Electrochemical Advanced Oxidation Process for Water Treatment

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The unique electrochemical properties exhibited by boron doped diamond films are such that new and improved electrochemical processes may now be explored both at laboratory and industrial scale. The coating of a conventional electrode material with a boron doped diamond film results in the realisation of an electrode which, not only is extremely chemically stable, but one which opens up the widest known electrochemical window before water decomposition takes place. The stability of DiaChem® electrodes has been proven through the loading of the electrodes with increasing current densities of up to several A/cm^2 in sulfuric acid over a period of several months without any degradation of the electrode surface or electrochemical performance.

Industrial scale production of DiaChem® electrodes has been made possible through the up scaling of existing hot-filament diamond (CVD) technology. Boron doped diamond films may now be deposited on various substrate geometries on areas of up to 100cm x 50cm. The electrical resistances are shown to be in the range of 5-100mΩcm and are achieved through in-situ doping using either diborane or trimethylborane.

The electrochemical generation of oxidants used for the recovery or treatment of wastewaters from industrial plants by electrochemical oxidation processes is playing an ever increasing role due to their reliable operating conditions and ease of handling[1,2,3]. The decomposition of acetic acid model waste water with different initial concentrations (fig.1) has shown that the COD is independent from the initial concentration of organic load to start with and then the increase is linear with ever increasing load. The current efficiency for decomposition in this linear region is almost 100%.

The decomposition of cooling fluid in water has also been investigated (Fig. 2). It has been clearly shown that, within the boundary of measurement accuracy, it is possible to completely mineralise any organic carbon present. Long chain organic molecules such as cooling fluid may be mineralised from hydroxyl radicals without the development of intermediate products.

EAOP pilot cells, as shown in fig. 3, are presently in use in a number of applications from the automotive industry to water recycling for the optics industry. These tests have displayed excellent results with regards to energy efficiency and effectiveness. It has been demonstrated that it is possible to achieve COD reduction of up to 5g/hour with water flow rates of up to 200 l / hour.

References

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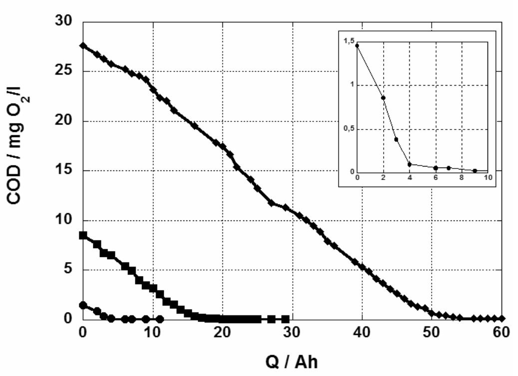

Figure 1: Decomposition of acetic acid model waste water with different initial concentrations

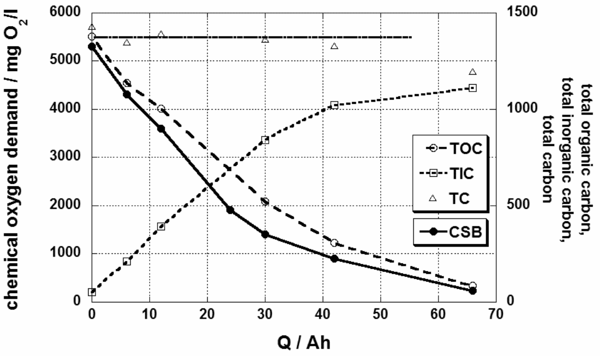

Figure 1: COD reduction and transfer of organic carbon into inorganic carbon at pH = 10

Figure 3: EAOP pilot cell using DiaChem® electrodes. Cell design and fabrication by G.E.R.U.S. mbH, Berlin