POTENCY OF (DOPED) RARE EARTH OXIDE PARTICLES AND THEIR CONSTITUENT METALS TO INHIBIT ALGAL GROWTH AND INDUCE DIRECT TOXIC EFFECTS

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Use of rare earth elements (REEs) has increased rapidly in recent decades due to technological advances. It has been accompanied by recurring rare earth element anomalies in water bodies, even to the extent that could induce toxicity. In this work we (i) studied the effects of eight novel doped and one non-doped rare earth oxide (REO) particles (aimed to be used in solid oxide fuel cells and gas separation membranes) on algae, the primary producers in aquatic ecosystems, (ii) quantified the individual adverse effects of the elements that constitute the REO particles and (iii) attempted to find a discernible pattern to relate REO particle physicochemical characteristics to algal growth inhibitory properties. Green algae *Raphidocelis subcapitata* (formerly *Pseudokirchneriella subcapitata*) were used as a test species in two different formats: a standard OECD201 algal growth inhibition assay and the algal viability assay (a 'spot test') that avoids nutrient removal effects. In the 24 h 'spot' test, algae were viable only at REE concentrations below 10 mg/L (minimal biocidal concentration), probably due to membrane damage or interference with calcium metabolism. 72 h EC_{50} values (algal growth inhibition assay) of REO particles ranged from 1 to 98 mg/L. The growth inhibition was at least in part due to the entrapment of algae within REO particle agglomerates. Adverse effects due to the dissolution of constituent elements from REO particles and the size or specific surface area of particles were excluded, except for La_2NiO_4. However, the structure of the particles and/or the varying effects of oxide composition might have played a role in the observed effects. As the production rates of these REO particles are negligible compared to other forms of REEs, there is presumably no acute risk for aquatic unicellular algae.

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