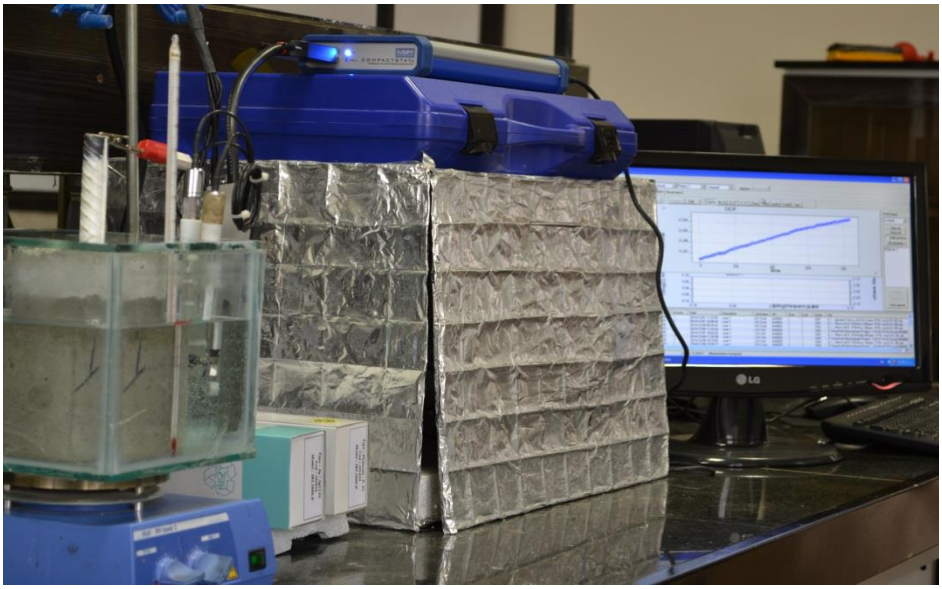
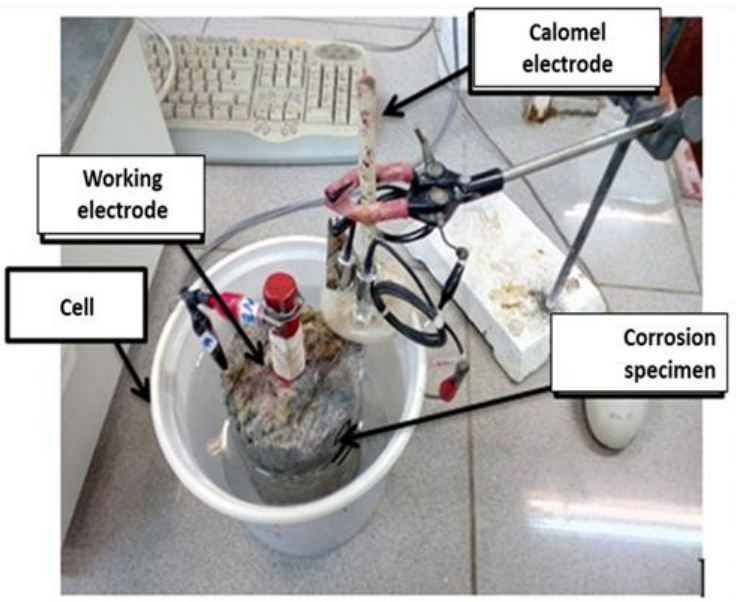
Corrosion Testing

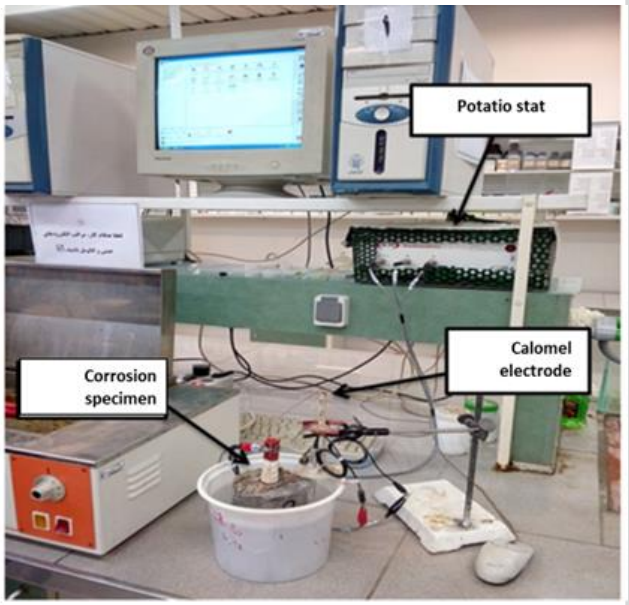
Name: Potentiostat



Remarks:

A potentiostat is the electronic hardware required to control a three electrode cell and run most electro analytical experiments. A Bipotentiostat and polypotentiostat are potentiostats capable of controlling two working electrodes and more than two working electrodes, respectively. he system functions by maintaining the potential of the working electrode at a constant level with respect to the reference electrode by adjusting the current at an auxiliary electrode. It consists of an electric circuit which is usually described in terms of simple op amps.





Some typical applications:

- ✓ ***Potentiostatic control of the working electrode***

After connecting the cell according to the rules given above, some checks should be done: Check the control voltage (and its sign) before switching to the potentiostatic mode. Some potentiostats have the possibility for such checks, operating on an internal dummy load. If your potentiostat has not, use the lowest current range when switching on: that keeps the current low and avoids destruction of your electrodes when wiring errors have occurred or a too high control voltage is applied.

- ✓ ***Recording current - potential curves***

Different methods are used to record current - potential curves. The standard method is the continuous or perhaps the stepwise variation of the potential from a start value to an end value. The start value can be the rest potential, or (usually) a cathodic potential where the working electrode does not dissolve. Whether smooth voltage ramps or steps are used for potential variation depends on the purpose. Stepwise variation of the potential may give additional information if e.g. pitting corrosion tests are performed, as the current decay within each single potential step helps to find the most negative pitting potential. In other cases, continuous potential variation is more desired, because the data processing is easier.

- ✓ ***Measurement of the Polarization Resistance***

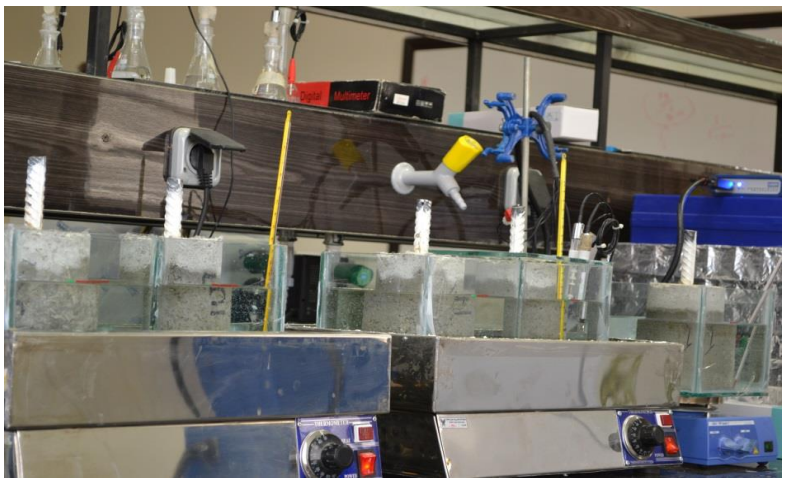
The measurement of the polarization resistance requires the polarization within a few millivolts in the vicinity of the rest potential. It is convenient to use galvanostatic polarization for this purpose, because the rest potential establishes as soon as no current is applied. On the other hand, varying electrode processes may cause appreciable changes in the polarization resistance, leading to undesired polarization voltages. Then, potentiostatic polarization is advantageous. Before starting the polarization, the rest potential shall be allowed to achieve a stable value. Then the working electrode is polarized a few mV from the rest potential. Doing this cyclically and checking the rest potential in intervals, continuous changes in the Rp can be measured.

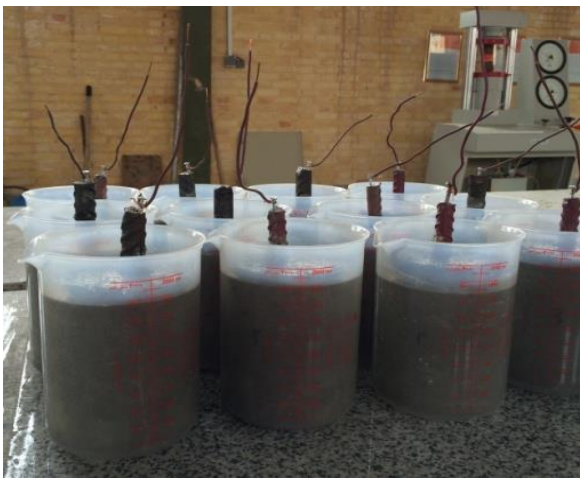
- ✓ ***Measurement of the rest potential***

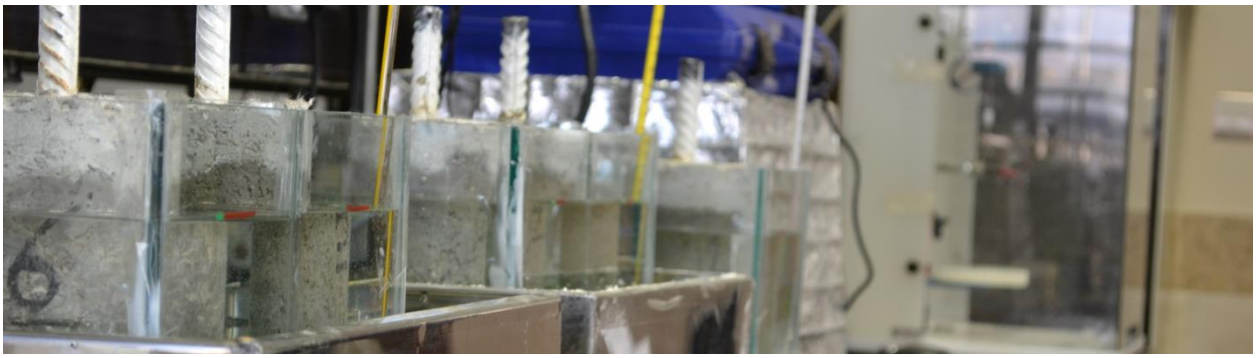
The rest potential can be obtained by feeding an equal voltage (of opposite sign) to the control input of the potentiostat. This method of compensation, cited in some books, is now obsolete. Most potentiostats have a separate operation mode for this task. As the reference electrode inputs now have extreme high input resistances, errors due to parasitic currents through the reference electrode are to be disregarded in all practical cases. On the other hand, it may be of interest to do such compensation also in the rest potential measurement mode of the potentiostat. Doing so, the current is zero when the potentiostat is switched to the potentiostatic mode and curve recording starts in the currentless state. If you want to use this method, please contact us.

- ✓ ***Galvan static Measurements***

Any potentiostat can act as galvanostat, too. To convert a potentiostat into a galvanostat, only a simple resistor is required. See chapter "Additional circuitry". However, when converting a potentiostat into a galvanostat, you loose the potential signal at the potential output. If you are interested in the actual potential, you have to use a separate potential meter. The main advantage of using the potentiostat as galvanostat is its very fast and "clean" response on pulses. Otherwise, it is much more convenient to use potentiostats which have a built - in galvanostatic mode.







Note: This test can be performed in collaboration with Iran High-Tech Laboratory Network (IHTLN)