

BIOASSAYS OF ADCOM WIRE PRODUCTS

JACKSONVILLE, DUVAL COUNTY, FLORIDA

NPDES #FL0030121

Biological Section
Bureau of Water Analysis
September 23, 1981

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EXECUTIVE SUMMARY

Bioassays of Adcom Wire Products (9 to 11 September 1981)

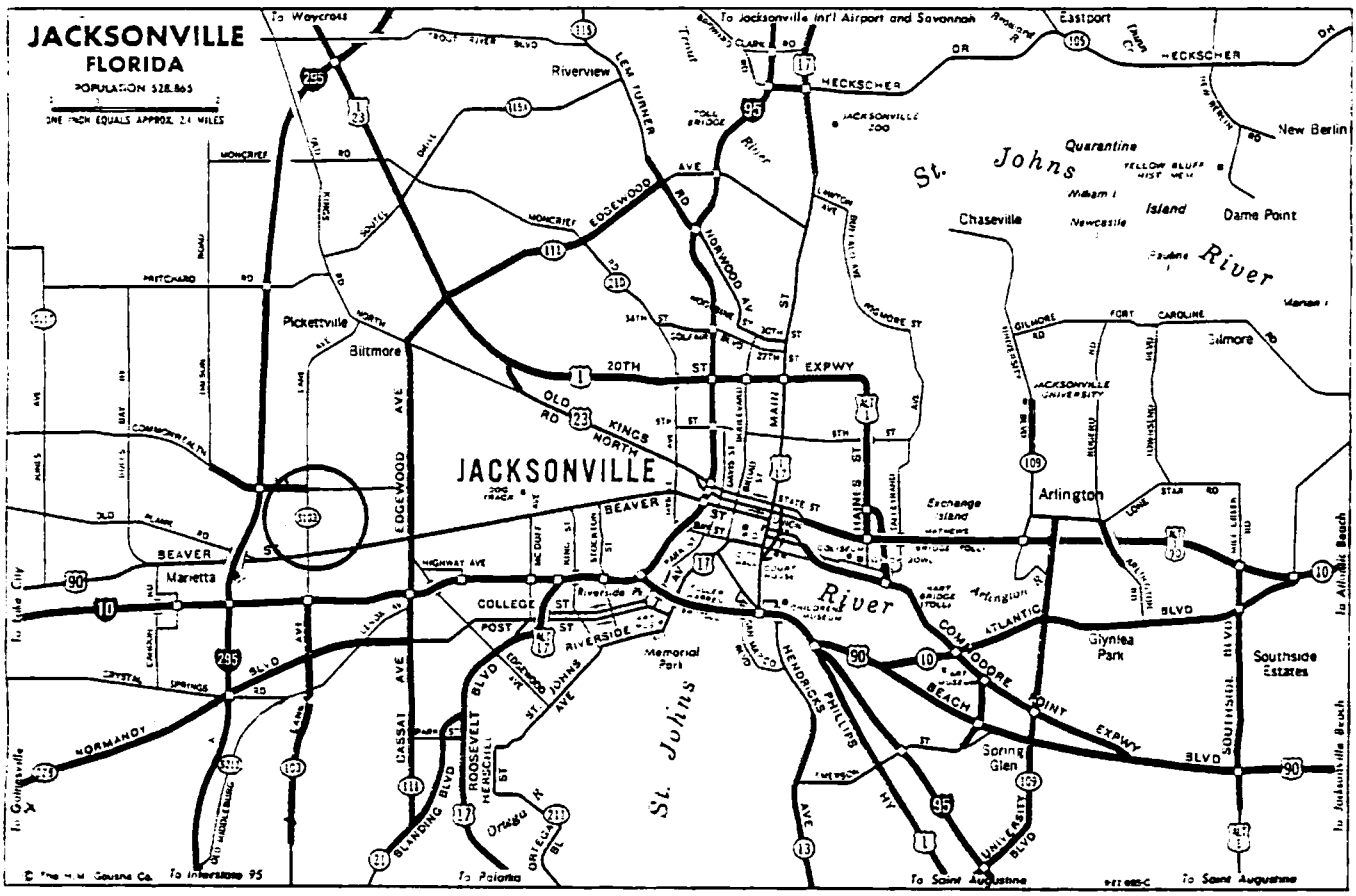
This effluent grab sample from Adcom Wire Products' Outfall #001 was toxic to the test organisms. The 48 hour LC_{50} for Daphnia pulex ranged from 13.7% to 14.8%. The 48 hour Simocephalus serrulatus bioassay was invalidated due to control mortality, however, a valid 24 hour LC_{50} was calculated between 19.7% and 24.0%. The toxicity could not be attributed to a specific chemical. The high sample pH (up to 10.9) and ion content (specific conductance =11200 µmhos/cm) may have contributed to the mortality.

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.

According to the NPDES file on this facility, an iron sludge was dumped into an adjacent ditch in July, 1979, and, a Notice of Violation was issued in February, 1980, for exceeding pH limitations (reported value was approximately 11 units). Additionally, a September, 1980, NPDES Compliance Inspection Report noted that the pH of the discharge was still very high.

To evaluate the effects of this discharge to the biota of the receiving waters, the Biological Section performed static acute toxicity bioassays, on a grab sample of effluent, on 9 to 11 September, 1981. The results of these tests are presented in this report.



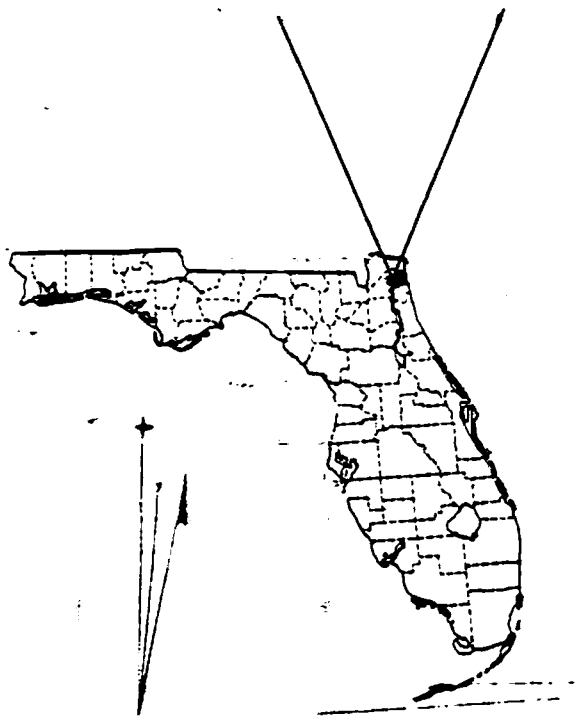


Figure 1. The City of Jacksonville, Duval County, Florida, including approximate location of Adcom Wire Products.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978). The organisms selected for this study include a specie 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 1015 hours on 9 September, 1981, to 1030 hours on 11 September, 1981, on a grab sample of effluent from Outfall #001. The sample was collected by Ms. Teresa Ashworth of DER's St. Johns River Subdistrict at 1240 hours on 8 September, 1981, using standard wastewater sampling procedures. The samples was iced and transported to the DER laboratory in Tallahassee for testing within 24 hours of its collection.

Freshwater for dilution of the effluent sample was obtained from the same DER 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 through stainless steel screens to isolate the proper size and age organisms (neonates). These neonates were then transferred individually by glass pipette and were loaded 10 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. Specific conductance was recorded for each test concentration at the beginning and end of the test. 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

Daphnia pulex and Simocephalus serrulatus (water fleas)

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, Jacksonville, Duval County, Florida, NPDES #FL0030121, on 9 to 11 September, 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[a] (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	8.3	8.9	8.6	8.0	8.3	8.2	115		118		21.3	20.0	21.3				
Control	10	10	10	8.4	9.0	8.7	8.0	8.3	8.2										209	220
5.6%	10	10	9	8.4	9.0	8.7	8.7	8.0	7.9					21.2	20.0	21.3				
5.6%	10	10	10	8.3	9.1	8.7	8.7	8.0	7.9										1000	1000
10%	10	9	7	8.4	9.1	8.7	8.8	8.0	7.8					21.2	20.1	21.3				
10%	10	9	5	8.4	9.2	8.7	8.8	8.0	7.8										1400	1425
18%	10	6	5	8.4	9.0	8.7	9.0	7.9	7.7					21.1	20.2	21.5				
18%	10	7	4	8.4	9.1	8.8	9.0	7.9	7.7										2300	2490
32%	10	0	0	8.4	9.1	8.8	9.2	8.6	8.1					21.2	20.4	21.6				
32%	10	1	1	8.3	9.2	8.9	9.2	8.6	8.1										3980	4090
56%	10	0	0	8.1	9.1	8.9	9.8	9.1	8.7					21.3	20.4	21.6				
56%	10	0	0	8.1	9.1	8.9	9.8	9.1	8.8										6750	6750
100%	10	0	0	7.3	9.2	8.9	10.9	9.5	9.0	345[b]/532		>1500		21.8	20.5	21.7				
100%	10	0	0	7.4	9.2	8.9	10.9	9.5	9.1										11200	11250

Remarks:

[a] Unable to obtain ammonia concentrations due to clogging of membrane by sample precipitate.

[b] Phenolphthalein alkalinity.

Table 3. Data recorded during 48 hour, Simocephalus serrulatus, static acute toxicity bioassay of Adcom Wire Products, Jacksonville, Duval County, Florida, NPDES #FL0030121, on 9 to 11 September, 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 [a] (mg/l)		Conductivity (µmhos)	
	0	24	48[b]	0	24	48[b]	0	24	48[b]	0	48	0	48	0	24	48[b]	0	48	0	48[b]
Control	10	10		8.3	9.1		8.1	8.3		115		118		21.3	20.4					
Control	10	10		8.4	9.0		8.1	8.4											209	
5.6%	10	8		8.4	9.1		8.7	8.1						21.2	20.6					
5.6%	11[c]	8		8.4	9.1		8.7	8.1											920	
10%	10	10		8.4	9.0		8.8	8.0						21.1	20.6					
10%	10	10		8.4	9.0		8.8	8.0											1400	
18%	10	6		8.4	9.0		9.0	7.9						21.1	20.7					
18%	10	8		8.4	9.1		9.0	8.0											2300	
32%	10	6		8.2	9.0		9.3	8.5						21.3	20.7					
32%	10	0		8.2	9.0		9.3	8.6											3925	
56%	10	0		8.3	9.0		9.9	9.1						21.4	20.6					
56%	10	0		8.2	9.1		9.9	9.1											6740	
100%	10	0		7.3	9.0		10.9	9.5		345[d]/532		>1500		21.8	20.2					
100%	10	0		7.3	9.0		10.9	9.4											11200	

Remarks:

[a] Unable to obtain ammonia concentrations due to clogging of membrane by sample precipitate.

[b] The bioassay at 48 hours was invalidated due to excessive control mortality (>20%), therefore, these data were not recorded.

[c] Extra organism loaded by mistake, allowed to remain.

[d] Phenolphthalein alkalinity.

RESULTS AND DISCUSSION

The grab sample of effluent from Adcom Wire Products proved to be acutely toxic to both Daphnia pulex and to Simocephalus serrulatus. The 24 hour LC_{50}'s for Daphnia pulex ranged from 18.3% to 20.4%, while the 48 hour LC_{50}'s ranged from 13.7% to 14.8% (Table 4). The 96 hour LC_{50} would therefore be $\leq$14.8%. The 24 hour Simocephalus serrulatus bioassay resulted in similar acute toxicity (LC_{50}'s = 19.7% to 24.0%), however, at 48 hours, the bioassay was invalidated due to excessive control mortality (Table 4). The 96 hour LC_{50} for this organism would therefore be $\leq$24.0%.

Since chemical analyses were not performed on this sample, it is difficult to attribute the cause of this toxicity. However, the extremely high specific conductance recorded in the effluent (11200 µmhos, Tables 2 and 3) may reflect an ion content which may have adversely affected the organisms. Additionally, the high pH recorded in the effluent (10.9 units, Tables 2 and 3) may have resulted in the toxicity.

Chapter 17-3.051, Florida Administrative Code, indicates that "all waters of the State shall at all places and at all times be free from...components of discharges which...are acutely toxic." "Acute toxicity" is defined in Chapter 17-3.021(1) to mean the "the presence of one or more substances...in amounts which are greater than one-third (1/3) of the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50})...". In the absence of a mixing zone, this 1/3 of the 96 hour LC_{50} applies at the point of discharge. Chapter 17-4.244(4) states that "in no event shall the maximum concentration of wastes in the mixing zone exceed the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50}) for a species significant to the indigenous aquatic community...". This criterion applies at the point of discharge if there is a mixing zone. The distinction between presence or absence of a mixing zone is not relevant here, however, since the testing procedure used does not involve effluent concentration. The 1/3 of the 96 hour LC_{50} criterion is three times as stringent as the 96 hour LC_{50} criterion, and therefore, in the absence of a mixing zone, the procedure used is very lenient. The procedure followed is also lenient in that testing is only done for 48 hours. The 96 hour LC_{50} derived from this testing is therefore reported as "less than or equal to" the 48 hour measurement. The value found after 48 hours can never be more restrictive than the value found after 96 hours. It must be noted that all organisms used in these tests are significant to the indigenous aquatic community since they are sensitive to toxic substances which may be expected to impact the indigenous community.

The toxicity reported here is in excess of allowable limits.

Table 4. LC_{50} Data for Bioassay of Adcom Wire Products, Jacksonville, NPDES #FL0030121, on 9 to 11 September, 1981.

Organism	Method of Data Analysis	24 hour LC_{50} and 95% confidence intervals	48 hour LC_{50} and 95% confidence intervals
Daphnia pulex	Binomial	20.4%(10 and 32)	14.8%(5.6 and 32)
	Moving Average	18.3%(15 and 22)	13.7%(11 and 17)
	Probit	18.7%(16 and 22)	13.7%(11 and 17)
Simocephalus serrulatus	Binomial	24.0%(10 and 56)	
	Moving Average	20.7%(15 and 28)	B
	Probit	19.7%(0.4 and 231),A	

A. Due to the distribution of mortality, results using the probit method are not statistically sound.
B. The 48 hour Simocephalus serrulatus bioassay was invalidated due to excessive control mortality, therefore, the 24 hour values are used to report lethality.

LITERATURE CITED

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