S7.6 Magnetic $CoFe_2O_4$ ferrites for PMS activation for disinfection of wastewater

J. Rodríguez-Chueca[a*], E. Barahona-García[a,b], V. Blanco-Gutiérrez[b], A.J. dos Santos-García[b]

[a]Departamento de Ingeniería Química Industrial y Medio Ambiente, Escuela Técnica Superior de Ingenieros Industriales. Universidad Politécnica de Madrid. Calle José Gutiérrez Abascal 2, 28006, Madrid (Spain)
[b]Departamento de Ingeniería Mecánica, Química y Diseño Industrial, Escuela Técnica Superior de Ingeniería y Diseño Industrial, Universidad Politécnica de Madrid, Ronda de Valencia 3, 28012, Madrid (Spain)

[*]jorge.rodriguez.chueca@upm.es

By 2020, it is expected that more than 3.5 billion of people might live in regions with hydric stress [1], that is, regions where the available water cannot fulfil the demand required for basic domestic, agricultural and industrial purposes. Under this scenario, the use of non-conventional water resources, as the regeneration and reuse of treated wastewater, is expected to be an alternative option for increasing the available water resources [2].

Nevertheless, the reuse of wastewater also presents many drawbacks that have to be addressed. For instance, it is mandatory to perform a disinfection of water previous to its reuse. The chlorination is the most common and cheapest used disinfection agent, but its utilization to treat wastewater is not recommended by the generation of disinfection by-products as trihalomethanes. Nowadays, new technologies have emerged as alternative. This is the case of Advanced Oxidation Processes (AOPs) based on the generation of highly reactive species, such as hydroxyl ($OH^{\bullet}$) and sulfate radicals ($SO_4^{\bullet-}$). These short-lived radicals are characterized by a high oxidation potential, being able to inactivate bacteria and to remove recalcitrant organic matter and micropollutants [3]. Sulfate radical based-AOPs (SR-AOPs) could involve the use of peroxymonosulfate (PMS; HSO_5^-) anion. But, PMS is not an effective disinfectant at low dosages, so it requires to be activated in combination with: i) heat; ii) UV-radiation; and/or iii) the addition of a transition metal cation [4]. In this regard, the use of Fe^{2+}, Co^{2+}, Ni^{2+}, another cations allowing a homogeneous catalytic activation has been widely reported by different authors [4, 5]. However, there exists legal restrictions concerning the amount of metals present in solution and they have to be removed from water previous to the reuse. For this reason, the use of a heterogeneous catalysts that can be recovered and reused is an eco-friendly alternative.

The main goal of this study is the synthesis of a magnetic and heterogeneous cobalt ferrite to activate PMS in combination with UV-A radiation, as an alternative disinfection treatment in the inactivation of *Escherichia coli* and *Enterococcus sp.* for wastewater regeneration purposes.

The optimization of the operating conditions was applied over a simulated wastewater, consisting in a mixture of inorganic salts and organic matter diluted to a total organic carbon value of 15 mg/L [6]. Fresh liquid cultures of *E.coli* and *Enterococcus sp.* wild strains were prepared in Luria-Bertrani broth and incubated at 37ºC for 24h. These microbial suspensions were added to simulated wastewater samples to obtain an initial concentration of microorganisms ranging 10^6 CFU/mL. The microbiological quantification during the treatments for *E.coli* and *Enterococcus sp.* was made using MacConkey agar (Scharlau) and Slanetz&Bartley agar (Scharlau) respectively as culture media. *E.coli* colonies were counted after 24h of incubation at 37ºC and *Enterococcus sp.* after 48h. Treatments were performed in a batch reactor photo-assisted with UV-A radiation (Philips TL 6 W with an emission maximum at 365 nm) with an average irradiance of 4.5 W/m^2.

Figure 1a and 1b shows the results corresponding to the optimization of ferrite concentration in the removal of *E. coli* and *Enterococcus sp*. using a concentration of PMS of 0.2 mM respectively. The corresponding control experiments were performed in the same conditions. Surprisingly, an increase

in the concentration of ferrite does not turns into an increase in the effectiveness of disinfection treatment. It can be due to a recombination process of the over generated free radicals. The optimal dosage of ferrite found in this study amounts to 0.05 g/L for a PMS concentration of 0.2 mM. The operating conditions are strongly dependent on the microorganism present, as is deduced from the total inactivation of *E.coli* and *Enterococcus sp.* that is reached in 30 and 120 minutes respectively.

Further studies of reusability will be performed in order to assess the efficiency loss of the catalyst.

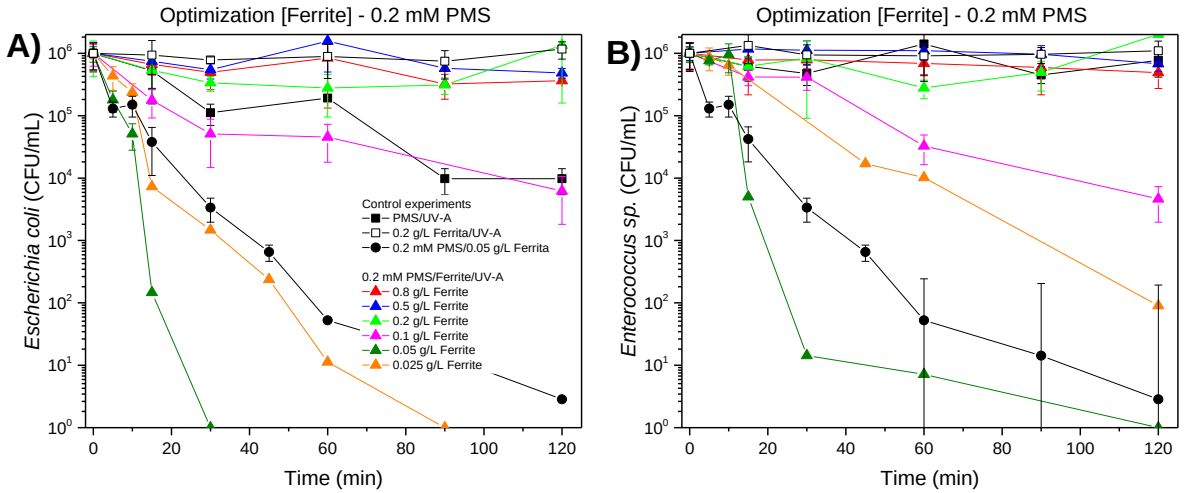

Figure 1. Optimization of ferrite concentration in the removal of a) *E.coli* and b) *Enterococcus sp.* [PMS] = 0.2 mM.

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