Test Loops

Corrosion tests should be performed in a valid and reproducible environment. Cormet's recirculation loops provide reliable and well designed instruments to control your test environment.

Benefits

Recirculation loops provide several benefits:

- Recirculating water flow maintains the test environment around the specimen
- Dissolved corrosion products do not affect the chemistry of the test environment because of the large water volume
- Test water can be purified in an ion exchanger, UV lamp cell and active carbon filter
- The dissolved gas concentration can be maintained in the storage tank
- Water chemistry can be monitored and controlled on-line

Applications

Recirculation loops are used in laboratories to provide an environment that is similar to a plant environment (water, steam, supercritical fluid). There is a large variety of operation parameters that could be simulated, but the most important ones are temperature, pressure, water chemistry, dissolved gases and flow rate. There is no standard loop design available, as the loops are designed to provide the required operating parameters.

Test loops simulating operation of a power plant provide clean water with well-defined dissolved oxygen or hydrogen concentrations. Special attention is paid to monitoring both incoming and outgoing water flows and the removal of contaminants from water.

High temperature and pressure are characteristic for loops operating in supercritical water environments (SCW). Special attention must be paid to the controlled heating and cooling of water and components. Water purification is also important, because the corrosive environment can cause high concentrations of dissolved species in water leaving the test chamber.

Steam loop operation focuses on the water purity and humidity of steam. Cormet has built steam loops for high-temperature high-pressure environments and also for sub-atmospheric pressure environments.

Loops simulating oil & gas industry applications are designed to resist corrosive hydrogen sulphide (H_2S) and carbon dioxide (CO_2) gases. They are built from corrosion-resistant materials, such as Hastelloy and certain polymers. Recirculation loops provide a large water volume, which stabilises the water chemistry during long test periods. The loops also provide the environment containing corrosive H_2S and CO_2 that is required in the tests described in the NACE standard TM0198-2011: Test levels IV-VII.

Typical medium-size Cormet Test Loop

Recirculation loop design and components

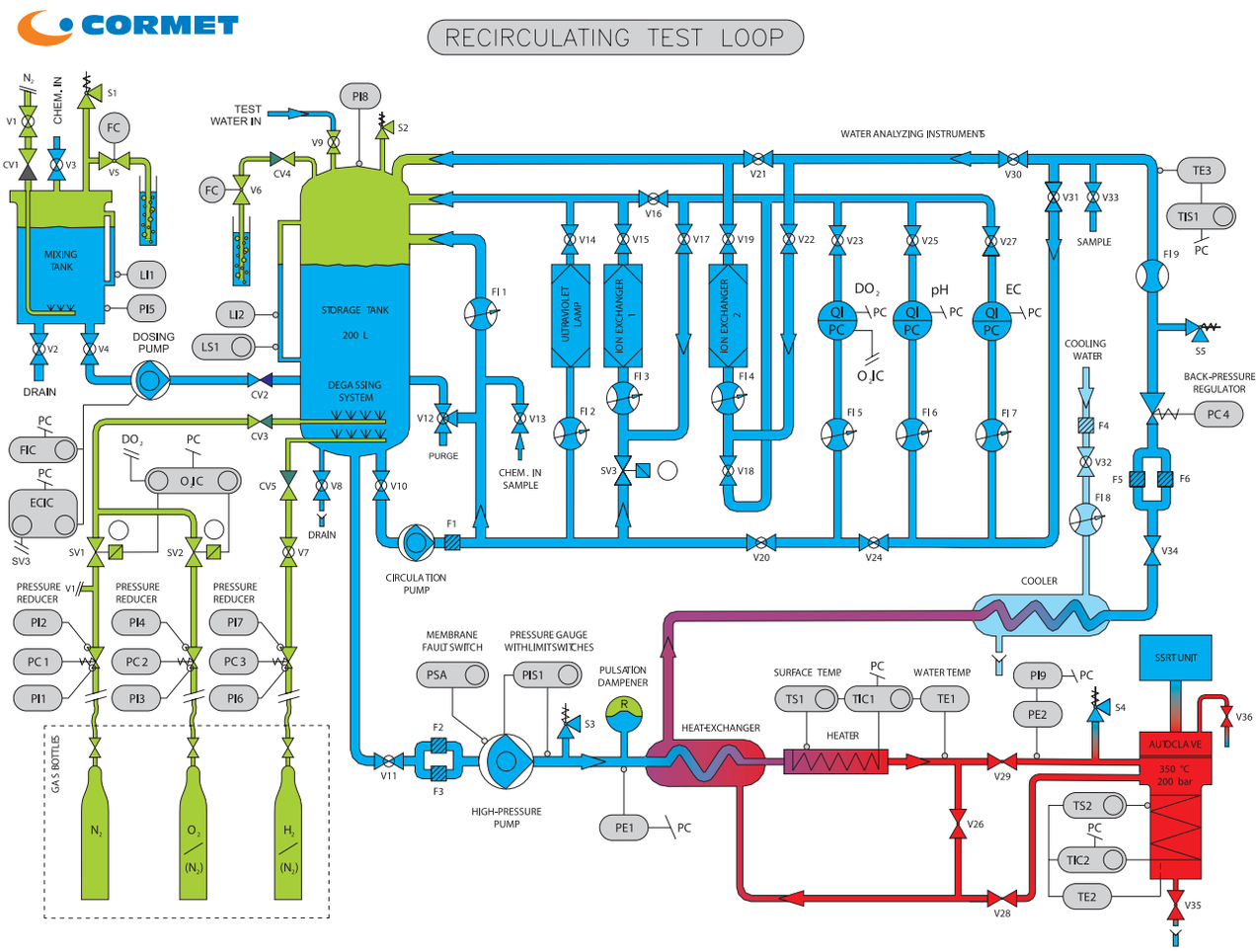
A loop design can be divided into two major parts: low-pressure and high-pressure parts. The low-pressure part includes a storage tank in which the water required is produced and stored. In most cases, the dissolved oxygen is removed from water by bubbling nitrogen through it in the storage tank. The storage tank can be pressurized with gas(es) if certain dissolved gas (e.g. oxygen, hydrogen, hydrogen sulphide and carbon dioxide) concentrations are needed.

A separate mixing pump circulates storage-tank water through an analyzing sensor group (e.g. pH, conductivity, dissolved oxygen, dissolved hydrogen). Cooled water returning from the external test chamber flows through a filter to a back-pressure regulator and then onto the water-chemistry sensor group. Water can be purified using large mixed-bed ion-exchanger units, UV cells and active carbon filters. Ion exchangers can be used to feed chemicals into the flow too.

The high-pressure part is pressurized using a diaphragm pump and a back-pressure regulator valve. The pre-heater, heat exchanger and cooler maintain the required temperature in the high-pressure section of the loop.

Automatic data acquisition of data produced by sensors and computerized control of instruments is an essential part of a loop. The data acquisition of various sensors and control of the preheater and gas-feeding system are performed using a PC and Cormet's Windows 7-based applications. You can control the whole loop from our software. Look for -\PC tags from our sample flow diagram below to see what, for example, can be controlled from our software.

Example flow diagram of our test loop



Safety features are given special attention, because typical loops often operate under high pressure and temperature. The purpose of the safety features is to protect the operators and also to prevent the instrument from damaging itself in case of an abnormal incident. All the hot parts are insulated, pressure vessels and tubing are equipped with safety valves or rupture discs, heating devices are protected against overheating, and possible leakages will stop the loop operation.

Parameters

Instrumentation and many design and operational parameters can be set according to the customer's requirements.

Typical loop features, parameters and parameter ranges

Parameter / feature	Range
Temperature	0°C – 650°C, typical 350°C
Pressure	0 MPa – 100 MPa (deep sea loop), typical 20 MPa
Flow rates	0 m/s – 16 m/s (high flow-rate loops)
Volume flow	0 l/h – 50 l/h (high flow-rate loops higher)
Dissolved oxygen concentration	down to < 10 ppb
Conductivity	< 0.1 µS/cm if water reasonably clean
Construction materials	stainless steel, Hastelloy, titanium, zirconium, polymers
Possible sensors	pH, dissolved oxygen, conductivity, dissolved hydrogen, redox
Accessories	UV-lamp to kill bacteria Dosing pump to add chemicals Mass flow controllers etc.

CORMET

Cormet manufactures material- and corrosion-testing instruments for the laboratory and field environments. We specialise in high-temperature high-pressure applications. Cormet delivers instruments to university and industrial laboratories including the power-generation, chemical, transportation and oil & gas industries. Nearly all the products are tailored according to customers' needs.

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