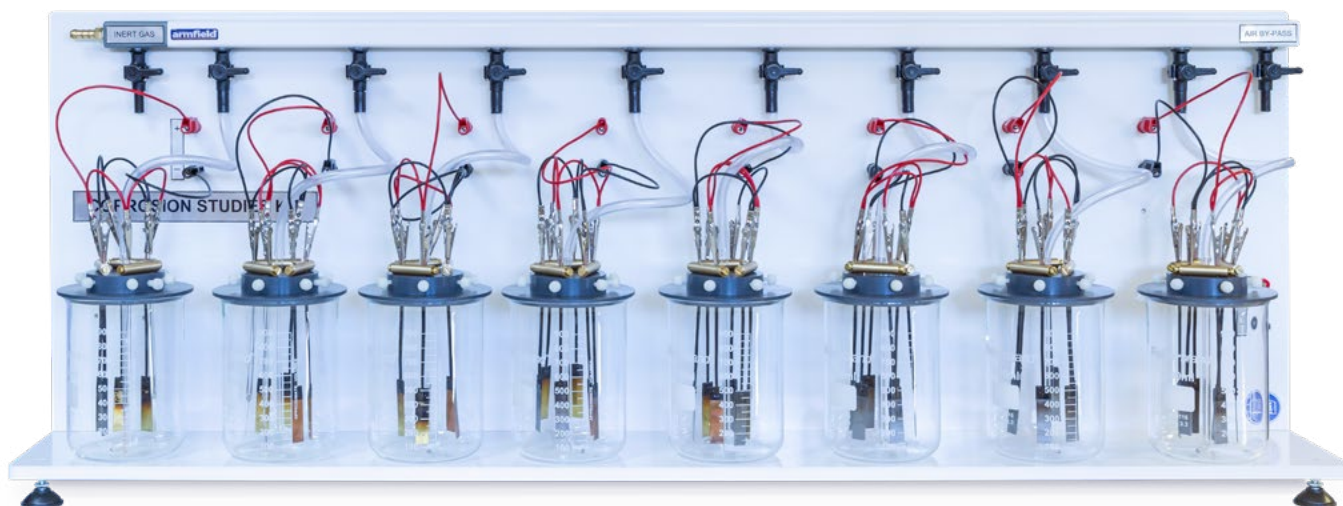


Corrosion represents a significant factor in determining durability and safety of industrial processes. Student engineers need to fully understand the effects of corrosion and how these can be anticipated and prevented.

The Armfield Corrosion Studies Kit is designed to provide an introduction to this topic and allows students to recognise potentially corrosive situations and develop information to permit the selection of adequate materials.

SIMULTANEOUS STUDY OF UP TO EIGHT CORROSION CELLS**Experimental content**

- ▶ The influence of pH on corrosion - To examine the effect of pH on the rate of corrosion of steel.
- ▶ Effect of dissolved oxygen concentration - To examine the effect of brine (sodium chloride solution) with or without the presence of oxygen, on the corrosion of steel.
- ▶ Galvanic action - To demonstrate the effect of electrically connecting together two dissimilar metals in a solution to form an electro-chemical cell.
- ▶ Electrolytic corrosion - To show that stray voltages between metals in a corrosive environment can greatly affect the rates of corrosion.
- ▶ Cathodic protection by impressed voltage - To demonstrate that the setting up of a 'corrosion cell' with dissimilar metals in contact may be opposed by applying a voltage from an external power supply.
- ▶ Corrosion Inhibition - To show that the corrosion of steel may be reduced by the use of certain chemicals (inhibitors).
- ▶ Stress Corrosion - To examine the effect of internal stress on the corrosion rate of steel.
- ▶ Prevention of scaling

Description

The Armfield corrosion studies kit uses a number of simple items of equipment in a series of tests, designed to demonstrate to the student how potentially corrosive situations may be recognised and avoided. Although the experiments refer principally to steel water systems, the apparatus may be used as a test bench for other chemical systems.

The equipment allows for the simultaneous study of up to eight corrosion cells of whatever type is selected according to the teaching syllabus being followed. Each test cell allows for the immersion of three similar test specimens in the test liquid at any one time, to eliminate 'rogue' results from atypical metal samples. Each sample is mounted in a manner that minimises secondary effects and the metal surface of known area is exposed to the test liquid.

Corrosion rates are measured both by visual observation and direct weighing after a known period of immersion. Stirring is by air or inert gas agitation.

All connecting glass and plastic tubing is provided, as are the appropriate supports for the specimens and glass test cells. A digital pH meter and microsensor is supplied to ensure the correct strength of initial test solutions. For the study of electrochemical corrosion effects, a low-voltage supply is included together with all necessary electrical connections. Initial buffer powders of pH 4, 7 and 9 are supplied.

The apparatus requires approximately 2m² of laboratory bench space for experimentation by two students. A full instruction manual is provided explaining how each corrosion cell situation is set up and the results assessed.

Typical experiments

The influence of pH on corrosion

Iron and steel corrode in acid environments but much less so in alkaline situations. Students carry out corrosion tests at values of pH 4, 7 and 9. The results are explained with reference to the electrode potential series.

Stress corrosion

Metal samples are stressed in a variety of simple ways, including bending, scratching, filing or drilling. The alteration of the metal crystal structure may explain the observed results.

Brine and oxygen environments

Oxygen may be artificially removed from water by nitrogen purging. Comparison of corrosion rates of metal samples in oxygenated and deoxygenated water may be related to localised ionic corrosion cells. The effects of sodium chloride solutions on the cells may also be deduced.

Galvanic action

Dissimilar metal pairs of steel/copper, and steel/zinc, are connected to form an electric circuit. The subsequent corrosion may be explained by reference to the electrode potential series.

Cathodic protection by impressed voltage

If platinum and steel are electrically connected, steel becomes the anode and corrodes in water. An external voltage may be applied to reverse the effect, thus protecting the steel.

Electrolytic corrosion

This demonstration shows that stray voltages between connected, dissimilar metals can greatly affect the corrosion rates. The low-voltage DC supply is connected to various combinations of steel samples with platinum, zinc or copper samples.

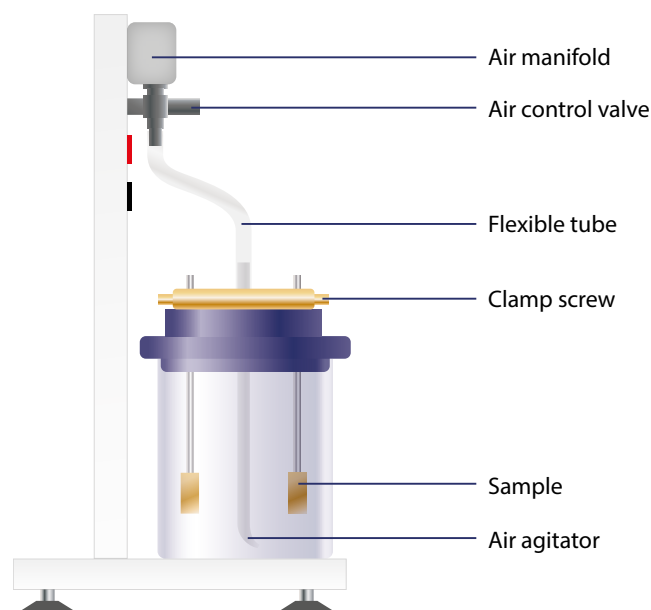
Corrosion inhibition

The passivating influence of certain phosphates and silicates in solution on corrosion rates of steel may be demonstrated.

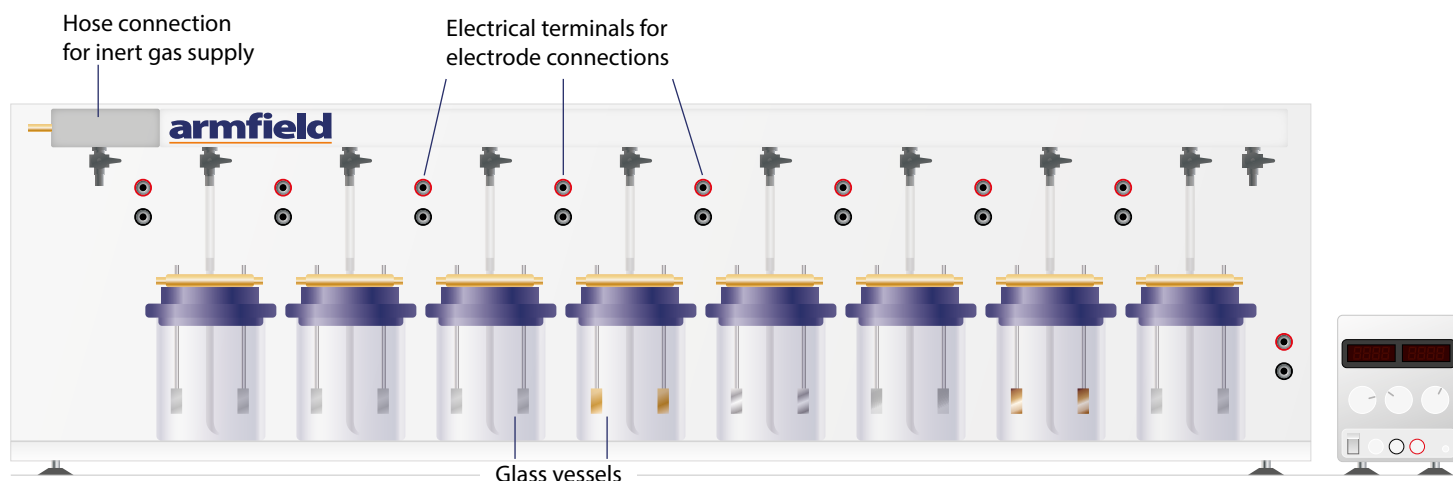
Water treatment projects

The following demonstrations may be conducted with the apparatus:

- ▶ Calcium carbonate stabilisation
- ▶ Oxidation of iron and manganese in ground waters
- ▶ Disinfection of waste water with chlorine solutions
- ▶ Water softening by chemical precipitation



Side view of equipment



Front view of equipment

Requirements	Scale
	
Electrical supply: CEQ-A: 220-240V / 1ph / 50Hz / 12A CEQ-B: 120V / 1ph / 60Hz / 14A CEQ-G: 220-240V / 1ph / 60Hz / 12A	
Consumables 17g Potassium iodine 10 ml Hydrochloric acid 60g Sodium chloride 8 litres De-ionised water	

Essential accessories
To be supplied by user: ▶ Electronic top-loading balance ▶ Cartridge de-ioniser ▶ Oven ▶ Laboratory glassware ▶ Inert gas cylinder eg nitrogen Smallest available size (pressure regulator needed)

Technical specifications	
Power supply unit:	
Outputs:	0-15V at 2A
	0-30V at 1A
Air pump:	Diaphragm type
Air flow rate:	6 l/min
Max head:	0.8 kg/cm ²
Max power of motor:	0.05kW
Digital pH microsensor and pH meter:	
Range of pH meter:	0-14pH
Resolution:	0.01pH
Accuracy:	±0.01pH
Dimensions:	195 x 29 x 15mm
Beaker (x8):	Borosilicate glass (Pyrex)
Capacity:	1,000ml
Electrodes:	Platinum
Test piece samples:	Zinc, mild steel, copper, brass

Overall dimensions	
Length	1.19m
Width	0.28m
Height	0.43m
Packed and crated shipping specifications	
Volume	0.5m ³
Gross weight	80Kg

Ordering specification
▶ The corrosion studies kit enables simultaneous study of up to eight corrosion cells each containing three test specimens ▶ Sample mounting in a manner to minimise secondary effects ▶ Corrosion rates measured visually and by weighing ▶ Stirring by air or inert gas ▶ A service panel ▶ Air pump ▶ Eight test cells of glass construction, with specially machined lids enabling samples to be mounted ▶ Test cell supports ▶ Digital pH meter ▶ Specimen pieces of steel, zinc, brass and copper ▶ Platinum electrodes ▶ Low-voltage supply ▶ Associated glassware, tubing and wiring



Related products
▶ CEK MkII - Fluid mixing studies ▶ CEL MkII - Fixed and fluidised bed apparatus ▶ CEN MkII - Solids handling study bench ▶ CEQ - Corrosion studieskit ▶ CERa MkII - Gaseous diffusion coefficient apparatus ▶ CERb - Liquid diffusion coefficient apparatus ▶ CES - Wetted wall gas absorption column ▶ CEU - Catalytic reactors ▶ CEXC - Computer controlled chemical reactor teaching equipment + 5 reactor types ▶ CEP MkII - Stirred tank reactors in series

Ordering codes
▶ CEQ-A ▶ CEQ-B ▶ CEQ-G

Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.



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