

Radiation Induced Decomposition of Pentachlorophenol in Water

Yongke He, Jun Liu and Jilan Wu

Department of Technical Physics, Peking University, Beijing 100871, China

The decomposition of PCP in water induced by γ -irradiation has been studied at low PCP concentration under various conditions (different atmosphere or different pH). PCP is consumed linearly with increasing dose. At the later stage where most PCP are consumed and the remaining couldn't compete for $\cdot\text{OH}$ radicals with products efficiently, thus the consumption rate (G value) decreases. PCP could be consumed almost completely by γ -irradiation at relative high doses. Chloride ions are eliminated simultaneously with the consumption of PCP. The amount of chloride eliminated increases also linearly with the increasing absorbed dose. At relative high absorbed dose, almost all chloride ions (*i.e.* five times of initial amount of PCP) are eliminated. The G values of PCP consumption and that of chloride ion formation are compiled in Table 1.

Table 1 The compilation of G values for PCP consumption and Cl^- elimination

pH	air		N_2		N_2O	
	$G(\text{PCP})$	$G(\text{Cl}^-)$	$G(\text{PCP})$	$G(\text{Cl}^-)$	$G(\text{PCP})$	$G(\text{Cl}^-)$
5	-0.22	1.1	N.D.	2.4	N.D.	2.7
9	-0.37	1.7	-1.2	4.8	-1.5	7.1

Note: G values in the units of 10^{-7} mol J^{-1} ; N. D. not determined.

Chemical oxygen demand (COD) has also been measured after irradiation. The results are shown in Table 2. These results suggest that at the early stage the benzene ring open is

negligible in the consumption of PCP induced by OH radicals though O₂ is present, which agrees to the low reactivity of phenoxy radical towards O₂. [1]

Table 2 COD_{Mn} values of irradiated PCP. [PCP]₀ = 6.3 × 10⁻⁵ mol dm⁻³, pH 5.3, air-saturated, dose rate 0.3~1.2 Gy s⁻¹.

Dose / Gy	0	530	1600	2500
COD _{Mn} / mg dm ⁻³	10.5	10.5	9.4	3.4

O₃ itself can decompose PCP at pH 8.6. After saturation of 4.81 × 10⁻⁵ mol dm⁻³ PCP aqueous solution with O₃ for 20 min, [PCP] drops 2.6 × 10⁻⁵ mol dm⁻³ while 1.56 × 10⁻⁴ mol dm⁻³ chloride is formed. This indicates that O₃ induced dechlorination of PCP might be in a cooperative way. When the ozonolysed PCP is subjected to γ irradiation, the *G* value for PCP consumption is measured to be 0.2 × 10⁻⁷ mol J⁻¹, while the *G* value for chloride formation is 0.8 × 10⁻⁷ mol J⁻¹. Comparing to the results obtained when PCP solution is γ irradiated without ozonation, the *G* value for the formation of chloride decreases markedly. This is reasonable however when one considers the high reactivity of Cl⁻ towards OH radical. [2]

References

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