

Solvothermal synthesis and characterization of novel [Ni(II)(Tpy)(Pydc)]·2H₂O metal–organic framework as an adsorbent for the uptake of caffeine drug from aqueous solution†

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Abstract

The discharge of pharmaceuticals and personal care products effluent after industrial processes with little or without treatment is increasing at an alarming rate. Health risks associated with the discharge of pharmaceuticals and personal care products effluent into the environment cannot be over emphasized. Therefore, there is an urgent need to develop metal–organic framework (MOF) material that can be used to adsorb pharmaceuticals and personal care products before the discharge of waste water into the environment. [Ni(II)(Tpy)(Pydc)]·2H₂O MOF was synthesized from the reaction of nickel nitrate, terpyridine (Tpy) and pyridine dicarboxylate (Pydc) via solvothermal method of synthesis. The synthesized MOF was characterized with melting point determination, elemental analysis, hot stage microscope, thermogravimetric analysis, SEM and X-ray crystallography analysis. All results clearly showed the coordination of the nickel(II) ion to the two ligands. In application, [Ni(II)(Tpy)(Pydc)]·2H₂O MOF was used for the adsorption of caffeine. The result clearly showed that 98.4 mg of caffeine was adsorbed by 1 g of [Ni(II)(Tpy)(Pydc)]·2H₂O MOF at 40 °C, pH of 4 for 1 hour via multiple binding site (Freundlich isotherm). Characterization of the aqueous caffeine solution after adsorption showed a negligible amount of nickel metal when compared with the WHO nickel intake recommendation. [Ni(II)(Tpy)(Pydc)]·2H₂O MOF is a potential adsorbent that could be used for the removal of caffeine from aqueous solutions..

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