

## Pesticide Destruction in Agrochemical Wastewater with DiaCell® - Technology

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*DiaCells® with boron-doped diamond electrodes were used for the destruction of pesticides in water. A rapid and complete destruction of a selected herbicide is presented. These results are particularly promising for the development of a very efficient and easy-to-use system for the treatment of waste water containing pesticides.*

Chemicals commonly called pesticides (herbicides, insecticides) are extensively used in farming to increase yields and protect crops. These products are very efficient but they are also very toxic. Pesticides may have ecological effects or be toxic for various terrestrial and aquatic animals and plants. These effects may be due both to the pesticide itself as well as its breakdown products. The release of large quantities of pesticides into the environment implies significant risks since their chemical fate and their transport mechanisms in soil, air, and water systems are often not clearly established<sup>[1]</sup>.

For these reasons, the development of an efficient system, able to destroy pesticides and their breakdown products or at least to reduce their concentrations below the legal standards is of great interest. Moreover, if it could be implemented in an easy-to-use setup, the system could be very useful in helping farmers to eliminate waste that contains pesticides or unused pesticide solutions.

The aim of this work was to evaluate the feasibility of pesticide destruction with the DiaCell® - Technology. This technology, which uses doped-diamond electrodes, has already proven its efficiency in the destruction of various organic compounds<sup>[2],[3],[4]</sup>. In this work, the degradation of several selected BASF herbicides was studied in drinking water. This report summarizes the results obtained with one pesticide, Basagran, a functionalized heteroaromatic compound.

This soluble pesticide was diluted, at an initial concentration of 1.5 g/l, in water containing a small amount of sodium sulfate. The COD value (chemical oxygen demand, in mg O<sub>2</sub>/L) of the initial colorless solution was approximately 2000 ppm O<sub>2</sub>. After a few minutes, the solution rapidly turned into an intense yellow. During the test, this color rapidly disappeared and a colorless solution was finally obtained. These changes are caused by the initial degradation of Basagran followed by the subsequent destruction of its breakdown products.

This mechanism is confirmed by Figure 1, which shows the COD evolutions and bentazone concentration measured by HPLC-UV chromatography. The COD value, which reflects the overall organic content of the solution, decreased from approximately 2000 to almost 0 ppm and, as expected, the decrease in the concentration of Basagran was even more rapid.

The overall COD-destruction can be modeled as follows:

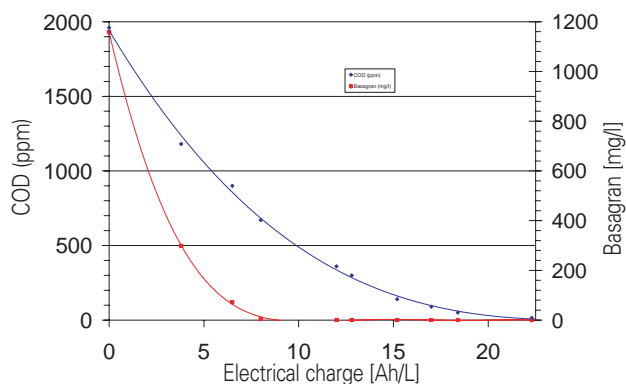
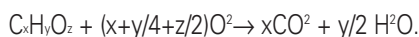


Figure 1: COD and Basagran concentration as a function of time.

Despite the fact that the electrolysis conditions (pH, electrolyte, current, starting and final concentrations, flow conditions...) were not optimized, this herbicide was decomposed to CO<sub>2</sub> and finally reached very low concentrations. An energy requirement of only 0.050 kWh/L was needed to reduce its concentration from 1200 ppm to less than 1 ppm and at 0.125 kWh/L, its concentration was reduced from 1200 ppm to ppb level.

Other pesticides (also mixtures) available in different forms - soluble compounds, suspensions and emulsions - were evaluated as well and all of them were successfully decomposed with the DiaCell® - Technology.

This feasibility study showed that the DiaCell® - Technology is a promising technology for the degradation of chemical pesticides and that, once the operating conditions have been improved, the process could easily be applied to real conditions. These evaluations form the basis for the development of an efficient system that is able to reduce the concentration of pesticides below the legal standards, and that could be implemented in an easy-to-use setup under reasonable operating conditions without production of any waste materials.

• BASF AG – Germany

[1] <http://www.epa.gov/pesticides/>

[2] L. Pupunat, F. Sollberger, Ph. Rychen, "Efficient Reduction of Chemical and Technical Oxygen Demand in Industrial Wastewaters", CSEM Scientific and Technical Report (2002)

[3] W. Haenni, Ph. Rychen, M. Fryda, C. Comminellis, "Industrial Applications of Diamond Electrodes", Semiconductors and Semimetals, Thin-film Diamond II 77 (2004) 149

[4] Ph. Rychen, W. Haenni and L. Pupunat, "Water Treatment Without Chemistry", *Chimia* 57 (2003) 655