MnCl₂ and MgCl₂ for The Removal of Reactive Dye Levafix Brilliant Blue EBRA from Synthetic Textile Wastewaters: An Adsorption/Aggregation Mechanism

A.Z. Bouyakoub, B.S. Lartiges, R. Ouhib, A.G. El Samrani, J. Ghanbajae, O. Barres

a) Nancy University - LEM-ENSG/INPL-CNRS, Pôle de l’Eau, 15 Avenue du Charmois, BP 40 54501 Vandoeuvre Cedex, France
b) University of DjillaliLiabes - LMSR, BP 89, 22000 Sidi Bel Abbes, Algeria
c) University of Toulouse (UPS) – Geosciences Environment Toulouse UMR 5563, 14 Av. E. Belin, F-31400 Toulouse, France
d) Lebanese University – Graduate School of Sciences & Technologies, Campus Rafic Hariri-Hadath Beyrouth, Lebanon
e) Nancy University - SCMEM-FST/UHP, 7137 boulevard des Aiguillettes, BP 239 54506 Vandoeuvre Cedex, France
zbouyakoub@yahoo.fr

Two divalent cation-based coagulants, magnesium chloride and manganese chloride, were used to treat synthetic textile wastewaters containing the azo-dye pigment Levafix Brilliant Blue EBRA. The jar-tests were performed in the presence or absence of auxiliary dyeing chemicals. They proved that (i) both divalent cation-based coagulants were effective in the treatment of those alkaline effluents, (ii) better performances in terms of color removal, residual turbidity, and settled volume, were achieved with manganese chloride, and (iii) the presence of dyeing auxiliaries significantly increases the required coagulant demand for treating the textile effluent. The dye removal mechanisms were investigated by combining observations of freeze-dried sediments with transmission electron microscopy coupled with energy-dispersive X-ray spectroscopy and selected area electron diffraction, Fourier transform infrared spectroscopy, adsorption experiments, and aggregates size measurements with a laser sizer under cyclic shear conditions. The results show that brucite (Mg(OH)₂) particles are formed when applying MgCl₂ to the textile wastewaters, whereas a mixture of feitknechtite (₋-MnOOH) and hausmannite (Mn₃O₄) is obtained when using MnCl₂. More poorly crystallized particles are formed in presence of auxiliary dyeing chemicals.

The adsorption experiments suggested that the azo-dye pigment adsorbs onto the surface of precipitating phases, whereas the aggregation dynamics indicated that a chargeneutralization mechanism underlies the formation of aggregates. The dye removal is then consistent with a precipitation/adsorption mechanism.