



DSL DYNAMIC SCALE LOOPS

The PMAC Dynamic Scale Loop (DSL) apparatus is an invaluable research and development tool for technologists responsible for the design, operation and efficiency of water handling systems in which changes in thermal, pressure or chemical can promote the deposition of scales. The apparatus provides an accurate, reproducible and rapid method for selecting and quantifying the most effective means of controlling scale deposition under dynamic conditions. PMAC DSL systems are being used by many laboratories around the world to provide accurate and repeatable results by leading Major Oilfield Chemical Companies.

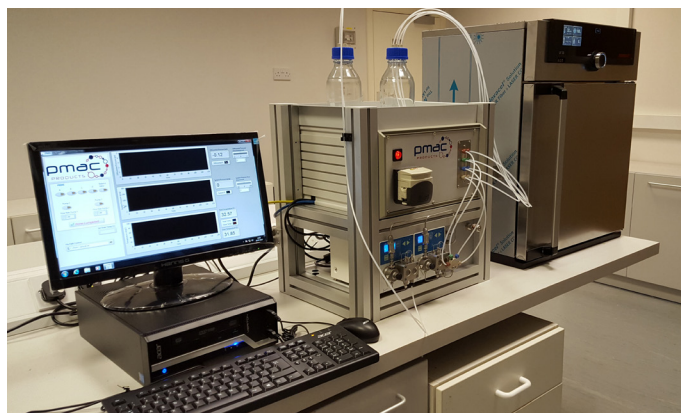
The system is designed for applications where the process or reservoir temperature exceeds 100°C and/or the impact of pressure on scaling tendencies needs to be studied. It is the only method available for studying Anhydride deposition under dynamic conditions. In cases where specialized tests involving the compatibility analysis of three "stable" waters, a third pump option is available. The standard PMAC DSL system features two HPLC pumps with 10cc pump heads, which include ceramic insert sleeves to minimize corrosion. It also includes an oven or water bath, differential and system pressure sensors, and a solvent organizer, all controlled via a PC with logging capabilities. The default setup provides a maximum flow rate of 20 ml/min. There is an optional 50cc pump head available, though it is not recommended for tests due to excessive shear.

The apparatus is available in two versions with different maximum working pressures: 2900 psi and 5800 psi. Both versions can operate within a temperature range from ambient to 300°C with the oven. Alternatively, a water bath can be used to achieve lower temperature range down to -20°C, allowing for simulation of field conditions. The flow configuration is programmable with flow ratios from 0-100%, allowing for single pump flow if necessary. The electronics are all fully enclosed in IP rated boxes for enhanced safety. The oven comes with an independent temperature control and thermal cut-out as standard. The system pressure and the differential pressure both come with pre-set inbuilt safety cut-out and bypass. Backpressure control is through a back pressure regulator valve installed at the front of the unit for easy access. All High Pressure pipework is made from stainless steel. However optional Monel can be used in heated zone.

SOLVENT ORGANIZER

The Solvent Organizer is a fully automated solvent mixing system with a four-valve solvent chamber. All wetted parts and connections to the pump-head are manufactured in corrosion resistant materials (PEEK, SS316, Titanium, PTFE with options of Monel or Hastelloy). The Solvent Organizer is programme driven from the PC to deliver pre-mixed anion + inhibitor concentrations to one of the pump-heads e.g., Port One supplying "pure" anion and port Two anion + inhibitor.

The Solvent Organizer pre-mixes the solutions at the desired ratio prior to the pump-head. The two remaining ports can be utilised to provide programmed cleaning of the DSL with the de-scaler solution and deionised water. Each of the ports is programmable to supply 100-0%. Valves are reverse flow enabled for cleaning if



CONTROL & DATA COLLECTION

The PMAC DSL software (based on LabVIEW) fully controls the test parameters, including, running a series of tests, a pre-scale and different dilutions followed by a cleaning cycle. The software logs all results in chronological files with the LabView controlling software; this is then easily manipulated for evaluation and reporting with readily available third party software.

Software includes non-linear programming, preheats, program save/load, program via ppm or %, repeat test/step/from, inbuilt/standalone calibration (including temperature), summary test report, events, temperature ramps, clean complete, live schematic as well as many others features.

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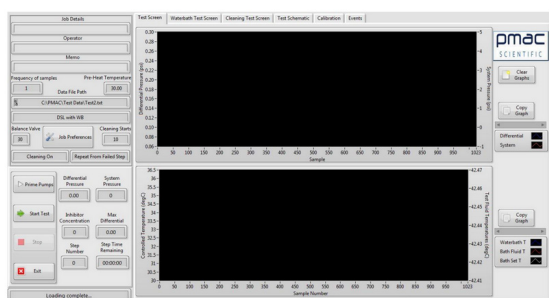


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OVEN

The oven is the heart of the instrument, containing the brine preheat coils and the test coil. Both the sample temperature at the test coil and the oven internal temperature are measured to be displayed on the PC as well as being logged. The oven is fan assisted operating from ambient to 300°C.

The PMAC oven is a standard oven unit with a stainless-steel interior, safety cut-out feature, and is controlled from the PC. Although controlled from the PC the oven will have a power source independent from the DSL.



TRANSDUCERS

Two pressure transducers are used:

- A system transducer to measure the system pressure,
- A differential transducer (measure the change in differential pressure across the test coil caused by scaling of the coil).

The Pressure Displays are all set and monitored on the PC.

DESIGN OPTIONS

1. Inline Filter

The loop can be replaced with an inline filter allowing for detection of non-adhering scales, such as lead and zinc sulphide inhibitors (reference SPE paper 100627). This option can be provided as a replacement to the coil as an either-or installation. Alternatively, it can be installed with a second differential, sequentially inline within the standard Automated DSL.

2. Elevated Temperature

The standard Automated DSL can be manufactured to operate at 5800 psi.

3. Third HPLC Pump

The third pump option is available for special test work with three "stable" waters being analysed directly for compatibility tests.

4. Refrigerated Water Bath

A standard refrigerated bath will allow for below ambient temperature testing; the bath will be manually set to the desired temperature, with actual sample temperature being measured and displayed on the PC. Complete with pre- and test coils. This is becoming a common request with the growing number of LT deep water tiebacks.

5. Higher Flow rates

Larger pump heads of 50cc are available but not recommended.

6. Support Trolley

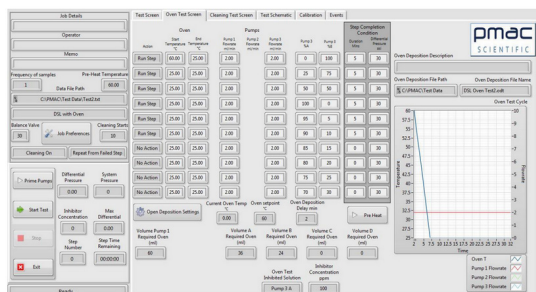
Custom fitted trolley for mounting the unit on, allowing for easy movement around a laboratory.

7. Additional or different Length Test Coils

The unit comes with a 1m test coil as standard but other lengths and additional coils can be provided.

8. Inline pH measurement device

The device is installed downstream of the test coil, which is after the system pressure regulator. Fluids passing through the sensor are depressurized and will have cooled to or near room temperature. The pH measurement range is from -2 to 16 pH, with a resolution of 0.001 pH and a measurement deviation of ± 0.02 pH. The minimal pH scale is 0.5



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