Reduced graphene oxide – supported nanoscale zero valent iron for the removal of the mycotoxin patulin from water

Craig R. McKerlie[1], Blanca Calderón[1], Ignacio Aracil[1], Andrés Fullana[1]

[1] Institute of Chemical Process Engineering, University of Alicante, 03080 Alicante, Spain

One challenge that has recently become evident in the water treatment industry is the remediation of micropollutants, which can prove difficult to remove with conventional water treatment technologies. There are many possibilities for the removal of these pollutants from water and this has shown to be an emerging area of study. This work assessed the suitability of nanoscale zero valent iron decorated reduced graphene oxide (nZVI/rGO) for this purpose. The study included the synthesis of the material using an anaerobic wet synthesis method, its subsequent characterisation and finally several performance tests for the removal of the mycotoxin patulin from water –which is commonly found in apple based products, particularly apple juices– using both Fenton and photo-Fenton oxidation.

The zero valent iron nanoparticles acted as a slow delivering source of ferrous iron required for Fenton hydroxyl radical formation, while the reduced graphene oxide helped this to occur at non-acidic pH, as graphene coupling promoted electron transfer which improved the action of Fenton mechanism. The use of UV-C further helped promote Fenton mechanism by recovering ferrous iron from complexes such as $Fe(OH)^{2+}$.

It was found that patulin was successfully removed through both Fenton and photo-Fenton oxidation, reaching a removal yield up to 99.9% in the presence of nZVI/rGO, UV-C and H_2O_2 after 240 min of treatment. Thus, the results show lots of promise for the future of nZVI and graphene-based materials in water treatment applications.