

BATHOPHENANTHROLINE INDICATOR PAPER FOR IRON(II) IONS

General The non-bleeding indicator paper for iron(II) ions has been developed as a simple and rapid test method to detect iron(II) ions. "Free", unbound, water soluble iron(II) ions are harmful to organic substrates like cellulose or collagen since they catalyse their oxidative degradation, causing discolouration and mechanical decay. Iron(II) ions originate from the dissociation of water-soluble ferrous compounds, as well as from the reduction of iron(III) ions.

The test can, for instance, be applied on paper or textile artefacts in order to verify if inks, stains, foxing spots or tidelines contain "free" iron(II) ions. Furthermore, it can be applied to evaluate the effect of a treatment aiming the removal or immobilisation of iron(II) ions. Contrary to commercially available iron(II) indicator papers, which bleed, this iron(II) test has the distinctive feature that it can be used in direct contact with originals.

Principle Iron(II) ions are water-soluble and will migrate into a humid test strip that is brought into contact with the surface of an artifact. The test paper contains the indicator bathophenanthroline which is specific for iron(II) ions and forms an intensely magenta-coloured complex with them (direct iron(II) test). In case of an unclear reading or in the absence of iron(II) ions, it is useful to apply a reducing agent to the test strip, e.g. a drop of a 1 % w/w aqueous solution of L(+)-ascorbic acid (99% p.a., Acros). This compound reduces potentially migrated iron(III) ions to iron(II) ions, which react with the indicator and form the magenta colored complex (indirect iron(II) test). The water-solubility of the indicator and the complex is very low, therefore the risk of bleeding during the contact is minimal.

Interpretation If the indicator paper turns magenta, iron(II) ions are present in the tested area. The intensity of the magenta colour formed on the indicator paper depends on several factors such as the concentration of iron(II) ions in the tested area, the amount of water applied, the contact time and the contact pressure. Under non-standardised circumstances, a contact test can't be used as a quantitative test. A negative result does not mean that no iron is present, but that no iron(II) or iron(III) ions migrated into the test strip.

Caution / Interference

- only use stainless steel tools / equipment and avoid any contact with iron and rust
- do not touch the test strips with bare fingers
- interference of the reading is expected from water soluble, coloured substances like paper or ink degradation products or ink additives (e.g. logwood) which could migrate to the indicator paper and disturb the observation of the magenta colour. Using distilled water, they can be washed away.

Availability The test is commercially available from Preservation Equipment Ltd., Vinces Road, Diss, Norfolk IP22 4HQ, U.K., Tel +44.1379.6474 00, Fax +44.1379.6505 82
www.preservationequipment.com, Product Code: 539-3000, £ 16,85 (Pack, 100 pieces)

Further reading Neevel Johan G. and Reissland Birgit

Bathophenanthroline Indicator Paper - Development of A New Test for Iron Ions, in: PapierRestaurierung, Mitteilungen der IADA, Vol 6, No. 1 (2005): 28-36.

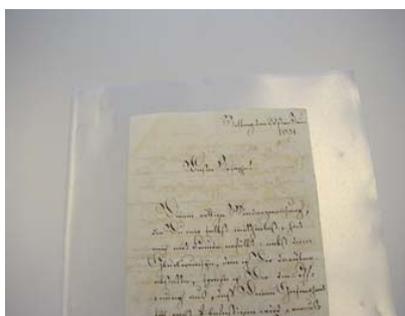
TESTING FOR IRON(II) IONS USING BATHOPHENANTHROLINE INDICATOR PAPER

Chemicals

- Distilled or demineralised water
- L(+)-ascorbic acid (99% p.a., Acros)

Materials and equipment:

- Iron(II) indicator paper
- pair of scissors (stainless steel),
- tweezers (stainless steel or plastic),
- inert plastic foil (Mylar, Melinex)
- blotting paper (filter paper, ash free)
- pipette
- timer



Place the object on an inert, clean support like glass or plastic.



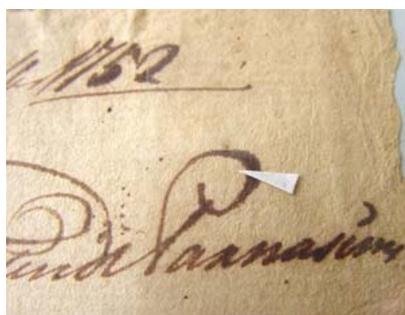
Cut a test strip as small as possible, preferably a triangle.



Dip the indicator paper in distilled water – use tweezers.



Remove the excess water by blotting - the indicator paper must be damp, not wet → risk of water stain formation on the original is reduced.



Place the indicator paper on the ink – pay attention that one part covers the testing zone, while the other part covers the blank paper.



Cover it with a piece of inert plastic foil.



Press the indicator paper on the support for 30 s - use a weight or fingers, low pressure → during this period, soluble products (e.g. Fe(II) ions) migrate into the test paper.

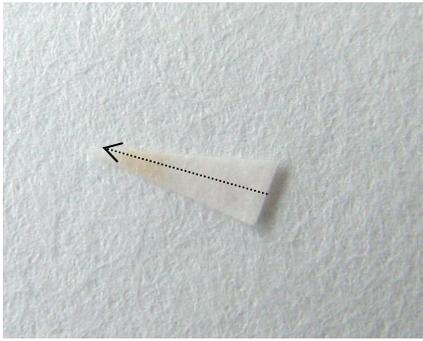


Remove the indicator paper from the object and place it on a white support (filter paper).



During drying, the colour change will intensify and be complete after 2-5 min. A magenta coloured complex is formed if iron(II) ions are present.

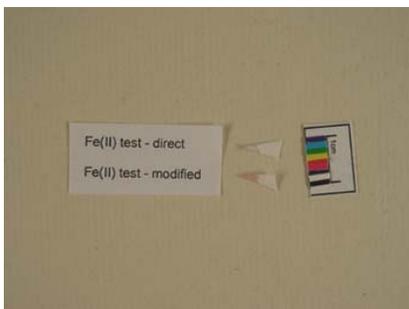
MODIFIED IRON(II) TEST



Cut the test strip in the middle, keep one part and carry out the indirect iron(II) test on the other half.

Add a drop of Ascorbic acid (1% w/w aqueous solution) → present iron(III) ions are reduced to iron(II) ions.

Place the indicator paper on a white support (filter paper). Present iron(II) ions react with the indicator.



Compare with the direct iron(II) test
Above: Direct Fe(II) test: negative
Below: Modified Fe(II) test: positive



No residues are left on the original.



Take care !
This test strip has been too wet and caused a water-stain.

TESTING FOR IRON(II) IONS USING BATHOPHENANTHROLINE INDICATOR PAPER DURING TREATMENT

In order to assess, if a treatment sufficiently removed present iron(II) ions, the object is tested during the treatment.

Materials and equipment:

- Iron(II) indicator paper
- pair of scissors (stainless steel),
- tweezers (stainless steel or plastic),
- blotting paper (filter paper, ash free)



Caution: Do NOT carry out an indirect iron(II) test by applying ascorbic acid on indicator paper that has been in contact with ca-phytate treated objects. The Fe-phytate complex will be destroyed, iron(II) ions come free and the reading is incorrect.



Test the object during treatment



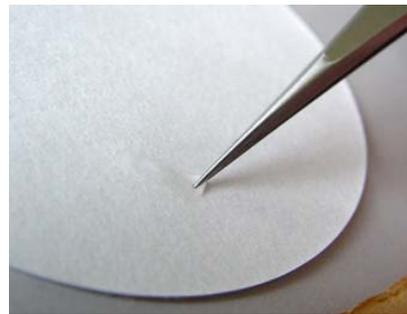
Cut a test strip as small as possible, preferably a triangle.



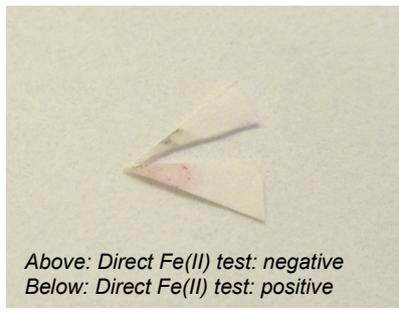
Lift the object a bit above the treatment solution.



Apply the DRY indicator paper directly on the ink, let it absorb some liquid



Remove the indicator paper from the object and place it on a white support (filter paper).



Above: Direct Fe(II) test: negative
Below: Direct Fe(II) test: positive

Observe the colour change. During drying, the colour change will intensify and be complete after 2-5 min.