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Simultaneous detection of Pb(II) and Cd(II) in aqueous solutions by UV-visible spectrophotometry

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The pollution of water resources due to disposal of metals, especially heavy metals is one of the most concerned environmental issues in the current world. Therefore, detection of these heavy metal ions with rapid, sensitive and accurate analytical tools is important. In recent years, water soluble porphyrins, macrocyclic compounds have gained growing interest as colorimetric agents for heavy metal detection by UV-VIS spectrophotometry. Porphyrins are highly sensitive to metal ions and display new Soret band (~ 400 nm) as well as minor Q bands (500–700 nm) upon metal ion chelation. This property has been widely used for detecting heavy metal ions in aqueous solutions. In this work, the influence of pH, water hardness (Ca(II)) and presence of other foreign ions (Mg(II), Co(II), Al(III), Cr(III), Fe(III), Ba(II), K(I), Mn(II), Sn(II), Ni(II), Zn(II), Bi(III)) for simultaneous detection of Pb(II) and Cd(II) by a porpyrin; 5, 10, 15, 20-tetrakis (1-methyl-4-pyridinio) porphyrin tetra (*p*-toluenesulfonate); (TMPyP) under the selected experimental conditions were investigated. TMPyP displayed a characteristic Soret band in the UV-Vis spectrum at 422 nm. Upon addition of Pb(II) and Cd(II) into TMPyP, the band at 422 nm was disappeared and new Soret bands were appeared at 474 nm and 444 nm, respectively indicating that these characteristic absorption bands, attributed to corresponding Metal(II)-TMPyP complexes. The lower detection limit (LOD) for Pb(II) and Cd(II) with TMPyP was found to be 0.02 mg/L and 0.01 mg/L, respectively which are considerably below the maximum permissible levels for wastewater discharge according to WHO guidelines. The best pH range for simultaneous detection of Pb(II) and Cd(II) was found to be pH 7 to 9. The water hardness (Ca(II)) and the presence of other foreign ions also had no significant effect on the simultaneous detection of Pb(II) and Cd(II) ions in aqueous solutions. It was possible to remove TMPyP complexes as well as unbound TMPyP successfully using chitosan before discharging the analyzed solutions. The results revealed that the TMPyP can function as a single optical sensor capable of detecting Pb(II) and Cd(II) simultaneously in aqueous solutions in the pH range 7-9.

Keywords: Cd(II), Pb(II), TMPyP, UV-vis spectrophotometry