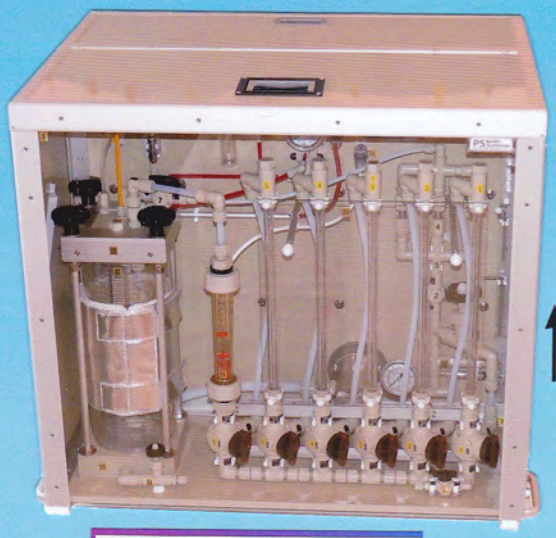
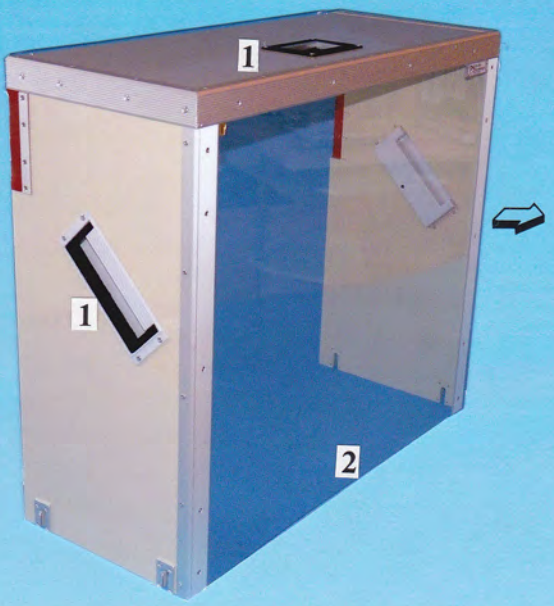
FlowLoops

A bypass flow unit system with reservoir to simulate biofouling and corrosion in the laboratory, to select materials, corrosion inhibitors and biocides, equipped with built-in temperature, flow and blanketing control facilities



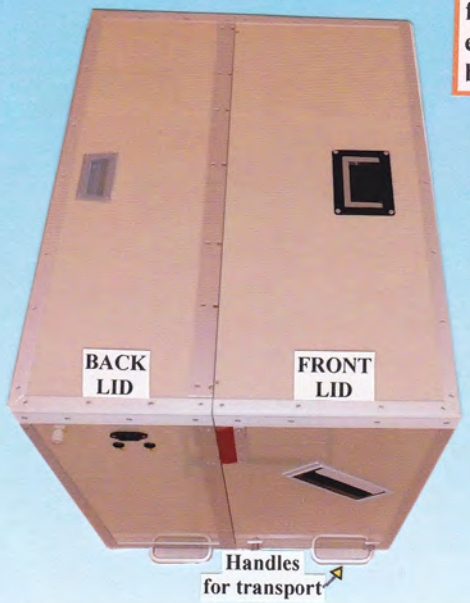
BENCH TOP CABINET
84X58X72 CM – 60 KG

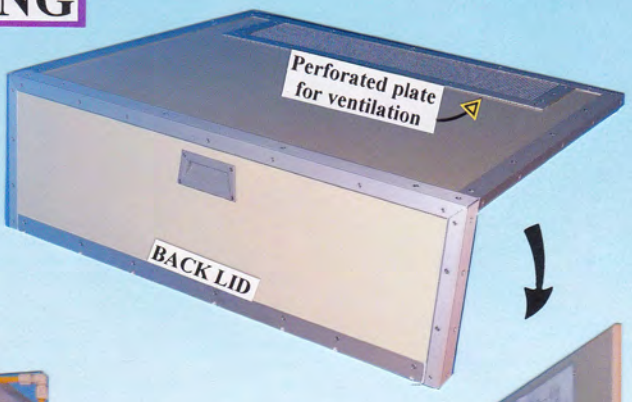
LID OFF
⇓
'everything ready to hand'

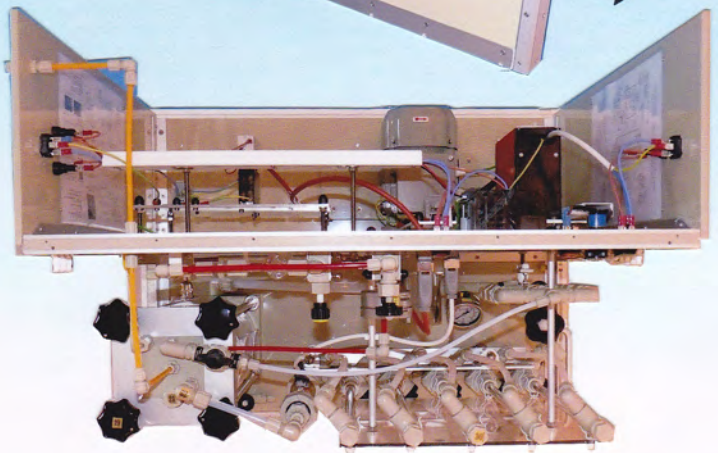


The front lid with 3 handles (1) can be easily taken off just by lifting – The front window (2) is delivered with an extra opaque plate of PP that can be easily changed by a transparent one of PC – To avoid the influence of light, biofouling should be simulated in the dark – For corrosion it is not relevant.

T-HOUSING







Such a so-called T-Housing (inverted T base), enables separation of the electrical and hydraulic circuits – The back houses the electricity: Pump motor, frequency inverter, T-controller - Flow and temperature e-circuits are totally separated. Each one has its own main circuit with independent plug.

The front side of the instrumentation houses the hydraulic circuits and the controls.

The facility is connected to the gas outlet at the top of the reservoir, opening Valve-2 (V2), it is possible to conduct normal gas sparging. By closing Valve-2 and opening Valve-1 (V1) just very slightly, the system can be pressurized, the gas bubble counter (B) enables constant pressure regulation using a minimum amount of gas. The safety valve (P) opens at 2.7 Bar (≅40 PSI), thus there is no danger of overpressure.

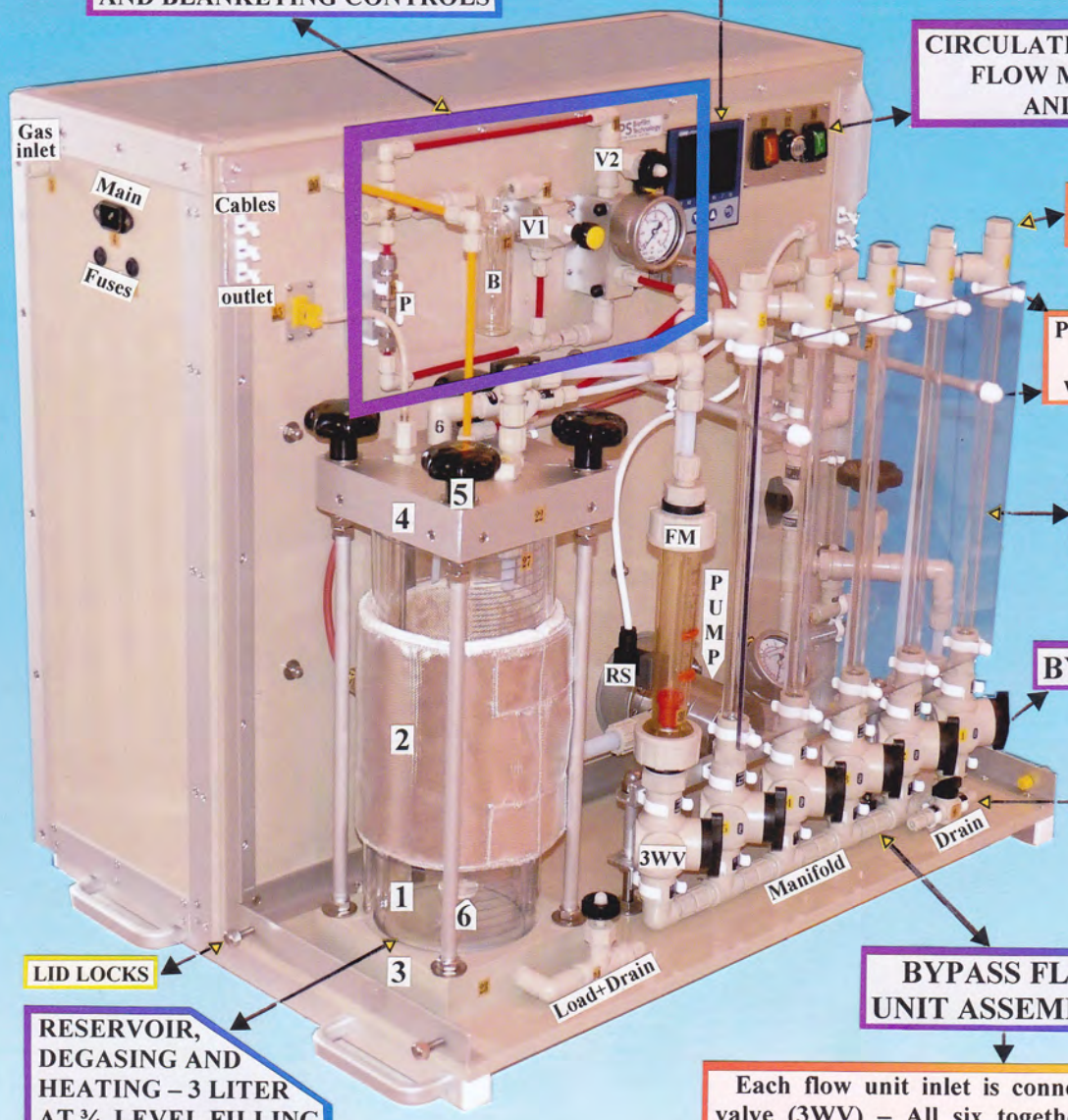
TEMPERATURE CONTROLLER WITH PROCESS AND SET VALUE DISPLAY

The continuous duty magnetically driven pump, throughput 9 L/min, enables a flow velocity at the coupon of 3 m/s ≅ 10 ft/sec – The electrical motor is driven by a frequency inverter, thus the flow velocity is perfectly and fully adjustable – The flow meter (FM), 10 L/min, with magnetic swimmer is equipped with a reed switch (RS) that stops the pump automatically, thus avoiding dry run.

GAS SPARGING AND BLANKETING CONTROLS

TEMPERATURE CONTROL

CIRCULATION – PROPULSION FLOW MEASUREMENT AND CONTROL



TOP-T – ARRAY OR PROBE FITTING

PC GLASS PROTECTION 'very easy to take off with hand-tighten screws'

FLOW UNIT ASSEMBLY-5

BYPASS FACILITY

,a quick and total drain is possible with the two drain valves'

LID LOCKS

RESERVOIR, DEGASING AND HEATING – 3 LITER AT ¾ LEVEL FILLING

BYPASS FLOW UNIT ASSEMBLY-5

Consists basically of a protected pressure glass cylinder (1) with extra thick walls, externally heated by a jacket (2) – The cylinder sits in a conical bottom block (3) of PP or PVDF – The top is closed by a block structure (4) with all corresponding connections – The two blocks seal the glass cylinder with special FPM o-rings – The pressure to seal is exercised by four tighting knobs (5) – A fritted glass candle mounted in the top block enables gas sparging (6) – The thermocouple is located at the first 1/4 level of the cylinder.

Each flow unit inlet is connected to a three way valve (3WV) – All six together are linked to the manifold – This results in following functions:

<u>FLOW UNIT ISOLATION FUNCTION</u>: Each unit can be individually isolated with the flow loop under pressure and running – It is posible to transfer coupons or change probes while the other units are running normally.

<u>FLUID EXCHANGE FUNCTION</u>: The drain valves at the bottom of the reservoir and the one in the manifold make an easy and quick drain possible – Such a function enables to use the instrumentation as biofilm generator and treatment loop at once.

Such a flowLoop can be used for a variety of applications:

BIOFILM GENERATION

The large port capacity is ideal to generate biofilm. Up to 100 biofilm coupons can be exposed to the fouling medium.

MATERIAL TESTING: Among the large variety of steels, alloys, coatings and plastics, to know which type is more resistant to biofilm development is of interest to pipe producers and designers of water systems.

The selection principle is easy, if five material types have to be tested each array is made out of a different material. A periodic transfer program with complete microbial assesssment and solids accumulation measurements will determine which material is best under strictly similar conditions.

BIOFILM TREATMENT

In the early days to treat the biofilm in the same generator loop seemed to be out of question – An additional treatment loop was recommended. The new ones equipped with:

-BYPASS FACILITY
-FLUID EXCHANGE FUNCTION
-FLOW UNIT ISOLATION FUNCTION

make possible to perform all tests in the same loop.

DYNAMIC TIME-KILL TEST ON BIOFOULED SURFACES: After development of a mature biofilm in the generation loop, the procedure is as follows:

- Isolation of all flow units.
- Total drain (10 min).
- Loading with treated fluid with biocide (10 min).
- Gas sparging under flow (5 min).
- Start treating flow unit-1 while the rest of the units remain isolated.

Now it is just the matter to run a conventional time-kill test. That is, periodic transfers of biofilm coupons, followed by assessment of the sessile bacterial population and solids accumulation if required.

After having treated flow unit-1, start previous procedure with flow unit-2 with biocide-2 . Repeat same procedure for the rest of units with the other biocides to select.

The best product is the one that reduces the bacterial population to a minimum within the shortest exposure time.

ITEM#805

COMBINATION FLOWLOOP

BYPASS BIOFILM, CORROSION AND TREATMENT LOOP WITH SAND PACK ASSEMBLY-3, PP/PTFE, 65°C, 2.7 BAR (≦40 PSI), 3 LITER, 9 L/MIN (3 M/S ≅ 10 FT/SEC), 5 FLOW UNITS, WITHOUT SENSORS, 110 or 220 V

SIMULATION OF A PERIODIC SLUG TREATMENT PROGRAM: Each unit is treated similarly as above described. After treatment, the array is left in the standby packing tube with sparged medium – Then, they are cultured all together again to start regrowth – It is a kill-regrowth study – Continuous injection can also be simulated with treated growth medium.

CORROSION MEASUREMENTS

By changing the biofilm arrays by gravimetric corrosion arrays and electrochemical probes, the loop converts itself in a corrosion resistant water circulation system to test materials and corrosion inhibitors with gravimetric and several electrochemical techniques simultaneously. The most relevant characteristics to be mentioned are:

- Perfectly adjustable flow velocity up to 10 ft/sec.
- Controllable gas sparging and blanketing up to 50 PSI.
- Adjustable temperature up to 90°C with PVDF/PFA loops.
- The five flow units make possible to use simultaneously gravimetry, linear polarization, potentiodynamics, AC impedance and electrical resistance, thus serious research programmes can be undertaken.
- Film persistence can be measured at the same loop.
- A layer of oil can be added to the corrosive medium, thus the positive or negative influence to corrosion inhibitor effectivenes can be studied.
- The combination of glass, PVDF, PFA and fluor rubber sealing elements make the instrumentation very resistant to highly corrosive environments.

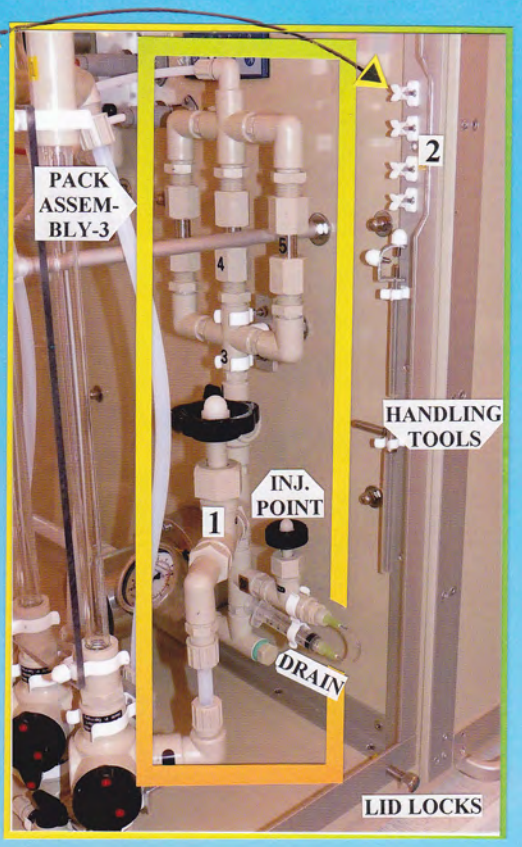
ELECTROCHEMICAL CABLES WAY OUT CLAMP – 2

MICROBIAL GROWTH IN POROUS MEDIA

The combination FlowLoop presented herewith enables simulation of microbial growth in porous media – The Sand Pack Assembly-3 is bypassed in the main stream – Valve-1 (1) generates a back pressure that squeezes the fluid through the assembly-3, reinjecting the fluid to the reservoir top – The sand pack bypass can be fully isolated by inlet and outled valves – Each run enables to gather the results of a blank or one product by triple measurement.

The assessment of the microbial population in a porous media pack as well as the significance of results is described in Page 36.

The assembly is ideal to select products to prevent wellbore plugging due to microbial growth. The products or treatment selected will be the one which decreases the bacterial population to a minimum.

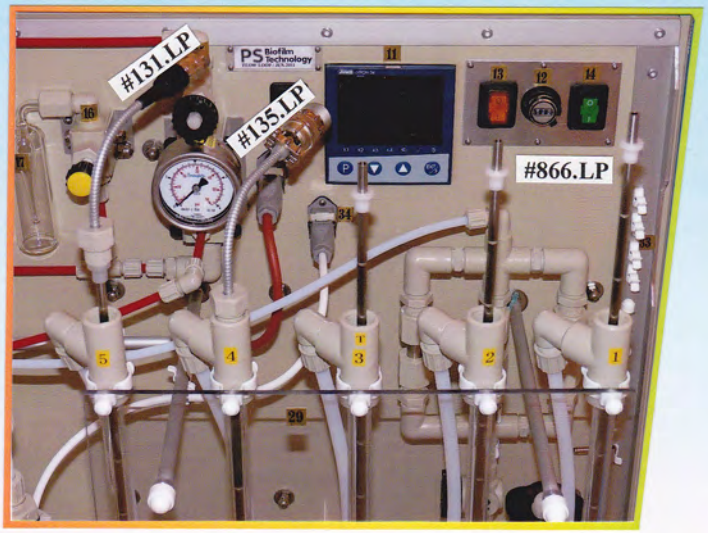


INJECTION POINT: Aseptic inoculation of cultures or chemical injection – Dead volume 1 ml – With luer-lock connection and capillary injection in the middle of the stream.

INDEX CODE: Each part is labeled with a number - In the users guide all comments and instructions are related to the numeration code.

ARRAYS AND PROBES FOR FLOWLOOPS

ITEM#551.LP – BIOFILM ARRAY 18 CS COUPONS 2 CM²
ITEM#552.LP – BIOFILM ARRAY 20 CS COUPONS 2 CM²
ITEM#866.LP – GRAVIMETRIC CORROSION ARRAY 6 CS COUPONS 8 CM² - SPACER 1.5 CM
ITEM#867.LP – GRAV. CORR. ARRAY 5 CS COUPONS 8 CM² - SPACER 5 MM
ITEM#131.LP – LPR PENCELL PROBE 3 CS ELEMENTS 8 CM²
ITEM#135.LP – ER PENCELL PROBE 2 CS EL. 12 CM² - REF. ECTFE COATED
(see details in Pages 31+32+33)



ITEM# 551.LP | ITEM# 866.LP | ITEM# 131.LP | ITEM# 135.LP