

# THE USE OF OZONE AND HIGH SILICA ZEOLITES TO ENHANCE REFRACTORY COMPOUNDS REMOVAL

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## Abstract

This work investigates the removal of organic pollutants from water through a three-phase process combining adsorption onto hydrophobic zeolites and in situ oxidation by ozone gas. Zeolites are aluminosilicates with various crystalline structures – and especially different pore sizes - which offer a great selectivity, profitable to organic pollutants separation in a complex matrix like natural water. They are highly resistant to chemical agents as acids, bases or oxidising agents such as ozone. Moreover, high silica zeolites have a high adsorption capacity for organics. Ozone is known to be a powerful oxidising agent able to react with various organic compounds. Its action – either direct or indirect - leads to the decomposition of organics into smaller molecules that are generally biodegradable. Previous studies have shown that organics adsorbed onto zeolites could be oxidised by ozonated water faster than in bulk water because of a micropore concentration effect (Fujita et al, 2004 and Sagehashi et al, 2005). In the gas phase, Monneyron et al (2003) showed that high silica zeolites could catalyse ozone decomposition into radical species and that adsorption properties were not significantly modified after exposition to ozone. Hence it is expected that zeolites saturated with organics could undergo regeneration by ozone without degradation of their structures or decrease of their adsorption capacities.

The present work showed that high silica zeolites could efficiently adsorb nitrobenzene from water although their capacity stayed beyond that of activated carbon, except at low concentrations. The adsorption capacity depended on the zeolite structure and the Si/Al ratio. Adsorption isotherms could be well described by Langmuir or Freundlich models.

As regards the three phase coupled process, the adsorbent could be efficiently regenerated during an ozonation step consisting in bubbling ozone through a suspension of saturated zeolite in a nitrobenzene solution at equilibrium. The initial adsorption capacity was quickly recovered and, continuing the treatment, the adsorption capacity of the zeolite was even increased. This may be due to the cleaning of zeolites pores by ozone (Pic et al, 2005). Yet traces of template molecules could probably remain from the zeolite synthesis process.

Until now the catalytic effect of the zeolites has not been evidenced in the liquid phase. Therefore future work will focus on the conditions in which the oxidation kinetics can be enhanced in the presence of zeolites through a concentration effect, and to what extent.

## References

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