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แบบเร่งปฏิกิริยาด้วยความร้อน และแบบเร่งปฏิกิริยาด้วยรังสียูวี



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**DEGRADATION OF TRICHLOROETHYLENE IN WASTEWATER  
BY HEAT AND UV ACTIVATED PERSULFATE OXIDATION**

**Miss Trakarn Prapasongsa**

**A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science in Environmental Management (Inter-Department)**

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Trichloroethylene (TCE) has been used as a component of industrial cleaning solution and as a universal degreasing agent. TCE is of concern due to its widespread use and highly adverse effects, especially a potential human carcinogen. TCE degradation by chemical oxidation processes can be by hydrogen peroxide, Fenton's reagent, potassium permanganate, or ozone. However, these processes have some limitations when applied to contaminated sites such as instability and requirement for specific conditions. The main objective of this study was to compare the performance of heat and UV activated persulfate oxidations. This research tried to enhance the efficiency of the heat and UV activated persulfate oxidation methods by determining the optimal oxidant/TCE molar ratio to degrade the contaminant in different ranges of TCE concentration. The optimum temperature of heat persulfate oxidation obtained from Liang et al. (2003)'s study was 40°C. In UV persulfate oxidation system, average UV intensity was 10.96  $\mu$  Einstein/s as was measured by ferrioxalate actinometer. The TCE degradation by heat and UV activated persulfate oxidations was found to follow a pseudo-first-order reaction. The most effective condition in this study was heat activated persulfate oxidation at 40°C using persulfate/TCE molar ratio of 15:1 with 99.9 % of TCE removal and 1.40  $\text{hr}^{-1}$  of rate constant within 5 hrs (initial TCE concentration of 10 ppm). For the UV activated persulfate oxidation, the optimal condition was persulfate/TCE molar ratio of 10:1 at UV intensity of 10.96  $\mu$  Einstein/s with 99.8 % of TCE removal and 1.35  $\text{hr}^{-1}$  of rate constant within 5 hrs (initial TCE concentration of 10 ppm). In the degradation of 50 ppm and 100 ppm TCE, heat persulfate oxidation was able to degrade TCE effectively. For UV persulfate oxidation, the efficiency was obviously decreased when increasing TCE concentration. The factors that limited the performance of heat and UV activated persulfate oxidation might be persulfate concentration, and UV intensity or lamp power, respectively. For energy consumption aspect, the UV persulfate oxidation system was more effective because it required much less energy (180 kJ for 20 W system and 9,000 kJ for 1 kW system) comparing with the heat activated persulfate oxidation system (62,760 kJ) for 1  $\text{m}^3$  of wastewater.

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## LIST OF ABBREVIATIONS

ATSDR	=	Agency for Toxic Substances and Disease Registry
ERTC	=	Environmental Research and Training Center
MCL	=	maximum contaminant level
MTBE	=	methyl <i>tert</i> -butyl ether
PCBs	=	polychlorinated biphenyls
PCE	=	tetrachloroethylene
ppb	=	part per billion
ppm	=	part per million
TOC	=	total organic carbon
TCA	=	1,1,1-trichloroethane
TCE	=	trichloroethylene