

Treating Tannery Effluent

Removal of persistent organics from tannery effluent

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Project Description

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Project Content

The overall objective of this project was to develop a pilot scale system capable of oxidising 4-chloro-3-methylphenol (CMP) in wastewater. Ozone was chosen as an appropriate oxidising agent and a series of laboratory trials were conducted to obtain the appropriate treatment conditions for a larger scale application. The effects of adding Fenton's reagents (hydrogen peroxide) on the ozone treatment efficiency was also assessed. Two pilot scale systems were then tested on site, one relied on a dissolved ozone delivery method (venturi injection), and the second used a direct ozone delivery approach (blower).

Project Outcome

The laboratory trials demonstrated that removal of CMP from wastewater was at least 70% within 2-3 hours. Fenton's reagent did improve CMP removal but only by 10%. The degradation rates of CMP in the ozone only and ozone plus Fenton's during lab scale treatment were similar, $\sim 120 \text{ mg CMP g}^{-1} \text{ O}_3 \text{ h}^{-1}$.

In the pilot trials, the addition of ozone via a venturi system achieved a 33% removal of CMP within 24 h, this equated to a removal rate of $7.5 \text{ mg CMP g}^{-1} \text{ O}_3 \text{ h}^{-1}$. The addition of Fenton's reagent increased the removal of CMP to 70% in the venturi injection trial and almost doubled the removal rate ($13 \text{ mg CMP g}^{-1} \text{ O}_3 \text{ h}^{-1}$). Note that the presence of solids in the wastewater resulted in frequent pump blockages that were a persistent issue. Future pilot systems using an ozone delivery system will need a more solids friendly pump. The addition of ozone via the blower system was not as effective as the venturi system because of the large loss of ozone from the tank reactor.

Benefit for Industry

Based on the pilot scale results we were able to design an optimised ozone/Fenton's system for further testing. The new system would be based on a 20 g h^{-1} ozone unit, a venturi-based delivery system, and Fenton's reagents (0.125 mM Fe^{2+} and $50 \text{ mM H}_2\text{O}_2$). With this system we estimate that it would be possible to remove $> 90\%$ of the CMP from 1500 L of tannery wastewater in 24 h .

The running cost of this treatment would be $\sim \$40$. Without the Fenton's reagents we could treat 670 L of wastewater in 24 h for $< \$10$.

Useful resources

<http://www.oxyzone.com.au/>

Table 1. Calculated volume of wastewater that could be treated to > 90% for CMP in 24 h under the given conditions. The power and chemical costs for this treatment are also provided

Treatment	O ₃ conc (g h ⁻¹)	H ₂ O ₂ (mM)	Fe ²⁺ (mM)	L in 24 h	Power (\$)	Chem (\$)
Mixed tank	-	50	0.125	646	4.6	29.7
Venturi	20	-	-	670	7.7	0.0
Venturi	20	50	0.25	796	7.7	29.8
Venturi	20	50	0.5	957	7.7	30.1
Venturi	20	50	0.125	1519	7.7	29.8
Venturi	20	75	0.125	1417	7.7	44.6
Blower	20	-	-	244	9.4	0.0
Blower	20	-	-	271	9.4	0.0
Blower	20	50	0.5	355	9.4	29.8
Blower	20	50	0.5	423	9.4	29.8