Comparison of different oxidation processes for the OBM (Deliverable D 2.2.4)

There is growing concern about the presence of emerging contaminants in different types of water. Indeed, harmful compounds have been found in the drinking water tap, hence there is need for new technology and processes that can remove these dissolved species at low concentrations.

Importance Importance

Ozone has due to its high oxidation and disinfection potential recently received much attention in water treatment technology. It is applied in order to improve taste and color as well as to remove undesired organic and inorganic compounds from the water. Regardless of several advantages of using ozone, it has some limitations, which restricts its application as water treatment technology. One important limitation is that, despite being a strong oxidant, ozone reacts slowly with some organic compounds such as inactivated aromatics. Moreover, in many cases, it does not cause a complete oxidation of organic compounds (e.g. natural organic matter (NOM), micro-pollutants, etc). Advanced oxidation is a process for generating hydroxyl radicals which have a much greater oxidation capability than ozone for the degradation of refractory organic micropollutants which are resistant to degradation by ozone alone. Various advanced oxidation processes have been investigated in the literature, such as UV/H_2O_2, O_3/H_2O_2, UV/TiO_2, UV/O_3, and Fenton's reagent. In recent years, particular attention has been paid to metal-catalysed ozonation processes for the degradation of organic materials due to their potentially low cost.

Approach

The catalytic effect of commercially available ceramic Raschig rings versus stainless steel rings (known to be oxidant resistant) at different water qualities, for the decomposition of ozone and the hydroxyl radical formation have been investigated by using an ozone bubble column. Parachlorobenzoic acid (pCBA) has been used as a model pollutant since it has been reported to be an ideal compound for ozone AOP studies because it displays slow reaction rates with ozone, but rapid oxidation kinetics with the OH radical.

Result

While the ozone was quite stable when the stainless steel rings were used as a packing media, the ceramic media enhanced the decomposition of the ozone. Nevertheless, the water quality was found to significantly affect the ozone stability. Indeed, in addition to high pH, both NOM and TIC lowered the ozone concentration in the system. When considering the degradation of pCBA, the ceramic packing rings, as high pH and NOM, increases its rate constant which is correlated to the higher decomposition of ozone and consequently to higher formation of hydroxyl radicals. In contrast, TIC decreased the degradation rate of pCBA even if it decomposes the ozone which is due to its scavenging effect.

More information

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