

Disinfection of Tertiary Effluent using Surfactants Immobilized on the Surfaces of Minerals

World Water Forum Project

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Background

- ▶ **Many regions of the world rely on imported water and frequently face critical water shortage**
- ▶ **To ensure safe and affordable water supply, the regions must diversify and increase local portfolio**
- ▶ **The use of recycled water for non-potable application can substantially supplement local sources and reduce quantity of imported water**

Research Objective

- ▶ **The main objective of the research is to evaluate the effectiveness of surfactants immobilized on the surfaces of minerals to disinfect tertiary effluent**

Research Tasks

▲ Adsorption studies

- ❑ Kinetic studies
 - ✓ To determine the time required for loading the surfactants on to the surface of minerals
- ❑ Isotherm studies
 - ✓ To determine surfactant-mineral combinations with highest affinities

▲ Disinfection studies

- ❑ To investigate the effect of varying mineral dose
- ❑ To evaluate the influence of varying surfactant dose
- ❑ To assess the impact of contact time

Materials

▲ Surfactants

- ❑ Hexadecyltrimethylammonium bromide (CTAB)
- ❑ Didodecyldimethylammonium bromide (DDAB)

▲ Minerals

- ❑ Granular Activated Carbon (GAC)
 - ✓ 4-12
 - ✓ 12-20
 - ✓ 20-40

Materials (cont.)

▶ Bacteria count

- ❑ Colisure
- ❑ Enteroleit
- ❑ AntiFoam

▶ Tertiary Effluent

- ❑ Padre Dam Water Recycling Facility
- ❑ Treatment processes at the facility
 - ✓ Primary Clarifier
 - ✓ Biological Nutrient Removal
 - ✓ Secondary Clarifiers
 - ✓ Flocculation/Sedimentation Clarifier
 - ✓ Denitrification Filter
 - ✓ Chlorination
- ❑ Sample collected after the filtration unit, before chlorination tank

Analytical Methods

▶ Total Organic Carbon (TOC) Analyzer

- Determine the concentration of surfactants

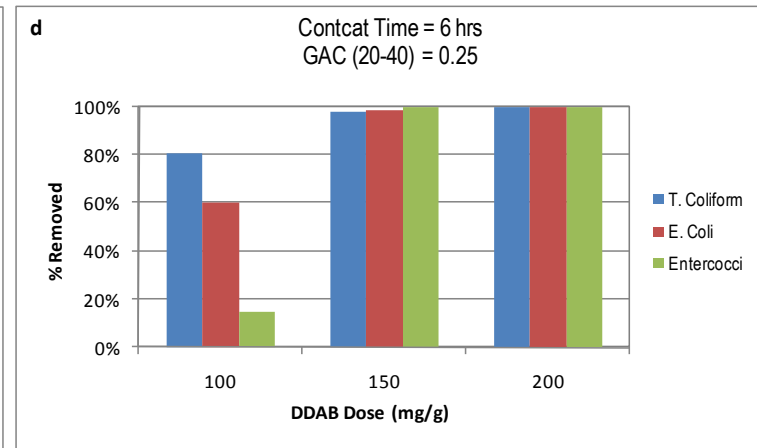
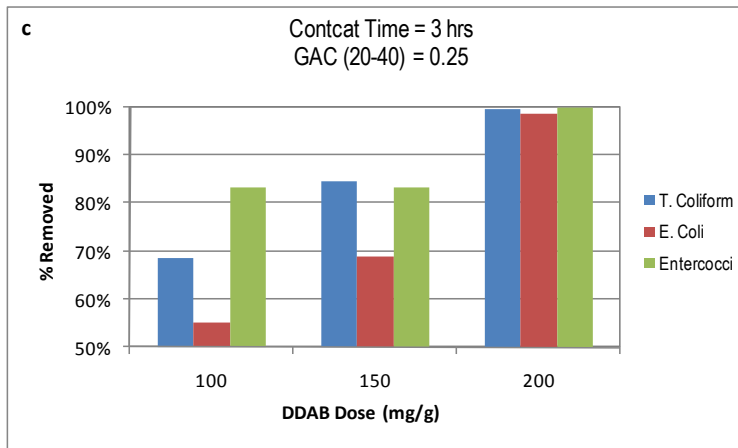
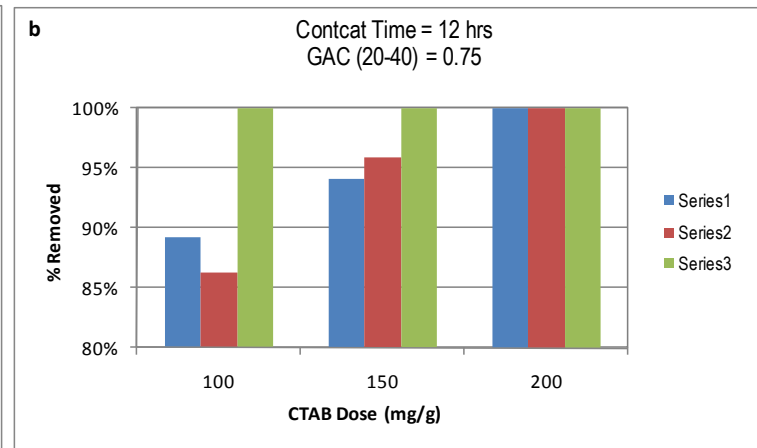
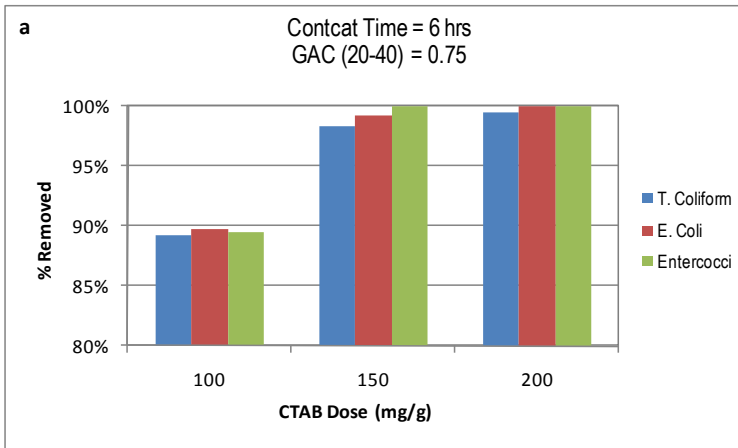
▶ IDEXX Method

- Used for bacteria count
 - ✓ Total Coliform
 - ✓ E. Coli
 - ✓ Enterococci

Results for Isotherm Studies – Summary

Surfactant	GAC	K_f
CTAB	4-12	110
	12-20	123
	20-40	123
DDAB	4-12	82
	12-20	106
	20-40	164

Results for Disinfection Studies



Results for Disinfection Studies - CTAB

GAC (g)	Surfactant Dose (mg/g)	Total Coliform			E. Coli			Enterococci		
		6 hrs	12 hrs	24 hrs	6 hrs	12 hrs	24 hrs	6 hrs	12 hrs	24 hrs
0.25	100	0.17	(0.01)	(0.39)	0.15	(0.03)	0.13	1.43	0.74	>1.32
	150	0.71	1.19	0.70	1.09	1.39	1.27	1.90	>1.70	>1.32
	200	2.81	2.80	2.36	>2.47	>2.35	>2.37	>1.90	>1.70	>1.32
0.50	100	0.53	0.27	1.19	0.48	0.50	1.68	0.69	0.55	0.14
	150	1.54	0.31	1.04	1.39	1.22	1.63	>1.53	>1.56	>1.42
	200	3.46	0.75	>3.27	>2.45	0.61	>2.31	>1.53	0.70	>1.42
0.75	100	0.97	0.97	0.73	0.99	0.86	0.83	0.98	>1.43	0.18
	150	1.78	1.23	0.85	2.10	1.38	>1.76	>1.68	>1.43	0.79
	200	2.33	>3.27	>2.68	>2.40	>2.29	>1.76	>1.68	>1.43	>0.80

Results for Disinfection Studies - DDAB

GAC (g)	Surfactant Dose (mg/g)	Total Coliform		E. Coli		Enterococci	
		3 hrs	6 hrs	3 hrs	6 hrs	3 hrs	6 hrs
0.25	100	0.50	0.71	0.35	0.40	0.78	0.07
	150	0.81	1.66	0.51	1.94	0.78	>0.78
	200	2.75	3.05	1.94	>2.41	>0.78	>0.78
0.50	100	1.25	1.24	1.16	1.18	1.56	>1.56
	150	1.21	1.54	0.95	1.50	1.56	>1.56
	200	2.83	2.66	>2.47	>2.47	>1.56	>1.56
0.75	100	1.78	1.45	1.34	1.25	1.97	>1.97
	150	1.59	1.57	1.11	1.04	>1.97	>1.97
	200	3.46	>3.76	2.86	>2.86	>1.97	>1.97

Summary

- ▶ **More than 3-log reduction in T. Coliform was achieved at 200 mg/g dose of CTAB for 6 and 12 hours contact times**
- ▶ **More than 3-log reduction in T. Coliform was achieved at 200 mg/g dose of DDAB for 3 and 6 hours contact times**
- ▶ **At 150 mg/g dose of CTAB, 0.75 g of GAC, and 6 hour contact time, approximately 2.1, 1.7, and 1.8-log reductions in E. Coli, Enterococci, and T. Coliform were achieved, respectively**
- ▶ **At 150 mg/g dose of DDAB, 0.75 g of GAC, and 6 hour contact time, approximately 1.0, 2.0, and 1.6-log reductions in E. Coli, Enterococci, and T. Coliform were achieved, respectively**

Q & A