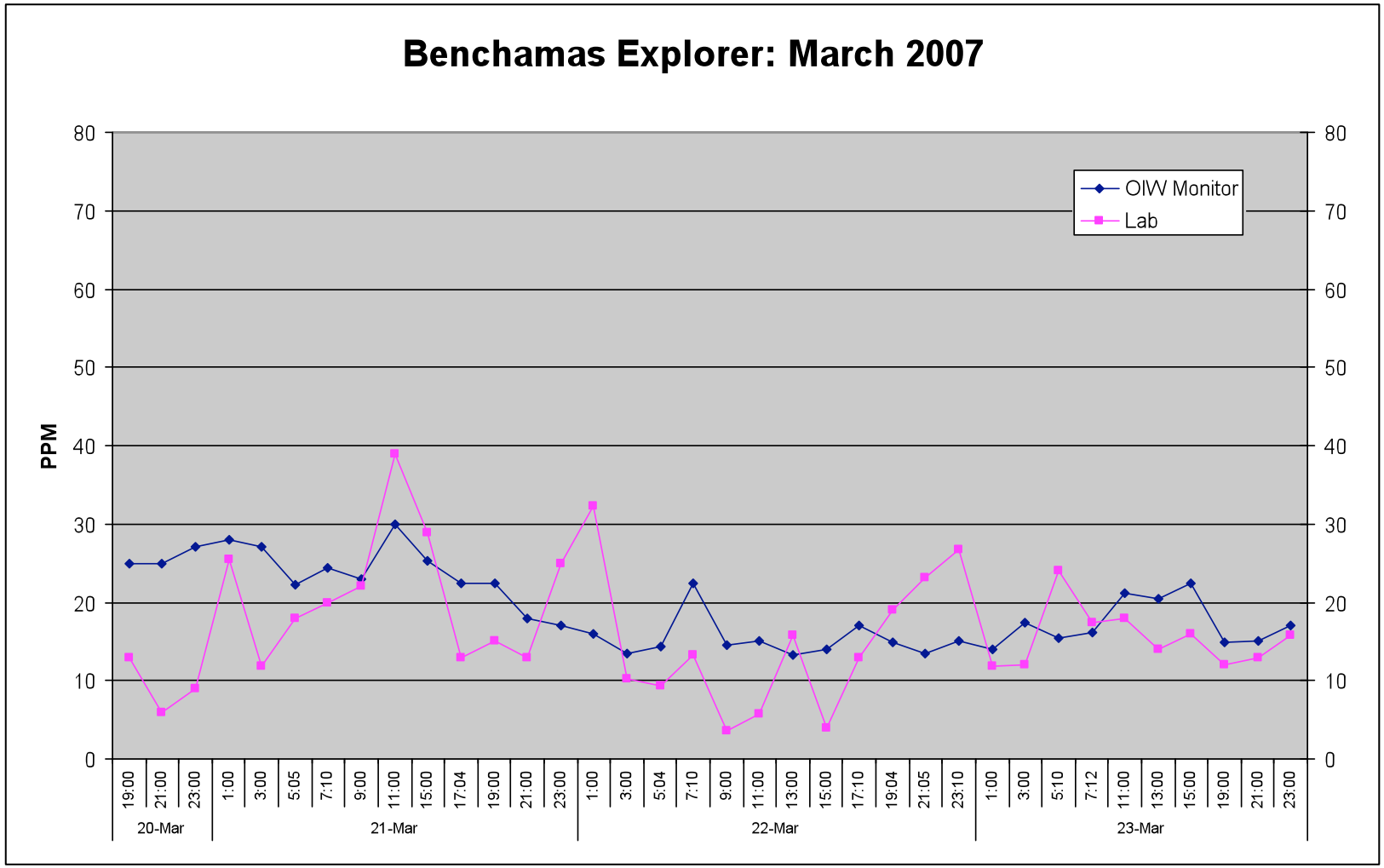
Benchamas Explorer

- After commissioning, the unit was functioning but periodically reporting higher OIW concentration results than the field laboratory that used solvent extraction and IR detection.

- It was later discovered that EX-100 unit on Benchamas FSO experienced interferences due to the injection of a demulsifier chemical into the water during oil-water separation operations.

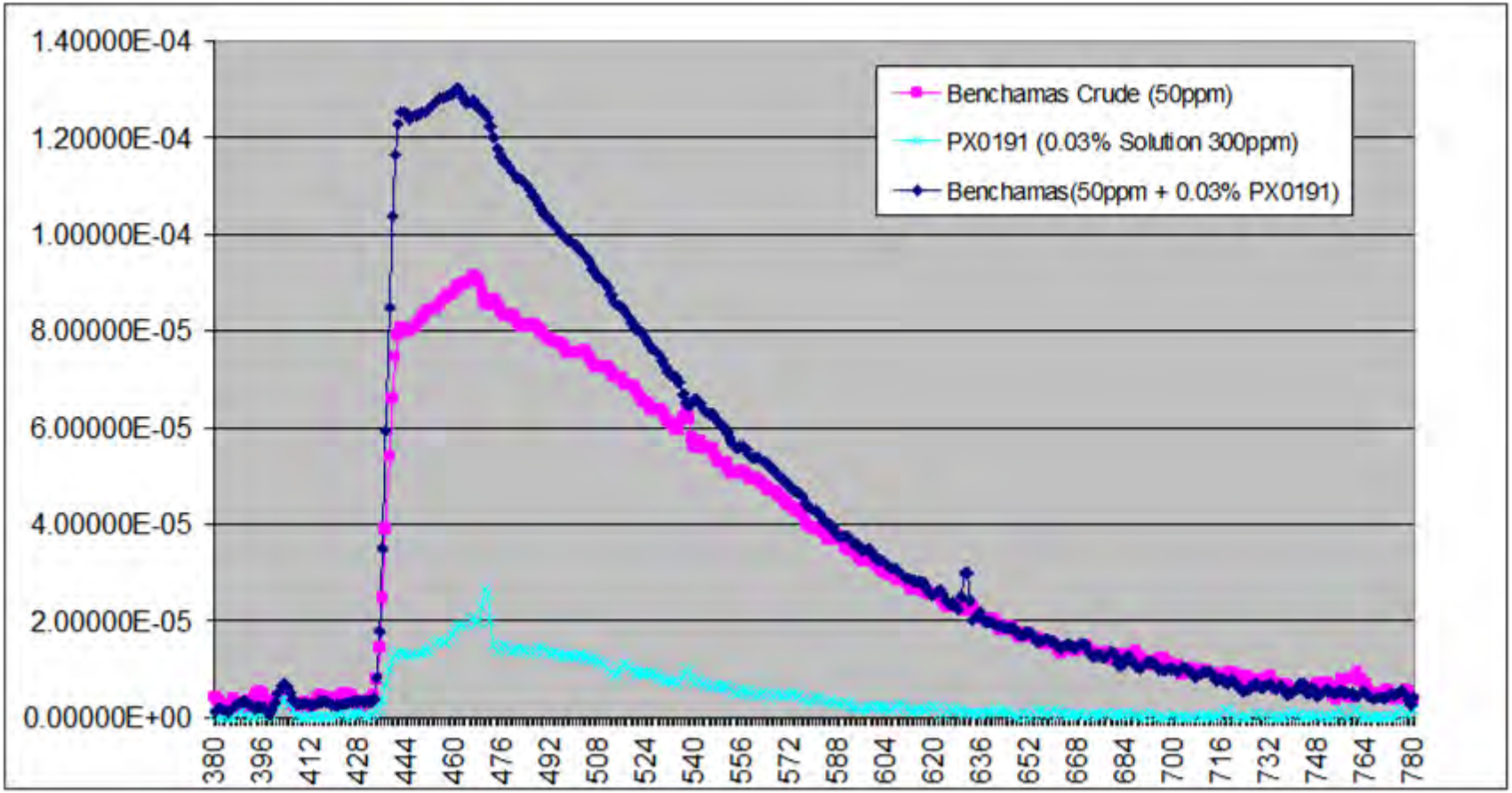
- Chemicals used on Benchamas were tested in the laboratory using the EX1000 spectrometer. One of the chemicals (PX0191) when present in increased concentration was causing irregular ppm readings. The unit did measure accurately except for when high concentrations on PX0191 were present.

Performance and Challenges



Performance and Challenges

Spectrophotometric scan of water, chemical and chemically-treated water
(y-axis intensity; x-axis wavelength, nm)



Performance and Challenges

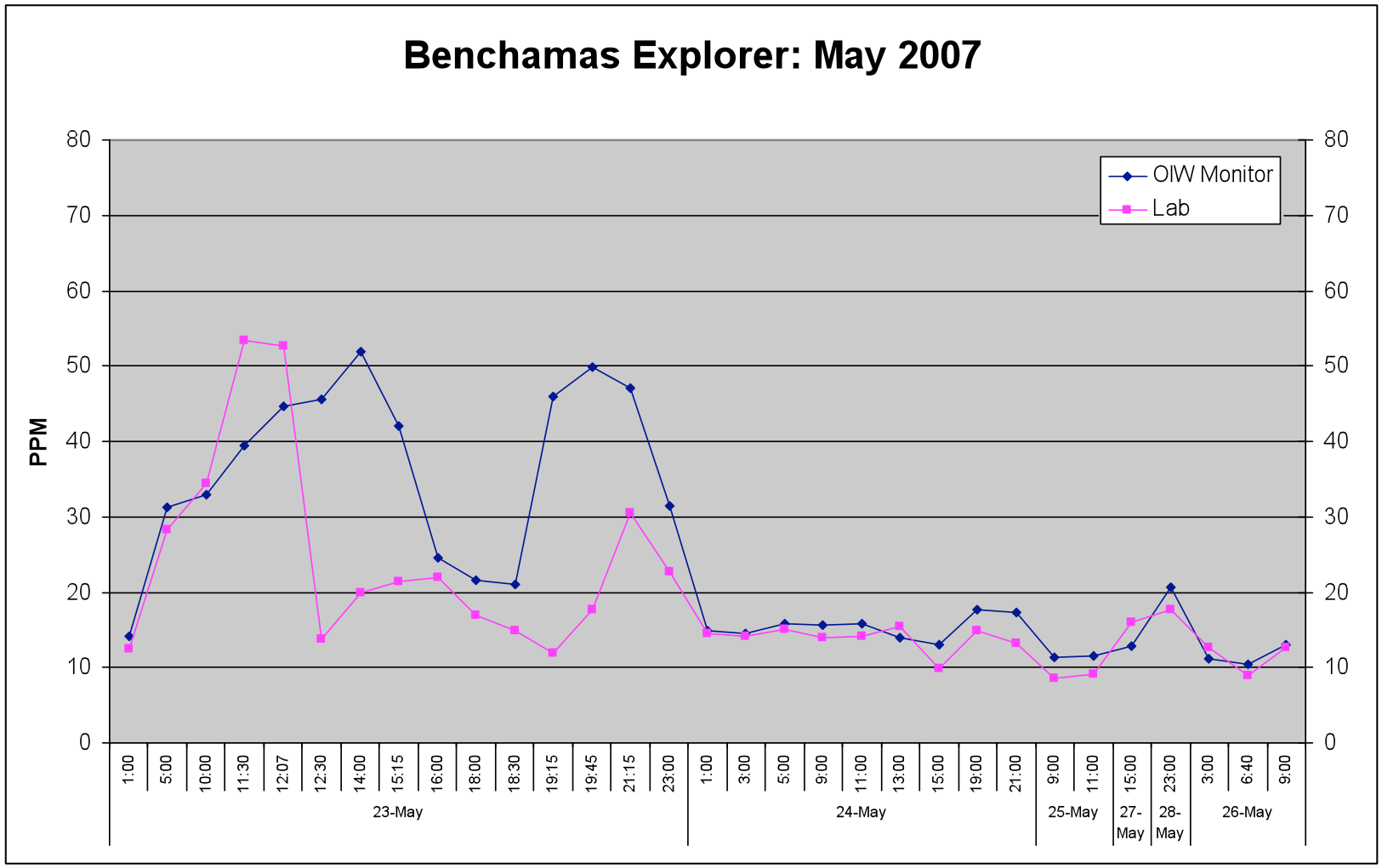
Solution

- A new optical filter was selected to reduce/eliminate the affect of this chemical. In May 2007, the optical filter changed and the optical spectrometer installed, effectively upgrading the EX-100 to EX-1000.

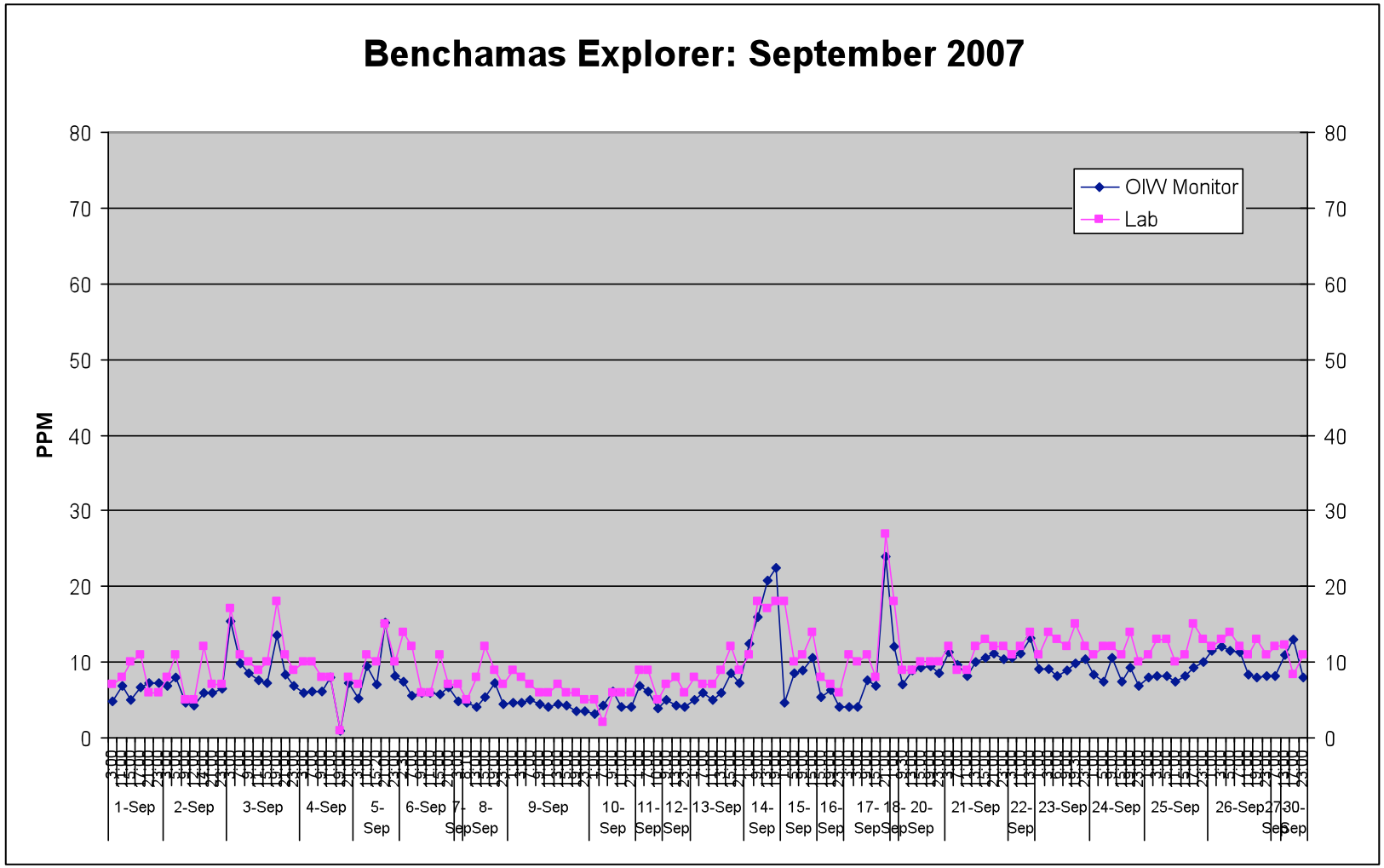
- The wavelength range of the filter was changed from 485nm to 593nm to avoid the interference.

- The EX1000 unit performs and archives the UV spectrum of the water every 10 minutes, This will facilitate further analysis of new chemicals or additives being introduced to the process.

Performance and Challenges



Performance and Challenges



Performance and Challenges

- After the upgrading, the unit on Benchamas Explorer has been working well. The readings from the unit is now close to the laboratory results.

- However there are couple failure due to the Hard Drive within six months. We suspected the direct sun light because it was installed on the deck. Vendor has provided sunscreen on for the unit.

Challenges

Other Challenges

- Cleaning/Fouling
- Oil Droplet Size Variation
- Operating Range

Challenges

Cleaning/Fouling

- It is critical to keep all optical transmission paths clean when using optical measurement techniques without the need of manual intervention, using of acids, detergents, or introduction of additives.

Solution

- The combined optical and ultrasonic sensor head.
- Ultrasonic cleans the sapphire windows ensuring that measurements do not deteriorate.
- EX-100 and EX-1000 performs this task automatically, so it requires no cleaning or routine maintenance.

Challenges

Oil droplet size

- Variation in Oil droplet size directly affect the florescent levels measured and in turn PPM levels.

Solution

- EX OIW monitors uses ultrasonics to periodically standardize oil droplet size to maintain an accurate measurement.

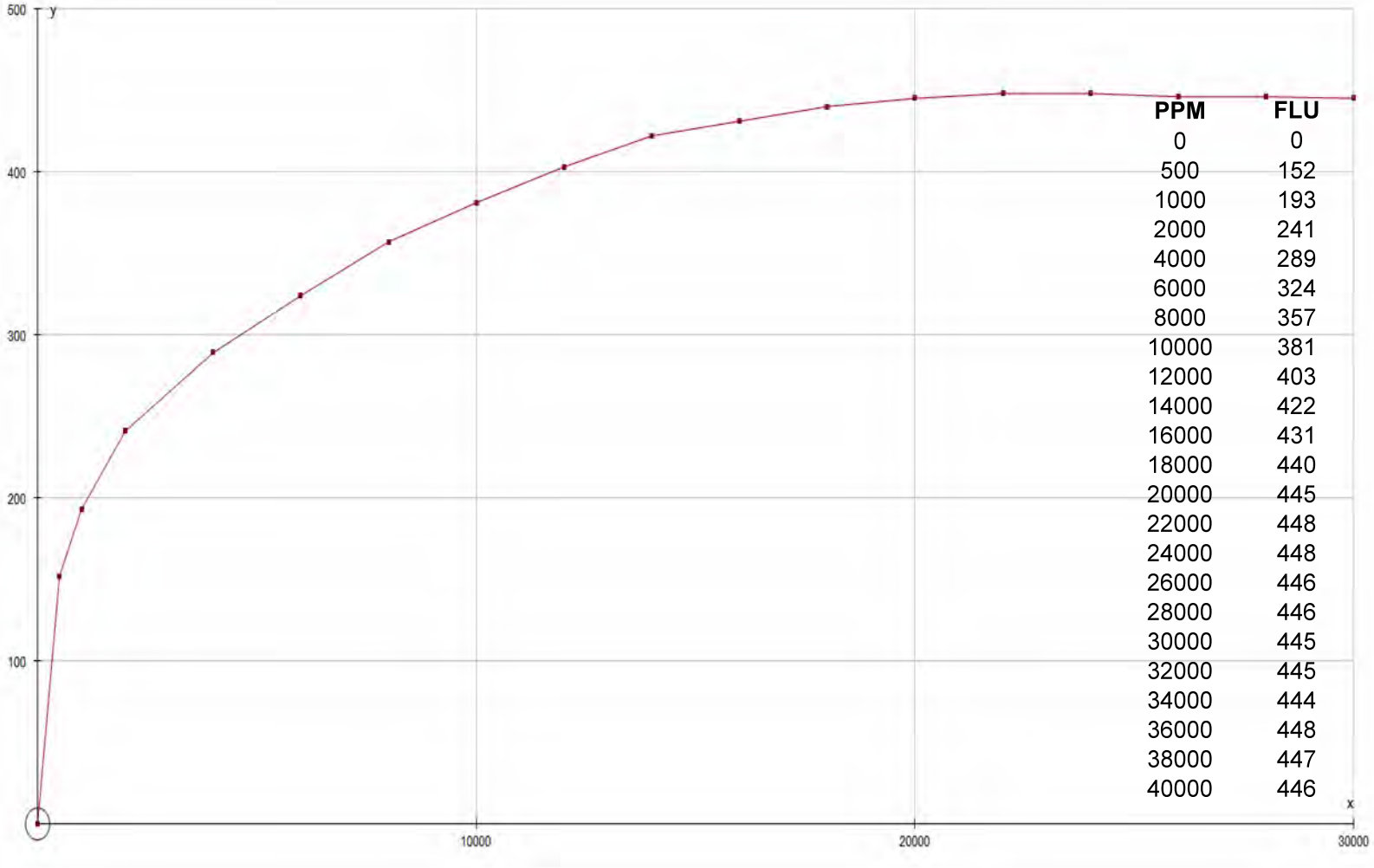
Challenges

Operating dynamic range

- The dynamic range of most OIW monitors is limited to 500 ppm or a maximum of 1000 ppm TPH.
- The standard EX-100/1000 can operate up to 3,000 ppm TPH. The "EX1000Advance" has a direct fluorescent dynamic range of 20,000 ppm OIW without any extrapolation.
- The extended range monitor "EX1000Advance" facilitates the monitoring the efficiency of separators and hydro-cyclones, providing a greater insight to process dynamics

Challenges

- Operating Range: 0 – 20,000ppm (2% oil concentration)



PPM	FLU
0	0
500	152
1000	193
2000	241
4000	289
6000	324
8000	357
10000	381
12000	403
14000	422
16000	431
18000	440
20000	445
22000	448
24000	448
26000	446
28000	446
30000	445
32000	445
34000	444
36000	448
38000	447
40000	446

Conclusions

- EX-100 installed on Tantawan Explorer has been performing well
  - Excellent agreement with grab samples – SX with Wilks IR
  - Operators love "maintenance free" monitor

- The unit installed on Benchamas Explorer performs well after being upgraded to EX-1000, because the interference from the demulsifier was eliminated.

- EX-1000 installed on Benchamas Processing Platform has been performing well. But the parameter should be adjusted to get better agreement with the laboratory result.

- Advanced Sensors' OIW monitors reduce lab technician time and solvent use /exposure.

- Advanced Sensors' OIW monitors provide an immediate alarm to Control Rooms when the water treatment system is upset.

Q&A