# Study on processes of coagulation and adsorption to remove perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) from domestic wastewater and industrial wastewater

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Key words: *PFOS, PFOA, Coagulation, Adsorption, Wastewater*

## 1. Introduction

Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic acid (PFOA) are two manmade chemical compounds which come under the chemical group of perfluorinated compounds (PFCs). They are also persistent, bio accumulative and toxic. Researchers have reported that the conventional water and wastewater treatment facilities can not eliminate PFCs. Thus coagulation process and adsorption process were tested for their feasibility to remove PFCs from contaminated water. Regeneration and reusability of the materials used for PFOS were tested as well.

## 2. Objectives

(1) To study the removal efficiencies of PFOS and PFOA in domestic wastewater and industrial wastewater by organic coagulation.
(2) To study the removal efficiencies of PFOS and PFOA by adsorption process and combined treatment of organic coagulation and adsorption processes.
(3) To study the regeneration and reusability of materials used in combined treatment process of organic coagulation and adsorption processes.

## 3. Materials and methodology

**(1) Coagulation experiments**

Jar test experiments were carried out using commercially available cationic organic coagulants and conventional inorganic coagulants in lab scale experiments with synthetic wastewater, domestic wastewater and industrial wastewater.

**(2) Adsorption experiments**

Batch test experiments were carried out to remove PFCs in industrial wastewater by adsorption. Non-ion exchange polymers, ion exchange polymers and granular activated carbon (GAC) were tested. Column run experiments were carried out with synthetic wastewater to remove PFOS by using non-ion exchange polymers, ion exchange polymers and GAC in a column set up.

Organic coagulation and adsorption by non-ion exchange processes were coupled and combined treatment process was tested to remove PFOS from synthetic wastewater.

**(3) Regeneration and reusability experiments**

Materials consumed in combined treatment process were regenerated by organic solvent washing method. Regenerated materials were reused using the same experimental set up used for combined treatment process.

## 4. Results and discussions

(1) Medium molecular weight organic coagulants were able to effectively remove PFOA in synthetic wastewater and FL 3050 showed best performance in PFOA removal in domestic wastewater. Ion (III) chloride was the best coagulant agent to remove PFOS from industrial wastewater.

(2) Ion exchange resin PFA 400 showed the best performance in PFOA removal from the industrial wastewater. In column run experiments for adsorption of PFOS by non-ion exchange polymers, Amb XAD 4 maintained over 90% removal for more than 55 days. In ion exchange adsorption all the polymers maintained over 90% PFOS removal even after 28 operational days. Combined treatment process provided over 99% overall PFOS removal for more than 100 operational days.

(3) Non-ion exchange polymer, Dow L 493 showed the best regeneration efficiency of 92%, when washed by methanol. In reusability experiment for combined treatment process, the average overall PFOS removal efficiency decrease from 96% to 66%.

## 5. Conclusions

**Figure 1** shows the variation of overall PFOS and PFOA removal efficiencies respective to different removal process studied in this study.

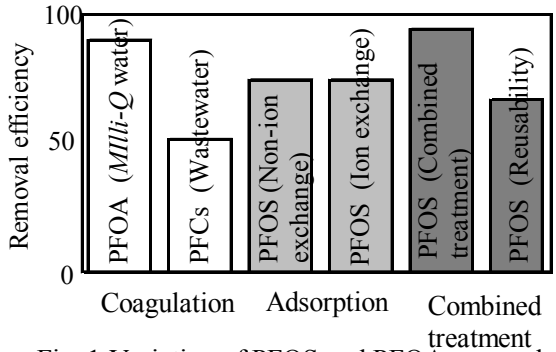


Fig. 1 Variation of PFOS and PFOA removal efficiencies with different removal methods.