DBD DISCHARGE PROCESS: A SPECIFIC PLASMA TOOL FOR GAS TREATMENT

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DBD discharge is an innovative plasma process for specific chemical gas treatment. The main characteristics of the DBD plasma discharge are its possibility to work at atmospheric pressure with electrical nanopulses of streamers at high voltage of few kilovolts and high frequency of giga hertz.

To describe a little more the hydrodynamic properties of these discharge we have to take into account that the ions pulses from the high voltage electrode to the ground electrode produce a wind jet of hundred meters per second and behind each pulse a convective motion in the gas phase. For the design of a chemical engineering process we have the gas mixing and the recycling process which are the first main parameters for a global gas flow treatment.

The second aspect is connected with the specific properties of the excited species and more generally with the energy exchange between electron pulses and the gas molecules species.

If we take into account the electron energy distribution (FDE) and the capture cross section of each specie (molecules and radicals) we point out that the excited states are first of all vibrational states ,but also homo/lumo new species with odd electron and radical species and at last ,connected with the high voltage of the discharge ,strong polar molecules appear with unusual debye polarizability.

The third part of the DBD process is linked with the short time of the electron pulses (few nanosecond) in agreement with the time of the elementary chemical reactions. Usually the energy transfer from electrons to the boundary layer of a molecular orbital is close to $10^{-14}$to 10^{-10}second while excited states are able to react and produce a new species in the range of 10^{-9} to 10^{-6} second . By that way the chemical reactions starting with the excited state, new molecular orbital and quenching process stabilize the non-equilibrium pathway and open a very efficient chemical process in a DBD reactor.

From this knowledge we have developed an industrial gas depollution pilot plant to eliminate the COV in a gas flow at a level of 500 ppm by an on line treatment at 60m3/mn. These polluted compounds produce by a bitumen industrial plant are treated in a triple steps DBD fluidized bed of zeolite and the DBD discharge produces a polymerization of the organic molecules and a desulfurization of the thiols which are trapped on the surface of the zeolite beads.