Research activities

In our group, we have developed a physico-chemical approach of the interaction between the chemical compounds present in surface water and the irradiation (light). Our research undertaken in our team can be classified in two categories:
The reactions which occur “naturally” in the environment and which condition to become to it the polluting one. They intervene when the pollutant absorbs itself sunlight (direct phototransformation) or when it is subjected to the attack of active species generated at the time of the irradiation of absorbing substance (iron, humic, substances) present in the environment (induced phototransformation).

In addition, the reaction which results from a voluntary action and the purpose of which are “eliminate of the pollutant”. We study processes of homogeneous and heterogeneous photocatalysis (iron,TiO_2) there. The photochemical reactions brought into play will depend primarily on specificities of each pollutant and its interactions with the active species created under irradiation. This activity lies within the durable scope of development using the sun like renewable source of energy.
The studied molecules are molecules of use representative of the great families of pollutants as well as model molecules; we study the complete chain of phototransformation since the transitory species created at the time of the absorption of the photon until possible mineralization, by giving a detailed attention at the initial stages of the phototransformation. In fact, the research undertaken in the team of aqueous photochemistry and environment can be based on three principal parts:

1-Absorption of the light by pollutant:

Molecules of use: they are pesticides, compounds entering the formulation of detergents, made up produced with strong tonnage or the intermediates of synthesis.
They are often complex molecules of structures comprising several sites or functions likely to intervene in the process of photransformation. The studies relate mainly to the kinetic and analytical aspect pf photochemical reaction. The reaction mechanism could be specified by the identification of intermediates of short life duration. Moreover by looking at the effects of the pH and the wavelength.

Model molecules: they are simpler molecules with one, even two sites function present in the molecules of use. Some of these molecules are pollutants themselves. Their study will allow a mechanistic approach much more pushed and in particular an approach of the primary process by measurements in fast kinetics (field of nanosecond).

2-Intervention of made up absorbents present in the environment:

Different light absorbing compounds are present in the environment and their interaction with sunlight depends on their intrinsic properties. A preliminary stage will be thus the characterisation of these compounds. This stage represents an important and essential work for the comprehension of the photochemical reactions brought into play under the natural conditions. The studied photosensitizers or photoinductors are the humic substances principal components of the natural organic matter (acids fulvic, acids humic...) of water and the soil, and iron (complexes of iron, goethite) in the soil. In the both cases, work requires specific methods of sampling and characterization.

3-Homogeneous and heterogeneous photocatalysis:

The motivation of this research is elimination of the pollutant. The reactive species brought into radicals $HO^{\bullet}$ accompanied by that of Fe(III) or TiO_2. Moreover, we are interested in certain aspects particular, fundamental or applied of TiO_2: (i) the development of methods of immobilization of TiO_2 preserving the maximum of effectiveness, (ii) the realization of devices photocatalytic usable as well in artificial light as in sunlight, (iii) used the nanoparticles of TiO_2 in order to be able to make a quantified kinetic follow-up of the degradation of a pollutant. Finally comparative studies iron/TiO_2 on the same pollutant and under experimental condition provides us a beginning of scale of effectiveness of these photocatalysis.

Dear Sir

I' am writing to apply for a postdoctoral position in your unit. I have the Ph.D on Chemistry. I'am enclosing a resume giving details about my education and fields of competence along with my articles. I recently published with Dr Gilles Mailhot and Michèle Bolte.

I was interested in your research focus on analytical and environmental chemistry. Applying my competence in analytical chemistry would broaden my experience while making a contribution to your research efforts. I would therefore greatly welcome the opportunity to become a member of your team.

During my Ph.D. thesis, I have studied the photochemical imapct of Fe(III)-organic matter (Fe(III)-nitrilotriacetic and Fe(III)-Citrate) on the fate of an organic pollutant (4-chlorophenol (4-CP)) and inorganic pollutant (chromiun(VI)) was investigated in natural water. The quantum yields of the photodecomposition of the FeNTA, iron-Citrate and Fe(II) formation, by an intra-molecular photoredox process (the first stage of the reaction) are high. This photoredox reaction represents the first step of the process leading to 4-CP disappearance and chromium(VI) reduction. Whereas oxygen does not affect FeNTA (or Fe(III)-citrate) photodegradation, 4-CP depletion requires the presence of oxygen. On the other hand, the chromium(VI) reduction is independent of oxygen. The radical species $HO^{\bullet}$ and $CO_3^{\bullet-}$ responsible of the 4-CP degradation were identified by ESR spectroscopy under irradiation. Two different wavelength-dependent mechanisms of 4-chlorophenol degradation are proposed. On the other hand, the radical species $RCO_2^{\bullet}$ identified by ESR and the Fe(II), $O_2^{\bullet-}$

formation responsible of the chromium(VI) reduction. Then, I have suggested the mechanism of the reduction process. It clearly appears that under solar irradiation, iron organic complex like FeNTA and FeCitrate can play a significant role on the fate of the organic and inorganic compounds present in natural water.

In summarizing, I have studied three important axis: (i) 4-Chlorophenol and Iron-NTA, (ii) 4-Chlorophenol and Iron-Citrate, (iii) Chromium(VI) and Iron-NTA.

If you have any questions/queries, please feel free to contact me.

Thank you for your consideration

Yours Sincerely.