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SHORT COMMUNICATION

Heavy-metal extraction capability of chalcogenoic aminophosphines derived from 1-amino-4-methylpiperazine

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Aminophosphine of the type (Ph_2PNHR) derived from 1-amino-4-methylpiperazine and its chalcogen derivatives ($Ph_2P(X)NHR$ $X = S$, Se) were used as ligands in solvent extraction of metal picrates such as Cu^{2+}, Ni^{2+}, and Pb^{2+} from the aqueous to the organic phase. Influence of parameters such as pH of the aqueous phase, ligand concentration in the organic phase, and concentration of the extractant extracted from the aqueous to the organic phase was investigated to determine the ligands' ability to extract metal ions. Metal picrate extraction was investigated at 25 °C using UV-VIS spectrophotometry in dichloromethane in the absence and in the presence of Ph_2PNHR and chalcogenides. The extraction results revealed that the extraction percentage of Cu^{2+}, Ni^{2+}, and Pb^{2+} metals was much higher at lower pH values, indicating an acidity dependent complexation equilibrium.

Keywords: aminophosphines, chalcogenides, extraction, heavy metals

Heavy metals are toxic substances and their presence in water, above certain concentration level, can cause damage to normal biological cycles. Industrialization has resulted in an increase in the heavy metals content in water, causing a problem that has not been completely solved yet (Castro Dantas et al., 2003). It is necessary to remove and recover these highly toxic and non-biodegradable materials in order to meet environmental quality standards and promote the recycling and reuse of heavy metal resources (Ren et al., 2007). The extraction of metal cations from water is a current environmental topic because of their harmful and toxic effects. A wide variety of analytical techniques have been used for metal extraction from water (Toumi et al., 2008; Abdel-Fattah et al., 2011). Most common of these techniques are the solid phase extraction (Su et al., 2011; Abdel-Fattah & Mahmoud, 2011; Parodi et al., 2011; Wang et al., 2011; Rofouei et al., 2011), liquid–liquid extraction (Mirzaei et al., 2011; Fischer et al., 2011; Sereshti et al., 2011; Molaakbari et al., 2011), cloud point extraction (Luiz Silva et al., 2009; Surme et al., 2007; Tang et al., 2005), and electroanalytical techniques (Hunsom et al., 2005; Bojic et al., 2009).

Liquid–liquid extraction, also called solvent extraction, is a process that allows the separation of two or more components due to their unequal solubilities in two immiscible liquid phases (Lee et al., 2009). The extraction using organic solvents has been proved to be an efficient and important technique for the removal, separation, and/or preconcentration of metals from environment (Dias Rodrigues et al., 2008; Zoubi et al., 2011). This technique has been used and improved extensively over the past half century to become an economically significant branch of techniques in industry, analytical chemistry and research. From a chemical point of view, there is still a need for more effective extractants for toxic metals extraction from water and soil.

Different kinds of reagents have been used as extractants in the solvent extraction process. Among the various extractants, neutral organo-phosphorus extractants have been widely studied (Tian et al., 2011). Organo-phosphorous extractants are a good

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