AOP FOR WASTEWATERS PURIFICATION

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Introduction

The AOPs are gaining a growing importance for purification of contaminated water and air. Ozonation and photooxidation - separately and in combination are the very powerful advanced oxidation process involving the generation of highly reactive hydroxyl radicals. The OH-radicals convert organic pollutants into harmless CO_2 and H_2O.

Experimental

Ozonation was carried out in the bubbling reactor and the concentration of ozone outlet of the reactor was recording (Fig.1).

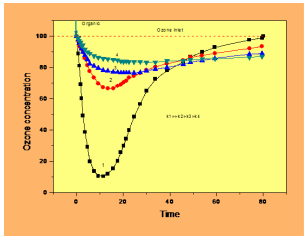

Fig. 1. Ozone absorption curves depend on the organics structure.

By the area above the concentration curve was calculated the absorbed ozone and the sthiochiometric coefficients. More than 50 organic compounds of different classes have been ozonized in water and the obtained products were analysed by GC MAD. Usually ozone oxidised toxic pollutants to much more less toxic or completely non toxic compounds like carbonic acids, CO_2, NO_x, SO_x, H_2O and etc.
More than 20 nano-sized powder photocatalytic materials were prepared and analysed as photocatalysts separately and in combination with ozonation. These materials were based on TiO_2 modified with SiO_2, noble metals (Au, Ag, Pt, Pd – 0.5 – 1 wt.%) or other semiconductors like WO_3. It was created photocatalysts that are activated by illumination with visible light. At characterization of catalysts were used x-Ray, SEM, TEM, XPS and absorption methods. For catalytic experiments were constructed reactors to carried out photoctalytic purification in gas and liquid phase and by joint applying of photooxidation and ozonation.

Results/Discussion

At ozonation of organics it was found that mechanism of the reactions depend on the structure of organics and there are 5 mechanisms that are recognised as 1,3 – cycloaddition; electrophilic addition; nucleophilic addition; 1,3 – insertion in the single bonds an hydrogen abstraction.
Modifying TiO_2 with SiO_2 (4%) enables high temperature treatment of the material without the undesired anatase-rutile transition, which deteriorates the photonic efficiency.
At modification of TiO_2 surface with noble metals particles the role of the metals is to separate the charge carriers – the photo-excited electrons and the positively charged holes The appearance in that case of Schottky barriers at the metal/semiconductor inter-phase surface preventing the return of the electrons and hindering the recombination process.
In contrast of the ozone desinfection of natural waters where it is a conventional approach, the purification of waste waters by combination of ozone and photocatalytic degradation is still an area of intensive research. This AOP proces is among the most approriate cleaning method, because separet using of ozonation is proper method for deactivation of midle concentrations of organic polutans and photooxidation is conviniant to complete degradation of small amounts of organic pollutants. Combination of these two methods gives total cleaning effect of the waters with midlle amounts of organic pollutance.
Present paper is deal with developing and appling of this AOP process to water cleanin by azo dyes and organics production waste waters.

Conclusions

1. Ozonation is a highly efficient method for the degradation of organic pollutants in the aqua media. It decomposed huge number of organics to nontoxic products. Ozonation always involves the reactions of two species ozone and OH-radicals. There are five mechanisms of ozone reaction with organics. Ozone produces OH-radicals, initiated by UV, TiO2, pH, H2O2 or combination of them.
2. The activity of TiO2 was improved by:
Co-precipitation with non photocatalytic oxides, like SiO2
Doping of TiO2 surface with Nobel metals, like Au, Ag, Pd and Pt
Co-precipitation with other semiconductors, like WO3
Exchanging the oxygen atoms in the lattice with N, P, S or C
The last manipulation increases the possibility of VIS-light usage.
3. Joint conduction of ozonation and photocatalytic oxidation is powerful AOP for wastewaters purification and mineralization. It can be applied to the waters with medium organic pollutance concentrations.

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