# Adsorption of antibiotics onto mixtures of goethite and manganese oxide

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As a consequence of the growing use of antibiotics in human and veterinary medicine, these chemical compounds are being introduced into the environment. Fluoroquinolones (FQ) including flumequine (FLU) and norfloxacin (NOR) are a group of broad-spectra antibiotics that are extensively used in human and veterinary medicines, resulting in their large presence in aquatic environments [1].The transport and mobility of these compounds are strongly related to their interactions with minerals such as goethite (α-FeOOH), gibbsite ($AlOH_3$), hematite (α-$Fe_2O_3$) and manganese oxide ($MnO_2$) [2, 3]. However, metal oxides do not exist as individual phases, but rather in association with other minerals, as aggregations or coatings on silica [4], which may affect the sorption ability of the oxides by altering their surface charges and the number of surface sites for contaminants. This work combined kinetics, batch experiments, ATR-FTIR and modeling approach to investigate the interactions of FLU and NOR with α-FeOOH and $MnO_2$ separately and in binary mixtures. By contrast with NOR, which was oxidized by both solids and the mixture, FLU removal from solution was only due to adsorption. Effects of NaCl concentration and ATR-FTIR results suggested that FLU adsorption to α-FeOOH and $MnO_2$ should predominantly occur as strong metal-bonded complexes with surface Fe sites and/or hydrogen bonded complexes with surface hydroxo groups. Sedimentation test evidenced heteroaggregation between α-FeOOH and $MnO_2$. However, FLU adsorption (both at low and high surface loadings, Fig. A and B, respectively) to various α-FeOOH: $MnO_2$ mixtures could simply be described by linear combinations of FLU adsorbed amount to single minerals. By giving an example of linear additivity, these results are shedding light on the extrapolation from simple model systems to complex environmental systems, and allow a better prediction of the fate and transport of antibacterial agents in environmental systems. Ongoing work aims at determining whether rates of NOR oxidation by α-FeOOH: $MnO_2$ (1:1) mixtures are affected by heteroaggregation between α-FeOOH and $MnO_2$.

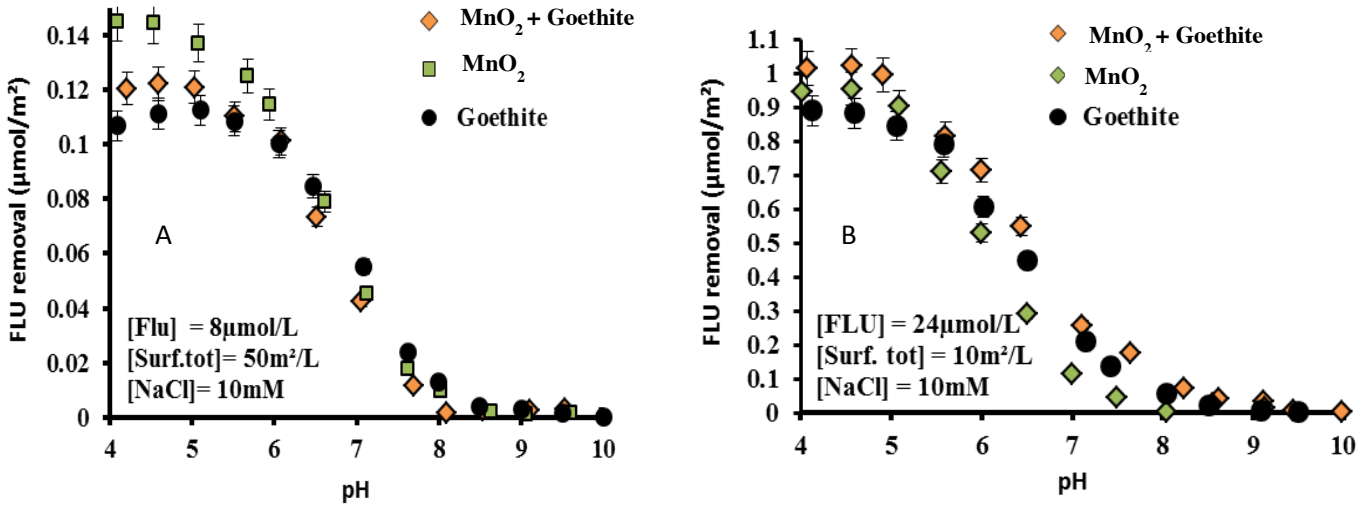


**Figure 1**: FLU removal versus pH: A: low surface loading and B: high surface loading of solids. [Surf. tot] corresponded at the total surface of solids and their binary mixture (FeOOH: $MnO_2$ (1:1)).

## References

[1] Marsac *et al*. (2016) *Environ. Sci. Technol*. **50** (2), 660–668. [2] Martin *et al*. (2015) *Environ. Sci. Technol*. **49**, 12197–12205. [3] Zhang *et al*. (2007) *Chemosphere* **66** 1502–1512. [4]Taujale *et al*. (2016) *Environ. Sci. Technol*. **50** [5] Hiemstra *et al*. (1996) *J. Colloid Interface Sci*. ***179*** (2), 488–508.