Nitrate reduction by Fe(II)-Fe(III) green rust : the key role of phosphate anions

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Green rust (GR) is a mixed Fe^{II}-Fe^{III} layered double hydroxides related to the mineral fougèrite found in hydromophic gleysols. The crystallographic structure consists of positively charged hydroxyde sheets containing both Fe^{II} and Fe^{III} species separated by anionic layers containing water molecules. The coexistence of an hydrated interlayer and Fe^{II} species induces a high reactivity of GR towards inorganic anions such as nitrate; the kinetics of reaction being much faster than the reduction rate observed for other Fe^{II} containing minerals [1]. The reactivity of hydroxycarbonate GR towards nitrate anions is studied as a function of the pH and Fe^{II}, NO_3^- and PO_4^{3-} concentrations in the framework of a full factorial design. The results show that phosphate anions play a key role : (i) for a ratio $[PO_4^{3-}] : [Fe^{II}]$ higher than 2 %, the reduction of nitrate is completeley inhibited, (ii) for a ratio $[PO_4^{3-}] : [Fe^{II}] <\sim 1$ %, nitrate anions are reduced and the ammonium production rate can be as low as ~ 10 %. These effects are attributed to a full or a partial saturation of the lateral surface sites of the GR hexagonal crystals, respectively [2] (Figure 1). If GR is intended to be used for a denitrification process, a dephosphatation pre-treatment should be performed.

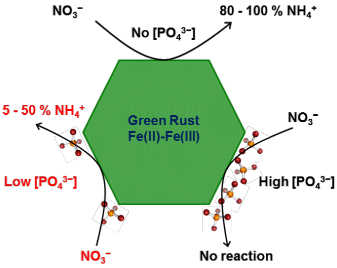

Figure 1 : Effect of the phosphate adsorption on the ammonium production rate when GR reacts with nitrate.

[1] C. J. Matocha *et al* (2012) *Adv. Agron.* **115**, 182-207 [2] F. Bocher *et al.* (2003) *Solid State Sci.* **6**, 117-124.