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Project Title	Iron Rust Reformer
Categories	Biology & Chemistry
Project number	JBBC249

Abstract

Iron nails treated with either oxalic acid or tannic acid displayed the best result with the least light absorbance, which had the lowest degree of rusting. While the iron nails treated with other acids (tartaric acid, malic acid or citric acid) demonstrated poor protection against iron rusting. It was believed that such protection against iron rusting was contributed by the formation of firmly attached impermeable protective layer on the iron nail. Such protective layer should be in polymeric structure with extensive coverage on the iron nail surface.

Iron rust on the surface reacts with tannic acid or oxalic acid to form iron(II, III) tannate or oxalate, which extensively cover the iron nail surface. Such layer protects iron nails from rusting by preventing iron nail from exposure of air and water. With reference to the chemical structure of oxalic acid, the oxalate anions ($C_2O_4^{2-}$) exhibited as bidentate chelating Fe^{2+} or Fe^{3+} from iron rust in trans-coordination alignment, leaving two vacant sites on the axial position, which may be occupied by other small molecules, such as water. Strong chelating effect by oxalate anions built up the network structure covering the iron nail surface, and hence provided the anti-rusting effect.

To conclude, destructive iron rust successfully converts to protective layer by treating with oxalic acid and tannic acid. Such protective layer is chemically attached on iron article and serves as the permanent barrier to prevent iron article exposing to water and air. The rough protective layer can also be dyed to give attractive colors for decorative purpose. Using oxalic acid and tannic acid as the raw materials for converting destructive iron rust to constructive protective layer opens up the possibility of development of green and effective method on solving iron corrosion.