THE CHALLENGES OF TREATING HIGH STRENGTH WASTEWATERS: CWAO USING MWNT SUPPORTED RUTHENIUM CATALYSTS

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High strength wastewaters containing aromatic compounds cannot be treated by conventional methods, including the common biological treatment. In these cases, a more sophisticated approach is necessary to attain the desired levels of purification. Catalytic wet air oxidation (CWAO) using carbon based catalysts is employed worldwide as effective pre-treatment of effluents with these characteristics. Carbon materials are preferred as active catalysts or supports, due to their morphological and structural characteristics. Due to a tremendous development in materials production and processing, nanostructured carbon materials became more accessible and common in recent years, widening their range of applications [1].

In this context, the scope of the present work is to illustrate one potential use of multiwalled carbon nanotubes (MWNT) supported ruthenium catalysts for catalytic wet air oxidation of wastewaters polluted with aniline. Ruthenium was supported by incipient wetness and excess impregnation, starting from liquid solutions of three different precursors. Impregnation was carried out on modified MWNT, namely on MWNT-COOH (HNO_3 modified) and MWNT-COONa (HNO_3/Na_2CO_3 modified). For 1% wt Ru/MWNT catalysts, the order of activities decreased in the sequence Ru(COD)(COT)>$RuCl_3$>$Ru(C_5H_5)_2$. The conversion of aniline after 45 min of reaction was 100% for the catalyst prepared with Ru(COD)(COT). The influence of the Ru precursor, preparation method and the support surface modification was studied comparing the conversion of aniline obtained for the different Ru/MWNT catalysts (Figure 1). MWNT as support material, provide a significant metal dispersion, very small Ru nanoparticles (Figure 2) being observed. This will induce an efficient contact between the aniline molecule and the active sites [2].

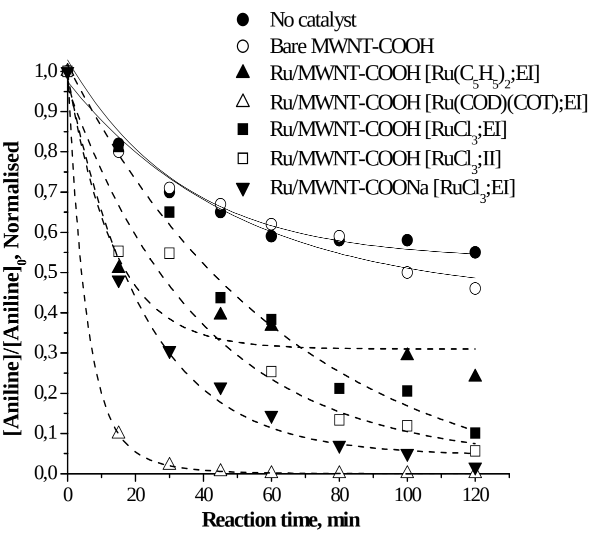

Fig. 1. Aniline concentrations normalised at 200ºC and 6.9 bar of oxygen partial pressure.

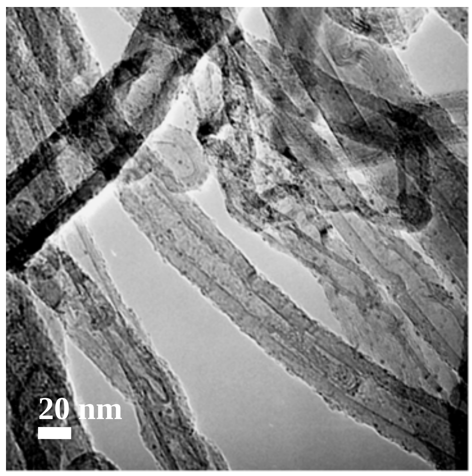

Fig. 2.TEM image of the Ru/MWNT catalyst with Ru(COD)(COT) precursor.

The excellent catalytic performances of Ru/MWNT are explained in terms of the high dispersion of Ru and high external surface of the catalysts, promoting an efficient contact between the substrate and the catalyst. The results obtained with model solutions of aniline, as well as real case effluents, led to treated water of excellent quality, which can be returned to the environment without any further treatment. In this way, CWAO can be used on its own, avoiding the need for additional post-treatments.

[1] P. Serp et al., Appl. Cat. A, **253(2)**, 337, **2003**.
[2] J. Garcia et al.., Cat. Today, in press, **2005**.