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Heptadentate trensal-type ligands for lanthanides coordination and separation

The recovery of critical elements from materials and devices with high technological content is currently necessary in the perspective of the circular economy precepts. Rare earth elements (REEs, lanthanides plus scandium and yttrium) are metals with peculiar optical and magnetic properties [1]. In recent years, the demand for REEs has grown significantly. Hence, efforts have been directed into the development of environmentally friendly methods for the REEs recovery from Waste Electrical and Electronic (WWE) and End-of-Life (EOL) devices. On the other hand, the quantity of recovered lanthanides corresponds to 5% of the total industry demand. Indeed, the current chemical processes used for the REEs recovery suffers from high costs and low environmental sustainability.

In this work, we focused on the recovery and selective separation of metals contained in high performance magnets (NdFeB) used in the manufacture of electronic devices, wind turbines, rechargeable batteries and electric vehicles. These magnets usually contain Fe (65%), Nd (20%) and Dy (1%). We have investigated a series of heptadentate ligands, which form stable complexes with Nd3+ and Dy3+ and which belong to the Trensal (2,2',2''-tris(salicylideneimino)triethylamine) family [2]. The subtle differences in the chemical properties of Nd3+ and Dy3+, such as ionic radius and coordination number, together with the different steric hindrance and lipophilicity of the ligands resulted in different complexes solubility, which is relevant for their separation and recovery.

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