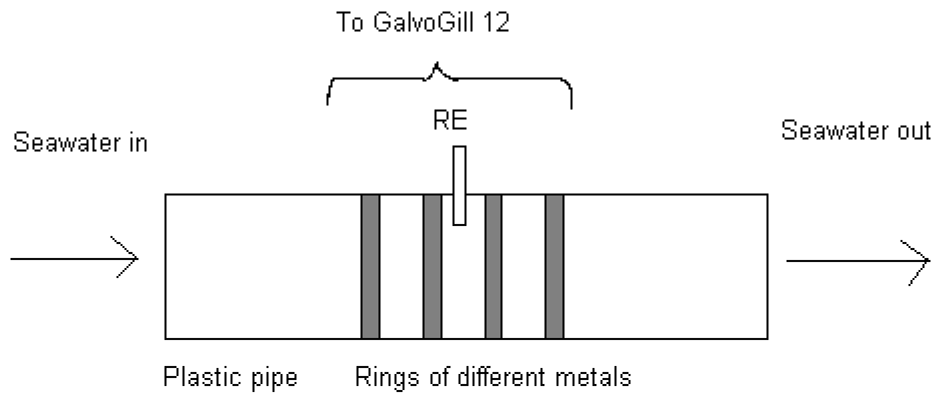
ACM Instruments

Sea Water

This electrolyte has the virtue of high conductivity making electrochemical tests a natural choice. In-situ testing has the advantage of allowing the natural bio-film to form. The Field Machine is used in this case to monitor galvanic currents Tafel slopes LPR and AC Impedance. In the laboratory the same tests are undertaken with the Gill range possibly using man-made sea water. Laboratory testing is usually short term with the advantage that specific environmental conditions can be controlled. The disadvantage of laboratory testing is that the actual service environment and conditions are not being evaluated. The special case of coated samples in sea water relies on testing with AC impedance to overcome the paint resistance and 'look through' to the metal surface. Galvanic coupling in seawater systems can be a problem the use of multiple electrode tests can help diagnose this. As an example consider the test rig below connected to a GalvoGill 12 for testing torpedo parts in seawater.



The effect of temperature in real seawater is not as straightforward as with industrial electrolytes. As a general rule the corrosion rate in seawater increases as the temperature is increased. This rule holds true when only the effect of temperature on the corrosion rate is considered. However other variables such as oxygen concentration and biological activity must be accounted for. The solubility of oxygen decreases as temperature is increased. Biological activity generally increases with increasing temperature and calcareous deposits and other protective scales are also more likely to form/deposit on metal surfaces at higher temperatures. The preferred environment for laboratory testing is natural seawater but synthetic seawater is often used. Natural seawater is fresh water piped straight to the laboratory once it is removed from it's natural environment and stored in bowsers the composition changes and this can have a large impact on the resultant metal corrosion rate. Synthetic seawater solutions that are typically used include 3.5 wt.% sodium chloride and ASTM D 1141 substitute ocean water mix. The results from this synthetic seawater may not be the same as for real fresh seawater. One advantage of using the easily made up 3.5% NaCl is that calcareous deposits will not form under cathodic polarisation conditions in the solution. Although seawater has high electrical conductivity there are cases when the IR drop should be considered. In systems with large current flow such as testing sacrificial anode material the I component could be of the order of Amps. Even with an R component of say 100 mOhm this would lead to a drop of 100s of mV between RE and WE. This may be minimised by good cell geometry and compensated for by using IR compensation after measuring the drop with AC Impedance.