The 7th NTTU Student Research Workshop (NTTU-SRW): Chemistry - Food – Environment

# COMBINATION PHOTOCATALYSTIC PROCESS WITH H2O2 FOR ENHANCEMENT DICLOFENAC REMOVAL IN WASTEWATER

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## Abstract

**Diclofenac (DCF)** is a synthetic nonsteroidal anti-inflammatory drug and is widely used for the treatment of inflammatory and painful diseases of rheumatic and non-rheumatic origin. It is a chemical that is difficult to biodegrade and difficult to completely remove by a conventional wastewater treatment plant. A large amount of DCF already in use in Europe (EU) has been detected in many cooperatives in EU countries. In recent years, higher-order oxidation processes have been applied to treat DCF by various processes including photocatalysis such as the TiO2/UV process. Heterocatalytic photocatalysts are increasingly widely applied with high decomposition efficiency as well as good photocatalytic activity, non-toxic, chemically inert and low cost.

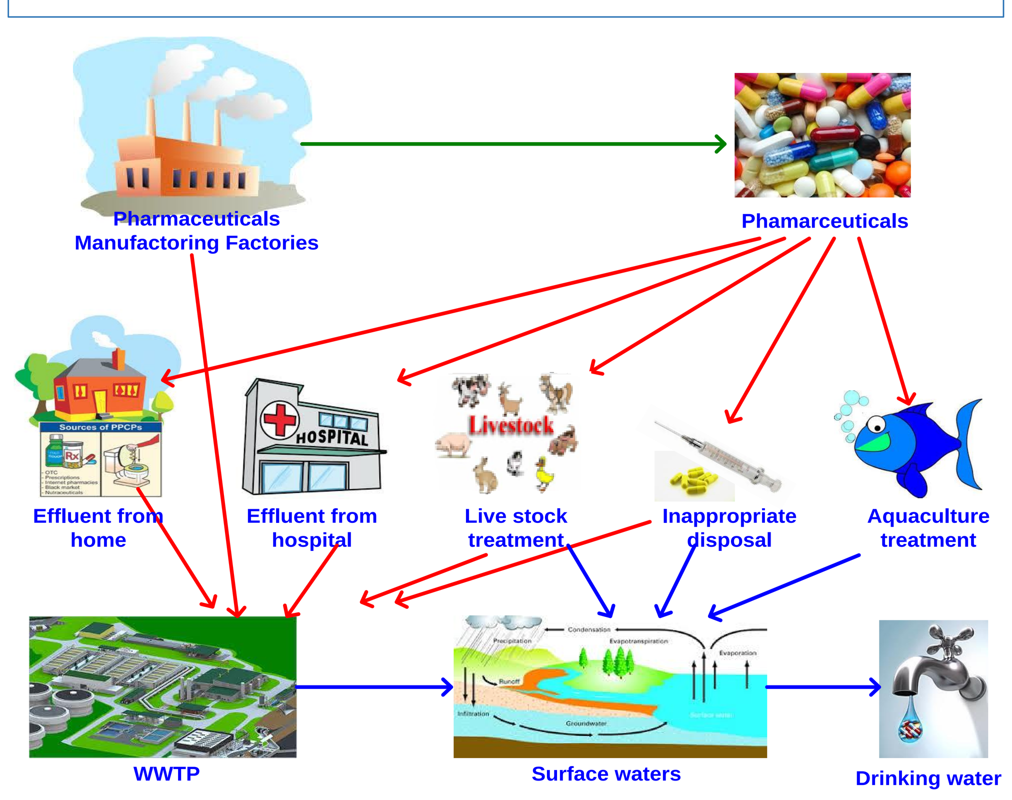


*Diagram of transporting pharmaceuticals to the environment*

## Introduction

Wastewater from industries, factories, laboratories,... Containing unwanted substances from various resources is the cause of serious problems for the environment. Pharmaceuticals become persistent organic compounds in wastewater becoming emerging pollutants due to currently unregulated water quality laws. Traditional wastewater treatment systems have limited pharmaceutical degradability. The application of advanced technologies with high efficiency of removal of persistent organic compounds such as pharmaceuticals, dyes, humic acids, etc. and low cost is necessary to achieve high quality of wastewater entering the water supply system.

Today, with the strong development and lack of control in terms of waste treatment, pollutants of many economic sectors have created serious environmental pollution. Many industries have released toxic substances into the environment that destroy the environment, causing serious diseases for humans. One solution can mitigate this problem if nanotechnology is applied to fabricate $TiO_2$ nanomaterials with photocatalytic effect to treat environmental pollution

## Methods and Materials

**Methods:**

- **Part one** investigates the influencing factors (pH, initial TiO2 concentration, and initial DCF concentration) on DCF decomposition by TiO2 photocatalysis.
- **Part two** investigates the effect of photocatalysis combined with$_{H2O2}$ on DCF decomposition.

**Materials:**

Sigma Aldrich Co.ltd supply commercial powder $TiO_2$ (Degussa-P25) (99.0%). Hydrogen peroxide (30%), purchased from Merck chemicals. Diclofenac or DCF is purchased from Volnac, T.O. Pharmaceutical Co., Ltd. Sodium hydroxide and sulfuric acid (96%) are purchased from Merck chemicals. All chemicals are laboratory type.

## Results

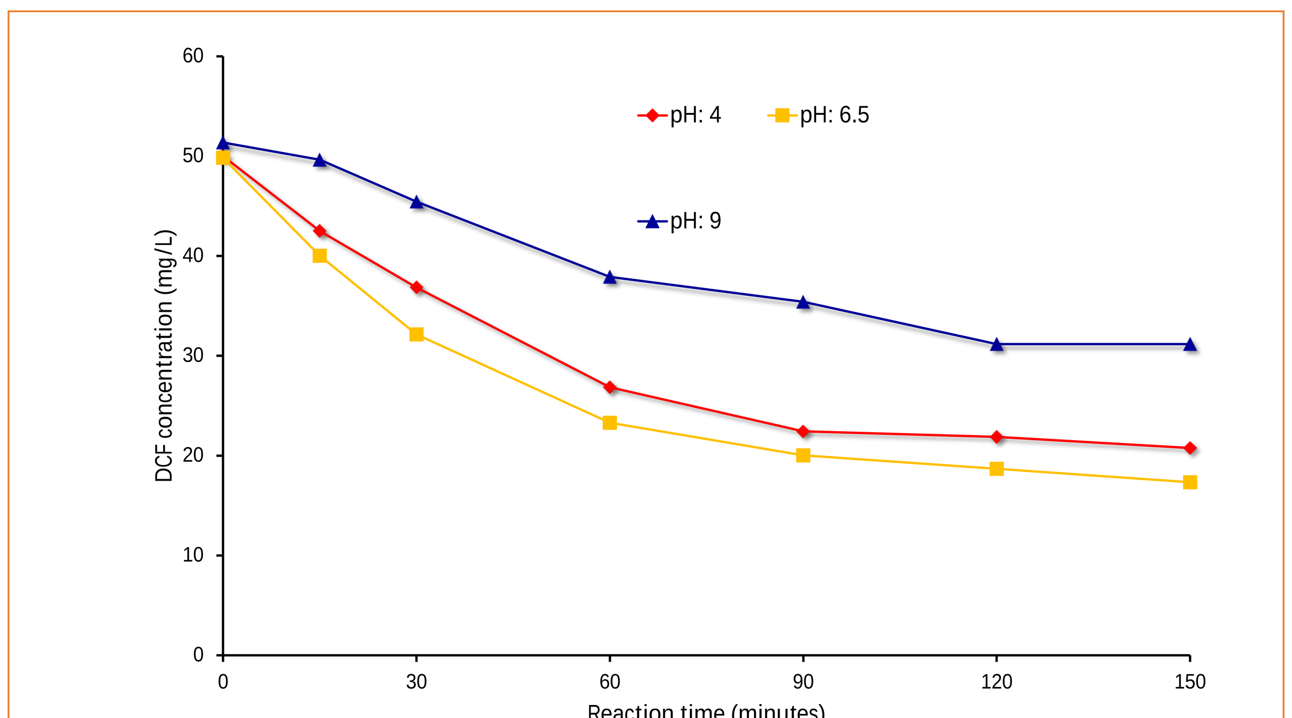


**Figure 1:** Effect of pH on the DCF removal efficiency of UV/TiO2 . process

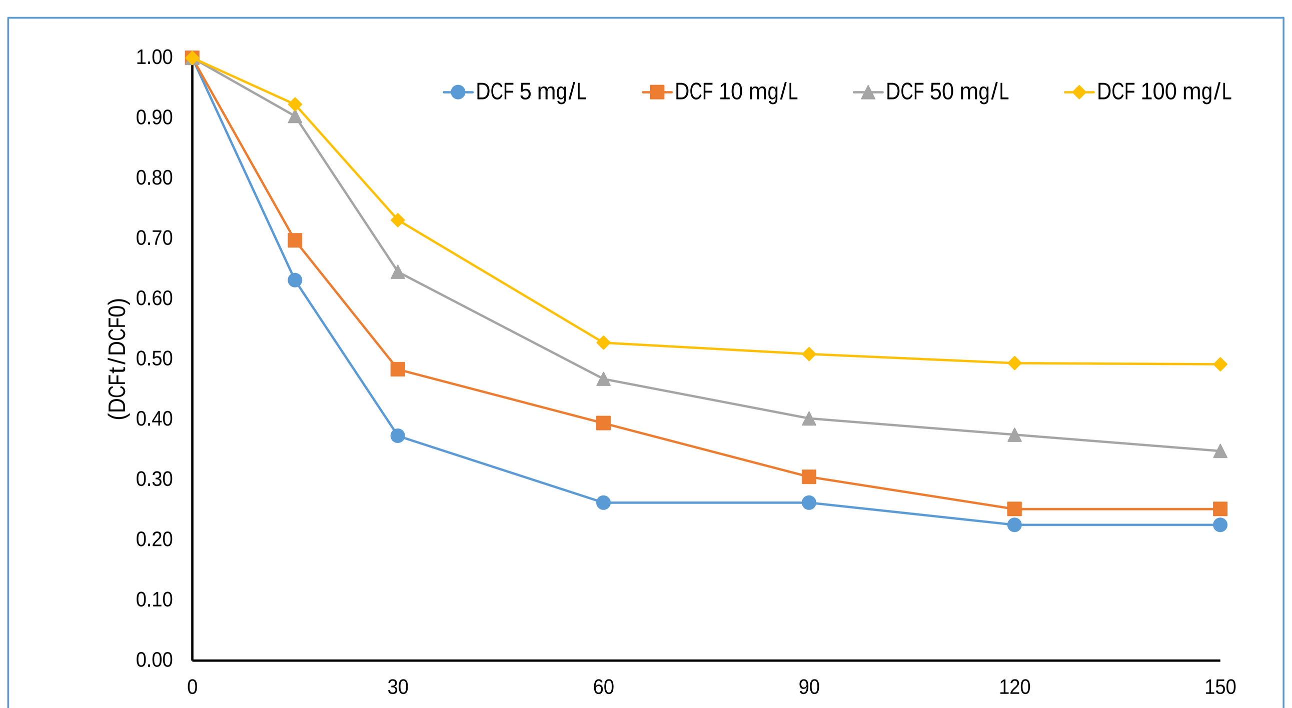


**Figure 2.** Effect of initial DCF concentration on DCF . treatment efficiency

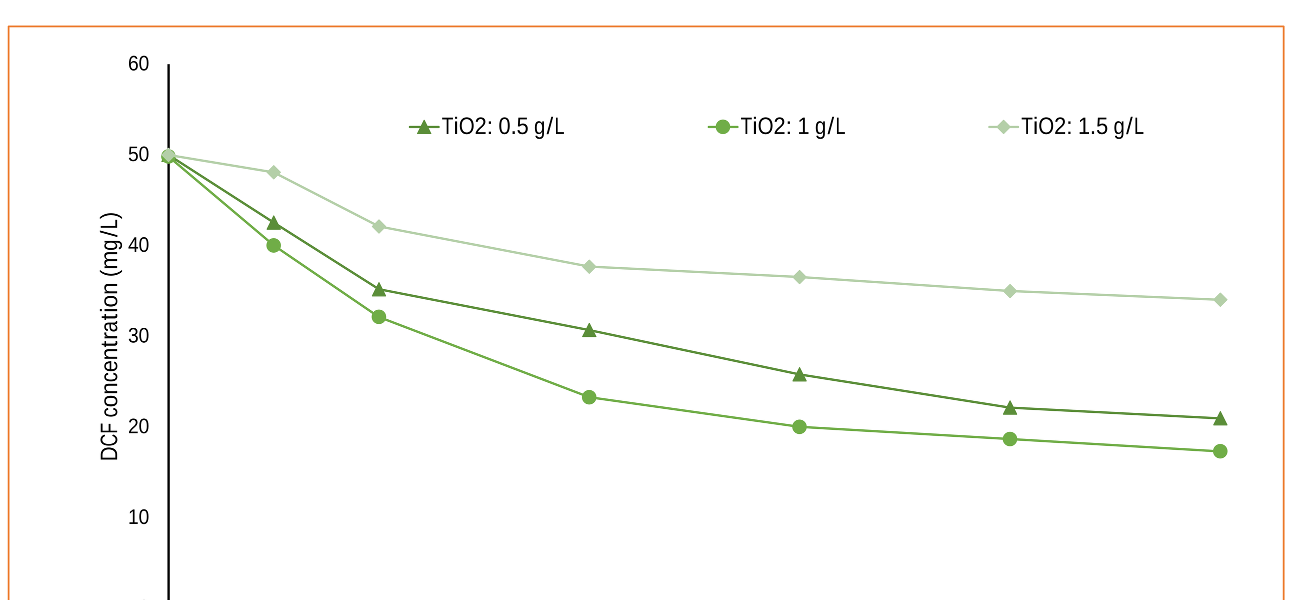


**Figure 3**. Effect of initial TiO2 concentration on DCF . treatment efficiency

## Analytical Process

**Step 1:** Take 5 mL of sample and put it in a 50 mL Erlenmeyer jar, then add 10 mL of $_{H2SO4}$ solution, 10-15 mL of potassium iodide solution, and two drops of ammonium molybdate solution in the order to be added to the Erlenmeyer jar.

**Step 2:** Titrate the sample with sodium thiosulfate 0.1 N to light yellow or straw color. Gently rotate the Erlenmeyer flask during titration to minimize iodine loss.

**Step 3 :** Then, add 2 mL of starch paste indicator to the sample and continue titration until the blue color disappears.

**Step 4:** For a white sample, replace 5 mL of DI water (without$_{H2O2}$) for the sample.

**Step 5:** It is also titrated with 0.1 N sodium thiosulfate which is repeated following steps 1 to 3.

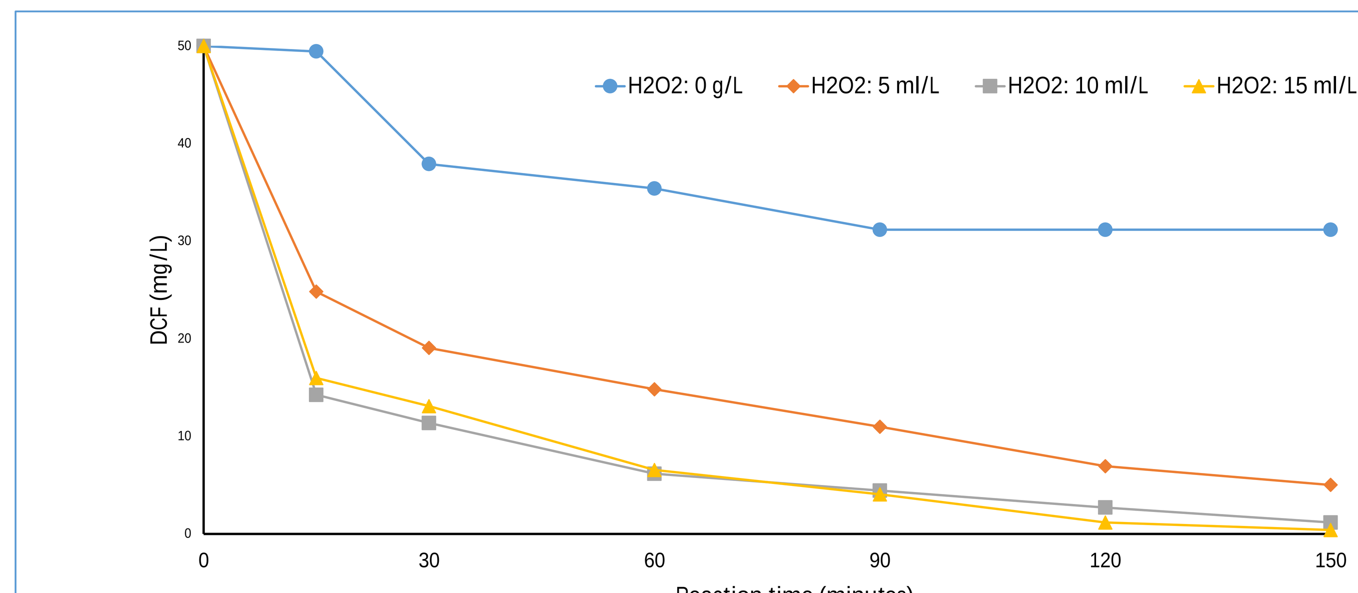


**Figure 4:** Effect of $H_2O_2$ on the DCF removal efficiency of UV/$TiO_2$ . process

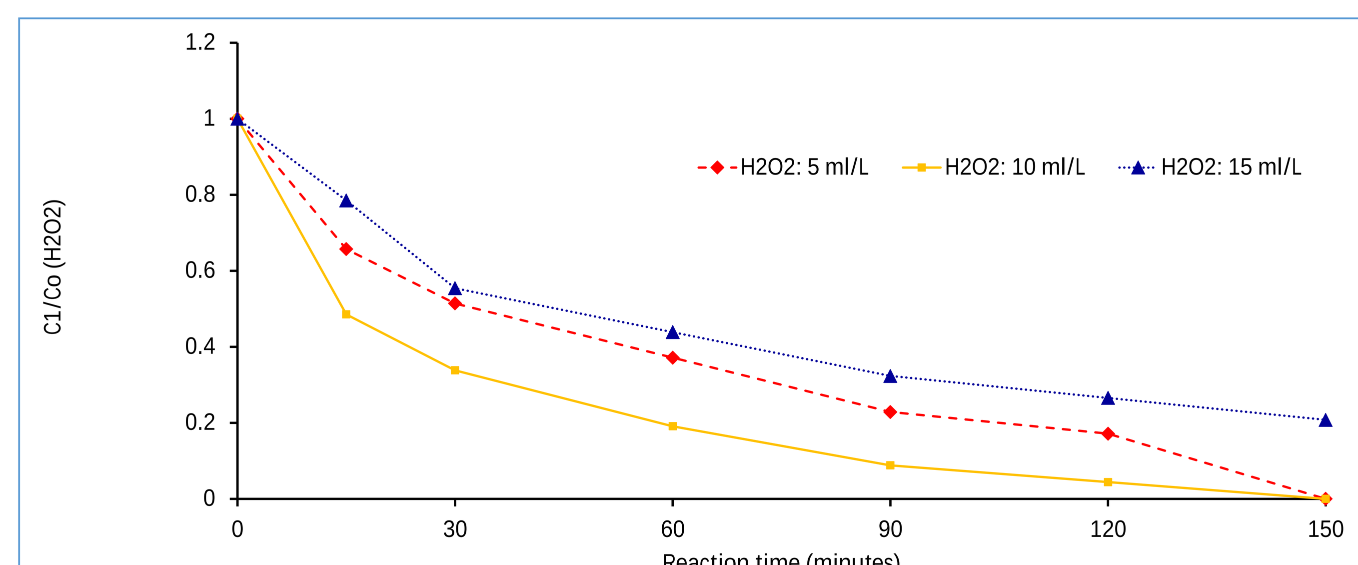


**Figure 5:** Residual of $H_2O_2$ during reaction time of UV/$TiO_2$ process

## Discussion

**The results of the experiment show that**
DCF absorbed on the $TiO_2$ surface.
DCF is less susceptible to degradation by UV-A light.
DCF is almost not oxidized by a single $H_2O_2$ agent.
DCF is degraded by the UV/$H_2O_2$ process.

## Conclusions

**CONCLUSION**

- DCF is decomposed by photocatalysis (UV/TiO2). Initial factors such as pH, DCF concentration, TiO2 concentration affect the DCF processing efficiency by photocatalysis.
- Adding $_{H2O2}$ to the photocatalytic process (UV/TiO2) will promote DCF processing efficiency.

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