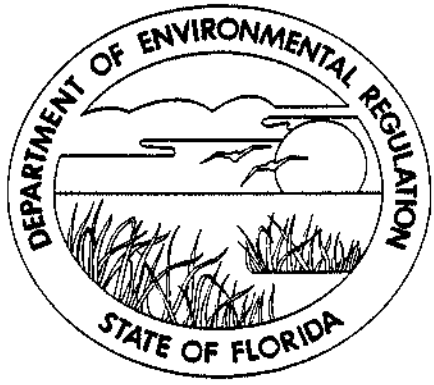


BIOASSAYS OF ADCOM WIRE PRODUCTS

CONTACT COOLING WATER DISCHARGE

JACKSONVILLE, DUVAL COUNTY, FLORIDA

NPDES #FL0030121

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Biological Section
Bureau of Water Analysis
October 26, 1981

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EXECUTIVE SUMMARY

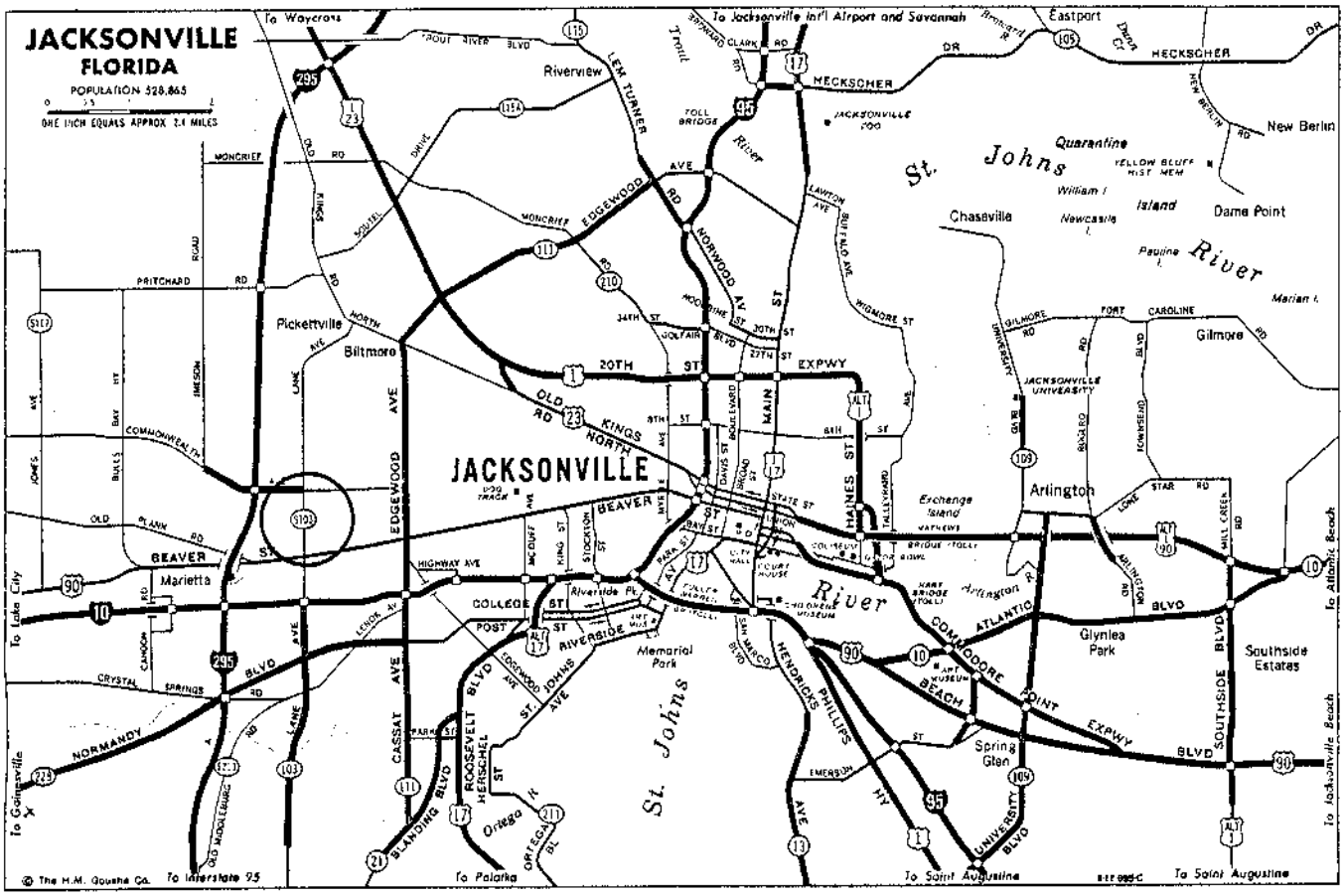
Bioassays of Adcom Wire Products, Contact Cooling Water Discharge
(30 September to 1 October, 1981)

Two static acute toxicity bioassays were performed on a grab sample of the contact cooling water discharge from Adcom Wire Products, to follow up on the reported toxicity of this facility's process wastewater (48 hour LC_{50} = 14.8%, FDER, 1981). Results indicated that the cooling water was acutely toxic to *Daphnia pulex* (48 hour LC_{50}'s = 86.8%) however, control mortality and the large 95% confidence interval cause the exact degree of toxicity to be doubtful. Therefore, we recommend that these tests be repeated.

INTRODUCTION

Adcom Wire Products, also known as Container Wire Products, operates from a facility located at 925 N. Lane Ave., Jacksonville, Duval County, Florida (Fig. 1). It produces a finished steel wire from the pickling, drawing and galvanizing of old steel wire. Wastewater from this operation consists of concentrated sulfuric acid, pickling acid, process rinse water and boiler blowdown. The wastewater is treated with lime to neutralize the acid and to precipitate iron, the major component. Discharge of the 0.003 MGD wastewater is to an unnamed ditch which flows to the Cedar River, a tributary of the St. Johns River. Another discharge from this facility consists solely of contact cooling water, which is used to cool the hot steel wire after processing. This discharge also enters the ditch to the Cedar River, and ultimately, the St. Johns River.

In September 1981, the Biological Section performed static acute toxicity bioassays on a sample of Adcom Wire Products process wastewater. Results indicated acute toxicity to the test organisms, with 24 and 48 hour LC_{50}'s of from 24.0% to 13.7% (FDER, 1981). The toxicity may have been due to the high pH and specific ion content of the wastewater. To evaluate all discharges from this facility, the Biological Section performed additional static acute toxicity bioassays. These tests were performed on a grab sample of the contact cooling water discharge, on 30 September to 1 October, 1981. The results of these latest tests are presented in this report.



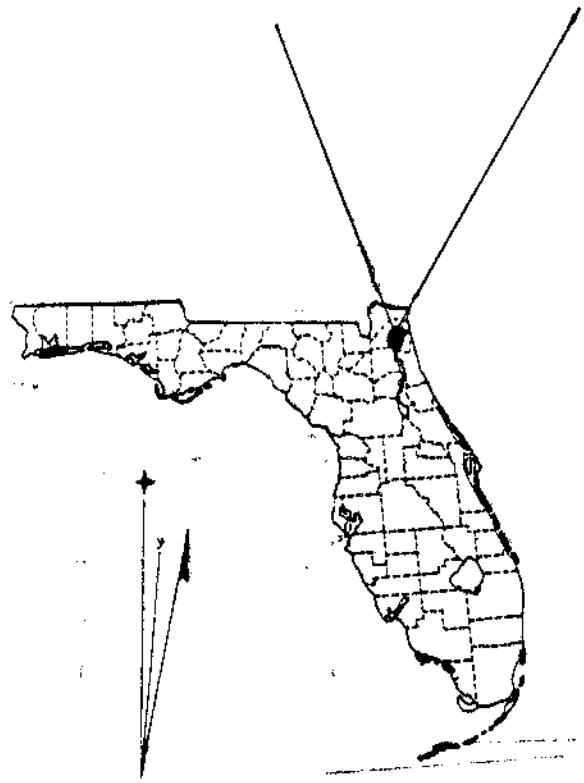


Figure 1. The City of Jacksonville, Duval County, Florida, including approximate location of Adcom Wire Products.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978). The organism selected for this study include a species recommended by Peltier (1978) and the U. S. EPA (1978). Additionally, the Biological Section maintains cultures of several species of organisms indigenous to the State of Florida. Life histories of these test organisms and maintenance procedures used to culture them are detailed below.

History and Maintenance of Bioassay Organisms

Daphnia pulex (water flea) - A breeding culture of Daphnia pulex was obtained from the EPA laboratory in Athens, Georgia in March, 1979. This culture has been maintained since its arrival, in 2½ gallon all glass aquaria filled with unchlorinated DER well water, using a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, and are kept at a constant temperature of 22° ± 1°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess daphnids. They are then refilled with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Simocephalus serrulatus (water flea) - An indigenous breeding population of S. serrulatus was collected from Lake Jackson, Leon County, Florida, in March, 1980, by personnel from DER's Biological Section. Positive identification of the organism was performed by Mr. Jeff Foran of the Department of Environmental Engineering Sciences, University of Florida in Gainesville. The cultures are maintained in 2½ gallon all glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. The organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, and are kept at a constant temperature of 22° ± 1°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess population. They are then refilled with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biological Section conducts monthly Standard Reference Toxicant Bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

Two separate 48 hour static bioassays were conducted from 1430 hours on 30 September, 1981 to 1430 hours on 1 October, 1981, on a grab sample of effluent from the contact cooling water outfall. The sample was collected by Mr. Dennis Murrin of DER's St. Johns River Subdistrict, at 0755 hours on 30 September, 1981, using standard wastewater sampling procedures. The sample was iced and transported to the DER laboratory in Tallahassee for analysis within 24 hours of collection.

Freshwater for dilution of the effluent sample was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study (Table 1) is that recommended by APHA (1976).

Two replicates, each with six concentrations and a control, were used to test with Daphnia pulex and Simocephalus serrulatus. Flint glass jars of 250 ml capacity were used as test chambers, and 200 ml of the appropriate test concentration was placed in each chamber. Daphnia and Simocephalus were siphoned into large culture dishes. The Daphnia were siphoned through a stainless steel screen to help isolate the proper size and age organisms (neonates). Neonates of both species were then transferred individually by glass pipette and were loaded ten per chamber, resulting in 20 per test concentration.

Dissolved oxygen, pH, temperature and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. Total alkalinity and total hardness were recorded at the beginning of the test for the controls and the 100% effluent concentration. The specific conductance of each test concentration was recorded at the beginning and end of the test. Ammonia concentrations, including total and unionized fractions (expressed in mg/l as N and NH_3, respectively) were recorded in the 100% test concentration at the beginning of the test. The total ammonia concentration was measured using an Orion specific ion probe and a Corning pH/millivolt meter. The unionized fraction was determined based on the total concentration, the pH and the temperature of the sample. These values were recorded on the bioassay data forms and are presented in Tables 2 and 3. Organisms were not fed during these tests.

Table 1. Concentration Series and Volumes Used for These Static Bioassays

Concentration	Dilution Water	Effluent	Total Vol.
Control	200 ml	---	200 ml
5.6%	188.8 ml	11.2 ml	200 ml
10.0%	180 ml	20 ml	200 ml
18.0%	164 ml	36 ml	200 ml
32.0%	136 ml	64 ml	200 ml
56.0%	88 ml	112 ml	200 ml
100%	----	200 ml	200 ml

Table 2. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of Adcom Wire Products, Contact Cooling Water Discharge, Jacksonville, Duval County, Florida, NPDES #FL0030121, on 30 September to 1 October, 1981.

Conc. or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Total Alkalinity (mg/ℓ as $CaCO_3$)		Total Hardness (mg/ℓ as $CaCO_3$)		Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Conductivity (μmhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	9	8.2	9.0	8.8	7.8	8.2	8.2	116		116		21.8	21.5	21.5				
Control	10	9	9	8.2	9.1	8.7	7.8	8.2	8.2										209	228
5.6%	10	10	8	8.2	9.1	8.7	7.8	8.2	8.2					21.7	21.5	21.5				
5.6%	10	10	9	8.2	9.1	8.6	7.8	8.2	8.2										225	244
10%	10	10	6	8.2	9.1	8.6	7.9	8.2	8.2					21.6	21.6	21.6				
10%	10	10	7	8.1	9.1	8.6	7.9	8.2	8.2										238	257
18%	10	10	8	8.1	9.1	8.5	7.9	8.2	8.2					21.5	21.6	21.7				
18%	10	9	6	8.1	9.1	8.5	7.9	8.2	8.2										257	279
32%	10	10	7	7.9	9.1	8.5	7.9	8.2	8.2					21.3	21.7	21.8				
32%	10	10	6	7.9	9.1	8.5	7.9	8.2	8.2										290	315
56%	10	9	5	7.9	9.1	8.5	8.0	8.2	8.2					20.8	21.9	22.0				
56%	10	10	6	7.8	9.1	8.5	8.0	8.2	8.2										339	379
100%	10	8	5	7.5	9.1	8.5	8.0	8.2	8.2	123		236		20.1	22.2	22.3	.02/.37			
100%	10	10	3	7.5	9.1	8.6	8.0	8.2	8.2										439	480

Remarks:

Table 3. Data recorded during 48 hour, Simocephalus serrulatus, static acute toxicity bioassay of Adcom Wire Products, Contact Cooling Water Discharge, Jacksonville, Duval County, Florida, NPDES #FL0030121, on 30 September to 1 October, 1981.

Conc. or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alkalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°C)			NH_3/NH_3+NH_4 (mg/l)		Conductivity (µmhos)	
	0	24	48[a]	0	24	48[a]	0	24	48[a]	0	48	0	48	0	24	48[a]	0	48	0	48[a]
Control	10	8	6	8.2	9.1		7.9	8.2		116		116		22.0	22.4					
Control	10	8	5	8.2	9.1		7.9	8.2											212	
5.6%	10	10		8.2	9.1		7.9	8.2						21.9	22.2					
5.6%	10	9		8.2	9.1		7.9	8.2											227	
10%	10	7		8.2	9.1		7.9	8.2						21.8	22.1					
10%	10	10		8.2	9.1		7.9	8.2											240	
18%	10	8		8.1	9.1		7.9	8.2						21.7	22.2					
18%	10	7		8.1	9.1		7.9	8.2											258	
32%	10	8		8.1	9.1		7.9	8.2						21.5	22.2					
32%	10	6		8.1	9.1		7.9	8.2											292	
56%	10	7		7.9	9.1		8.0	8.2						21.0	22.3					
56%	10	7		7.9	9.1		8.0	8.2											348	
100%	10	7		7.4	9.1		8.0	8.2		123		236		20.7	22.2		.02/.37			
100%	10	10		7.4	9.1		8.0	8.2											440	

Remarks: Data not reported since the test was invalidated at 48 hours due to excessive control mortality (>20%).

RESULTS AND DISCUSSION

The grab sample of contact cooling water from Adcom Wire Products was acutely toxic to the test organisms Daphnia pulex and Simocephalus serrulatus. The 24 hour LC_{50}'s for these organisms were both much greater than 100%. The 48 hour Daphnia pulex LC_{50} ranged from 65.6% to 67.9% (Table 4). The 48 hour Simocephalus serrulatus bioassay was invalidated due to excessive control mortality. Although, the Daphnia test was still a valid and definitive test, two animals had died in the controls by hour 48 of the test. Therefore, Abbot's formula (APHA 1980) was used to adjust the LC_{50} value by accounting for this control mortality. This raised the Daphnia pulex 48 hour LC_{50} value (i.e., decreased the toxicity) to a range of 82.5% to 86.8% (Table 4). The 96 hour Daphnia pulex LC_{50} would therefore be ≤86.8%. However, in addition to the control mortality, the large confidence intervals associated with the calculated LC_{50} values (Table 4) reflect the wide distributation of mortality throughout the test concentrations. Therefore, we suggest that, although cooling water from Adcom Wire Products is acutely toxic, the exact degree of toxicity is in question and the tests should be repeated. Since concurrent chemical analyses were not performed on this effluent sample, the cause of the observed toxicity is unknown.

Table 3. Data recorded during 48 hour, Simocephalus serrulatus, static acute toxicity bioassay of Adcom Wire Products, Contact Cooling Water Discharge, Jacksonville, Duval County, Florida, NPDES #FL0030121, on 30 September to 3 October, 1981.

Conc. or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Total Alkalinity (mg/ℓ as $CaCO_3$)		Total Hardness (mg/ℓ as $CaCO_3$)		Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Conductivity (µmhos)	
	0	24	48[a]	0	24	48[a]	0	24	48[a]	0	48	0	48	0	24	48[a]	0	48	0	48[a]
Control	10	8	6	8.2	9.1		7.9	8.2		116		116		22.0	22.4					
Control	10	8	5	8.2	9.1		7.9	8.2											212	
5.6%	10	10		8.2	9.1		7.9	8.2						21.9	22.2					
5.6%	10	9		8.2	9.1		7.9	8.2											227	
10%	10	7		8.2	9.1		7.9	8.2						21.8	22.1					
10%	10	10		8.2	9.1		7.9	8.2											240	
18%	10	8		8.1	9.1		7.9	8.2						21.7	22.2					
18%	10	7		8.1	9.1		7.9	8.2											258	
32%	10	8		8.1	9.1		7.9	8.2						21.5	22.2					
32%	10	6		8.1	9.1		7.9	8.2											292	
56%	10	7		7.9	9.1		8.0	8.2						21.0	22.3					
56%	10	7		7.9	9.1		8.0	8.2											348	
100%	10	7		7.4	9.1		8.0	8.2		123		236		20.7	22.2		.02/.37			
100%	10	10		7.4	9.1		8.0	8.2											440	

Remarks: Data not reported since the test was invalidated at 48 hours due to excessive control mortality (>20%).

Table 4. LC_{50} Data for Bioassay of Adcom Wire Products, Contact Cooling Water Discharge, NPDES #FL0030121, Jacksonville, Florida, on 30 September to 1 October, 1981.

Organism	Method of Data Analysis	24 hour LC_{50} and 95% confidence intervals	48 hour LC_{50} and 95% confidence intervals	48 hour LC_{50} and 95% confidence intervals corrected for control mortality[C]
Daphnia pulex	Binomial	A	67.9% (5.6 and ∞)	82.5% (5.6 and ∞)
	Moving Average	A	66.8% (0 and ∞)	82.5% (0 and ∞)
	Probit	>>100%	65.6% (33 and 650)	86.8% (47 and 515)
Simocephalus serrulatus	Binomial	A		
	Moving Average	A	B	
	Probit	>>100%		

A. Due to an insufficient number of dead organisms, or to the irregular distribution of mortality, an LC_{50} value cannot be calculated using this method of statistical analysis.

B. The 48 hour Simocephalus serrulatus bioassay was invalidated due to excessive control mortality (>2%).

C. The effects of control mortality (≤10%) were accounted for using Abbot's formula (APHA 1980).

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