BIOASSAYS OF THE ANCHORAGE DRIVE WASTEWATER TREATMENT PLANT

NORTH PALM BEACH, PALM BEACH COUNTY, FLORIDA

NPDES #FL0029106

SAMPLED 8/17/82

Biology Section
Bureau of Water Analysis
September 17, 1982

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EXECUTIVE SUMMARY

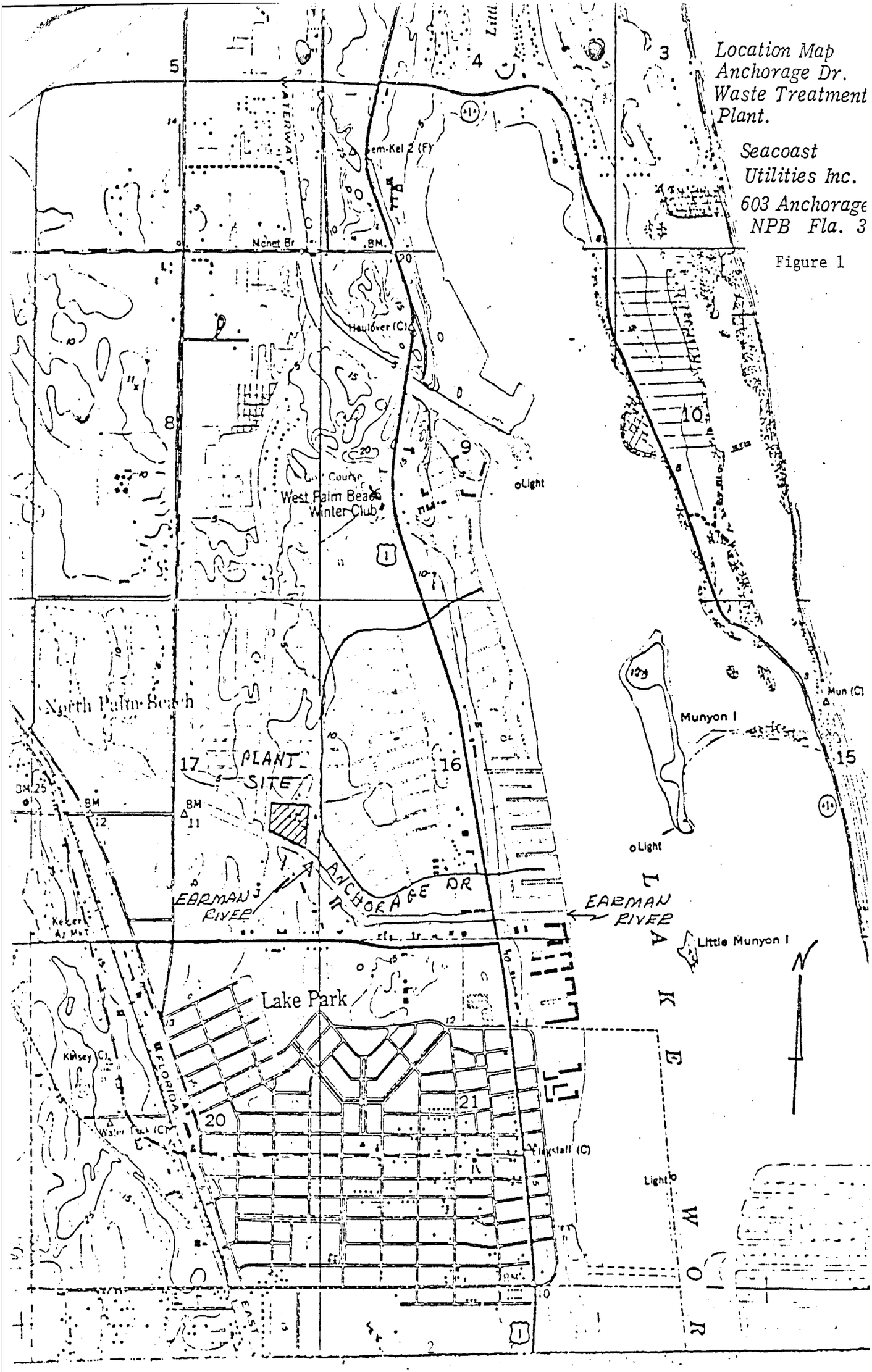
Anchorage Drive WWTP, N. Palm Beach, NPDES #FL0029106, on 18 to 20 August, 1982

All three samples of pre-chlorinated, chlorinated and de-chlorinated effluents from this domestic waste treatment facility were acutely toxic to Mysidopsis bahia, with 48 hour LC_{50} values of 24%, 13.4% and 25.1% to 26.5%, respectively. The toxicity of these effluents can be attributed to the presence of significant concentrations of ammonia (total and unionized) and to a variety of organic and metal constituents. The increased toxicity of the chlorinated sample can be attributed to the added toxic effects of the total residual chlorine measured in that sample. Chemical analyses indicated the presence of 12 unidentified organic compounds, 5 of which were halogenated, and, significant amounts of the metals copper (17 µg/l), mercury (0.6 µg/l), nickel (94 µg/l) and zinc (45 µg/l).

INTRODUCTION

The Anchorage Drive Wastewater Treatment Plant is located at 603 Anchorage Drive in North Palm Beach, Palm Beach County, Florida (Fig. 1). This domestic waste treatment facility, owned and operated by Seacoast Utilities, serves a surrounding residential population of approximately 50,000. The facility has a design flow capacity of 4.85 MGD, but treats only 1.95 MGD of domestic waste. Treatment consists of complete mix activated sludge with two aerobic sludge digesters. A flow diagram of the treatment process is presented in Figure 2. Discharge of effluent is to the Earman River (C-17 Canal), which flows to Lake Worth, a portion of the Intercoastal Waterway.

To evaluate the existence and extent of toxicity of this effluent to the biota of the receiving waters, the Biology Section performed static acute toxicity bioassays on pre-chlorinated, chlorinated and de-chlorinated grab samples on 18 to 20 August, 1982. The results of these tests are presented in this report.



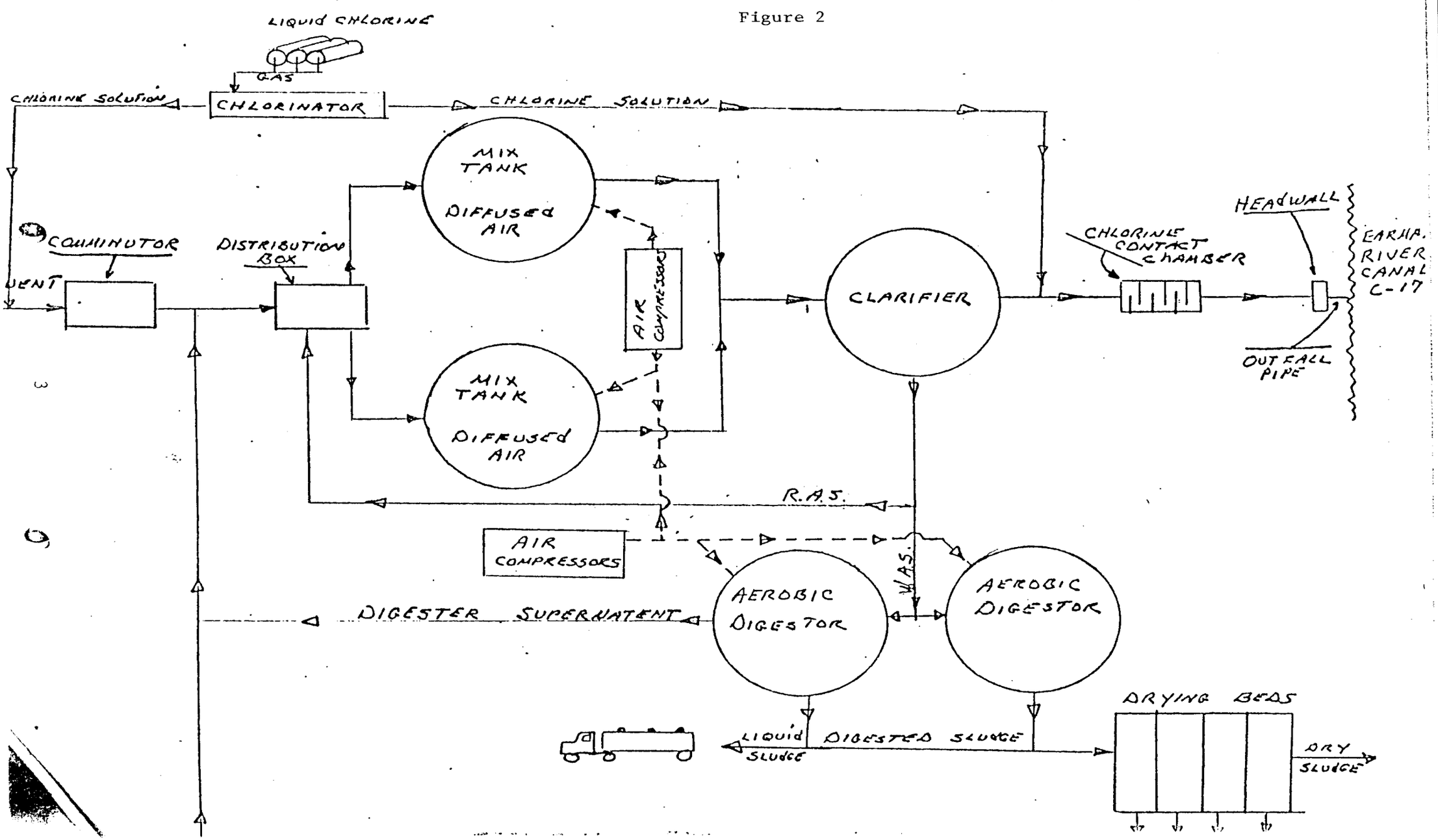
Location Map
Anchorage Dr.
Waste Treatment
Plant.

Seacoast
Utilities Inc.
603 Anchorage
NPB Fla. 3

Figure 1

SEACOAST UTILITIES INC.
ANCHORAGE DRIVE WASTE TREATMENT PLANT.
603 ANCHORAGE DRIVE, N. PALM BEACH FLA.

Figure 2



METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978). The organism selected for this study is among those recommended by Peltier (1978) and the U.S.EPA (1978). The life history and maintenance procedures used to culture the organism are detailed below.

History and Maintenance of Bioassay Organisms

Mysidopsis bahia (mysid shrimp) - In September, 1978, approximately 300 adult mysid shrimp were obtained from the EPA laboratory in Gulf Breeze, Florida. The mysids are cultured under a 16:8 hour light-dark cycle in 10 and 15 gallon all glass aquaria equipped with undergravel filtration and aeration. The mysid shrimp are cultured over a wide range of salinities (10-30 ppt) to minimize acclimation periods to low or high salinity effluents. Seawater is obtained from the FSU Marine Laboratory located at Turkey Point, Florida (salinity range 17-31 ppt) and partial water changes are performed weekly. Freshwater, for dilution of the seawater as necessary, is obtained from a deep well near the DER laboratory. The mysids are fed twice daily with freshly hatched Artemia (brine shrimp) and are kept at a constant temperature of 22° plus minus 1°C. Ten to fifteen day old (three-quarter adult size) mysids were used in this test.

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

Three separate 48 hour static acute toxicity bioassays were performed on samples of pre-chlorinated, chlorinated and de-chlorinated effluents from the Anchorage Drive WWTP. The tests were performed from 1130 hours on 18 August to 1200 hours on 20 August, 1982. The samples were collected by Mr. Kevin Ruddick of DER's Port St. Lucie Office at 1332 hours on 17 August, 1982, using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analyses were preserved with HNO_3. Samples for organic chemical analyses and for the bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

To differentiate between the toxicity resulting from chlorine and the toxicity assosiated with some other component of the effluent, the Biological Section adopted the following test procedure:

Test #1. Pre-Chlorinated Effluent (Table 2). This test was performed on an effluent sample collected at the end of the treatment process but prior to chlorination, and was intended to evaluate the toxicity of the effluent without the added toxic effects of chlorine.

Test #2. Chlorinated Effluent (Table 3). This test was performed on an effluent sample collected at the point of discharge.

Test #3. De-chlorinated Effluent (Table 4). This test was performed on a subsample of the chlorinated effluent sample in which the chlorine had been neutralized. De-chlorination was accomplished by adding a calculated amount of 0.025 N sodium thiosulfate. This test was intended to evaluate the combined toxicity of the effluent and the chlorine reaction products.

Saltwater for dilution of the effluent samples was obtained from the FSU Marine Laboratory at Turkey Point (salinity = 28 ppt). This saltwater diluent was then adjusted to within the salinity range of the receiving body of water (Earman Canal = 11 to 22 ppt) by adding an appropriate amount of DER well water. The final salinity of the dilution water was adjusted to 19 ppt. For test concentrations of 56% and below, this adjusted diluent was mixed directly with the effluent, achieving a range of final salinities (9 ppt to 19 ppt). For the 100% effluent test concentrations, freshly autoclaved artificial sea salts (Ocean 50®) were added until salinities of approximately 7 ppt were achieved (the lower limit of mysid shrimp salinity tolerance). A series of five control groups (Table 5) were then used to ensure that any mortality in the test organisms was not the result of toxic properties associated with the diluent, the artificial sea salts, or the salinity range. The control groups included: adjusted Turkey Point seawater (salinity = 19 ppt), artificial sea salt (Ocean 50®) adjusted well water (salinity = 7 ppt), and a salinity control consisting of Turkey Point seawater and well water (salinity = 9 ppt). Additionally, two control groups were added consisting of sea salt adjusted 100% sample and sea salt adjusted well water, with their pH's adjusted with hydrochloric acid to the original pH of the sample. Since sea salts increase the pH, thereby increasing the amount of toxic unionized ammonia, these additional controls were necessary to ensure that any mortality was not the result of an artificial rise in pH. The concentration series selected for this study (Table 1) is that recommended by the APHA (1980).

Two replicates of each test concentration and of the controls were used to test with Mysidopsis bahia. Immediately prior to the bioassays, a suitable number of mysids were transferred by net from the 10 ppt, 15 ppt and 20 ppt salinity aquaria to culture dishes for observation and selection of individuals for the tests. Ten to fifteen day old (three-quarter adult size) mysids were used in these tests. Individual mysid shrimp were siphoned using a glass tube, carefully examined for injury, and transferred to wide mouth quart jars, each containing 500 ml of the appropriate concentration. For each concentration, the mysid shrimp were pre-acclimated to within 4 ppt salinity. Five organisms were loaded per test chamber, giving ten per concentration. Based on the recommendations of EPA (1978), the mysids were fed brine shrimp (Artemia) nauplii at the rate of approximately 10 to 20 nauplii per mysid per day to minimize cannibalism.

Dissolved oxygen, pH, temperature, and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. The salinity 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 as NH_3, respectively), were recorded in the seawater control and the 100% effluent test concentrations at the beginning and end of the test. Total ammonia concentrations were determined using an Orion® specific ion probe and an Orion Ionalyzer®. The unionized fraction was then determined based on the total ammonia concentration, and the pH, temperature, and salinity of the sample. These values were recorded on the bioassay data forms and are presented in Tables 2 through 5.

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

Mysidopsis bahia (mysid shrimp)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	---	500 ml
5.6%	472 ml	28 ml	500 ml
10.0%	450 ml	50 ml	500 ml
18.0%	410 ml	90 ml	500 ml
32.0%	340 ml	160 ml	500 ml
56.0%	220 ml	280 ml	500 ml
100.0%	--	500 ml	500 ml

Table 2. Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of Anchorage Drive WWTP, North Palm Beach, Florida, NPDES #FL0029106, on 18 to 20 August, 1982.

Test #1 Pre-chlorinated Sample[a]

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Salinity (ppt)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	0	48
5.6%	5	5	5	7.5	7.9	6.0	7.9	7.8	7.7	21.1	20.0	20.1				
5.6%	5	5	5	7.5	7.9	6.2	7.9	7.8	7.7						19.0	19.0
10.0%	5	5	5	7.6	7.8	6.0	7.9	7.8	7.7	21.1	19.9	20.1				
10.0%	5	5	5	7.6	7.8	6.0	7.9	7.8	7.7						17.5	17.5
18.0%	5	5	5	7.5	7.9	6.3	7.8	7.8	7.7	21.1	19.8	20.0				
18.0%	5	5	5	7.6	7.7	6.5	7.8	7.8	7.7						16.5	16.5
32.0%	5	4	0	7.6	7.5	6.4	7.8	7.8	7.7	21.0	19.8	20.0				
32.0%	5	5	0	7.6	7.5	6.3	7.8	7.8	7.7						13.0	14.0
56.0%	5	1	0	7.5	8.3	6.8	7.6	7.8	7.8	21.0	19.8	20.0				
56.0%	5	3	0	7.5	8.1	6.8	7.6	7.8	7.8						9.0	9.5
100.0%	5	0	0	7.5	8.1	6.9	8.2	8.0	8.0	21.4	19.9	20.1	.65/9.5	.36/9.4		
100.0%	5	2	0	7.7	8.1	7.0	8.2	8.0	8.0						7.5	7.5

Remarks: [a] Total Residual Chlorine: None Detected

Table 3. Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of Anchorage Drive WWTP, North Palm Beach, Florida, NPDES #FL0029106, on 18 to 20 August, 1982.

Test #2 Chlorinated Sample[a]

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Salinity (ppt)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	0	48
5.6%	5	5	5	7.6	8.4	6.7	7.9	7.9	7.8	21.0	19.5	19.6				
5.6%	5	5	5	7.6	8.4	6.7	7.9	7.9	7.8						19.0	19.0
10.0%	5	5	5	7.6	8.6	7.0	7.9	7.9	7.9	21.0	19.4	19.5				
10.0%	5	5	4	7.6	8.6	7.1	7.9	7.9	7.9						17.5	18.0
18.0%	5	0	0	7.6	8.6	--[b]	7.8	7.9	--[b]	21.0	19.5	--[b]				
18.0%	5	0	0	7.6	8.6	--	7.8	7.9	--						16.0	--[b]
32.0%	5	0	0	7.8	8.8	--	7.8	7.9	--	21.0	19.5	--				
32.0%	5	0	0	7.7	8.8	--	7.8	7.9	--						14.0	--
56.0%	5	0	0	7.7	8.9	--	7.6	7.9	--	21.2	19.6	--				
56.0%	5	0	0	7.7	8.9	--	7.6	7.9	--						9.0	--
100.0%	5	0	0	7.7	9.1	--	8.2	8.1	--	21.5	19.7	--	.55/8.6	.43/9.1		
100.0%	5	0	0	7.8	9.1	--	8.2	8.1	--						7.0	--

Remarks:

[a] Total Residual Chlorine: 1.8 mg/l (HACH DPD Method), 1.5 mg/l (Iodometric Method I)

[b] Remaining parameters not recorded since all organisms were dead by hour 24.

Table 4. Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of Anchorage Drive WWTP, North Palm Beach, Florida, NPDES #FL0029106, on 18 to 20 August, 1982.

Test #3 De-chlorinated sample[a]

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Salinity (ppt)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	0	48
5.6%	5	5	5	7.6	7.9	6.4	7.9	7.8	7.7	21.0	19.6	19.6				
5.6%	5	5	5	7.7	7.9	6.3	7.9	7.9	7.7						17.5	18.0
10.0%	5	5	5	7.7	7.8	6.3	7.9	7.9	7.7	20.9	19.5	19.4				
10.0%	5	5	5	7.7	7.8	6.4	7.9	7.9	7.7						17.5	18.0
18.0%	5	5	3	7.7	8.0	6.2	7.9	7.8	7.7	20.8	19.4	19.4				
18.0%	5	5	4	7.8	8.0	6.2	7.9	7.8	7.6						16.0	16.5
32.0%	5	5	3	7.7	8.0	6.3	7.8	7.8	7.6	21.0	19.4	19.5				
32.0%	5	5	1	7.8	8.0	6.5	7.8	7.8	7.7						14.0	14.0
56.0%	5(4)[b]	4	0	7.8	8.2	6.5	7.7	7.8	7.7	21.1	19.5	19.5				
56.0%	5	3	0	7.8	8.2	6.5	7.7	7.8	7.7						9.5	9.5
100.0%	5	1	0	7.8	8.5	6.6	8.3	8.1	7.9	21.6	19.6	19.9	.71/8.8	.27/9.1		
100.0%	5	0	0	7.8	8.5	6.6	8.3	8.1	7.9						7.0	7.0

Remarks: [a] Total Residual Chlorine: <0.02 mg/1 (HACH DPD Method).

[b] Number in parentheses used in calculations since one organism was cannibalized between 0 and 24 hours.

Table 5. Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of Anchorage Drive WWTP, North Palm Beach, Florida, NPDES #FL0029106, on 18 to 20 August, 1982.

Control Series

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/ℓ)			pH			Temperature (°C)			NH_3/NH_3+NH_4 (mg/ℓ)		Salinity (ppt)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	24	48
Seawater Control	5	5	5	7.5	8.3	6.0	7.9	7.8	7.5	21.3	19.8	20.0	0/0	0/0		
Seawater Control	5	5	5	7.6	8.2	6.0	7.9	7.8	7.5						19.0	19.5
Sea Salts Control	5	5	5	8.3	8.4	6.3	8.5	8.3	7.9	21.9	19.5	19.8				
Sea Salts Control	5	5	5	8.3	8.6	6.3	8.5	8.3	7.9						7.0	7.0
Salinity Control	5	5	5	8.2	8.6	6.2	7.9	7.9	7.8	21.5	19.5	19.8				
Salinity Control	5(4)[b]	4	4	8.3	8.7	6.4	7.9	7.9	7.7						9.0	9.0
Sea Salts pH Adj.	5	5	5	8.0	9.2	6.4	7.1	7.7	7.7	22.9	19.2	19.7				
Sea Salts pH Adj.	5	5	5	8.0	9.2	6.4	7.1	7.7	7.7						7.0	7.5
100% Eff. pH Adj.[a]	5	0	0	7.8	8.2	--[c]	7.2	7.7	--[c]	22.0	19.0	--[c]	.07/9.5	.24/10.1		
100% Eff. pH Adj.[a]	5	0	0	7.7	8.3	--	7.2	7.7	--						7.0	--[c]

Remarks:

[a] Pre-chlorinated effluent used in this control.

[b] Number in parentheses used in calculations since one organism was cannibalized between 0 and 24 hours.

[c] Remaining parameters not recorded since all organisms were dead by hour 24.

Table 6. LC_{50} Data for Bioassays of Anchorage Drive WWTP, North Palm Beach, NPDES #FL0029106, on 18 to 20 August, 1982.

Organism	Method of Data Analysis	24 LC_{50} and 95% Confidence Intervals	48 Hour LC_{50} and 95% Confidence Intervals
Test #1: M. bahia: Pre-chlorinated Sample	Binomial	50.6% (32 and ∞)	24.0% (18 and 32)
	Moving Average	54.9% (37 and 79)	a
	Probit	57.5% (44 and 80)	a
Test #2: M. bahia Chlorinated Sample	Binomial	13.4% (10 and 18)	12.6% (10 and 18)
	Moving Average	a	a
	Probit	a	a
Test #3: M. bahia De-chlorinated Sample	Binomial	70.2% (32 and 100)	26.5% (10 and 56)
	Moving Average	68.7% (56 and 91)	25.1% (18 and 35)
	Probit	69.8% (55 and 88)	25.3% (19 and 33)

---

a Due to the pattern of mortality, an LC_{50} value cannot be calculated using this method of statistical analysis.

RESULTS AND DISCUSSION

The sample of pre-chlorinated effluent from the Anchorage Drive Wastewater Treatment Plant proved to be acutely toxic to Mysidopsis bahia, producing 24 hour LC_{50} values of 50.6% to 57.5% and a 48 hour value of 24.0% (Table 6). The chlorinated effluent was more toxic to Mysidopsis bahia, producing a 24 hour LC_{50} value of 13.4% and a 48 hour value of 12.6% (Table 6). The sample of de-chlorinated effluent was similar in toxicity to the pre-chlorinated effluent, producing 24 hour LC_{50} values of 68.7% to 70.2% and 48 hour values of 25.1% to 26.5% (Table 6). The 96 hour LC_{50}'s for these effluents would be less than or equal to their 48 hour values. The toxicity of these effluents can be attributed to the presence of significant concentrations of ammonia (total and unionized) and to a variety of organic and metal constituents. The increased toxicity of the chlorinated sample can be attributed to the added toxic effects of the total residual chlorine measured in that sample.

The role of ammonia in the toxicity of these effluents is dependent upon the pH of the sample. Since much of the toxic unionized fraction of ammonia measured in the 100% effluents was caused by an increase in pH from salinity adjusting the 100% effluents, an adjusted pH effluent control was added (Table 5) to ensure that mortality was not the result of this artificial rise in pH and unionized ammonia. Due to the lowering of the pH to that of the original sample, the concentration of unionized ammonia in this control was below reported toxic levels (Thurston et. al 1981). However, all organisms in this control were dead by hour 24, suggesting that some other toxic component(s) was present in this effluent.

The DER Chemistry Section has analyzed samples of effluent from the Anchorage Drive WWTP for certain organic compounds and metals (Table 7). These analyses indicated the presence of 12 unidentified organic compounds, 5 of which were halogenated, and, significant concentrations of the metals copper (17 µg/l), mercury (0.6 µg/l), nickel (94 µg/l), and zinc (45 µg/l). Therefore, the toxicity of these effluents, other than that attributed above to residual chlorine and partly to ammonia, can be attributed to the synergistic effects of the organic compounds and metals, specifically, mercury and nickel. Toxic studies with mercury have shown that concentrations as low as 0.23 µg/l mercury were toxic to P. promelas over a 3 month period, and, that concentrations of 1.0 µg/l mercury represent a distinct threat to selected species of marine organisms (U.S. EPA 1976). Likewise, studies with nickel demonstrated that a concentration of 95 µg/l nickel caused a 50% impairment in reproductivity of D. magna (U.S. EPA 1976).

DISCUSSION OF THE TOXICITY CRITERIA

The toxicity standards of Chapters 17-3 and 17-4, F.A.C., are complex. Because of this complexity, they will be briefly reviewed here so that these test results may be more readily compared with the standards. For legal purposes, however, the language of the Florida Administrative Code should be consulted directly.

The two basic concepts utilized in the standards are acute and chronic toxicity, (defined in 17-3.021(1) and (3), respectively). Simplifying the actual F.A.C. language somewhat, acute toxicity is defined as the presence of a substance in a concentration one-third as great as that concentration which kills one-half of the test organisms in 96 hours, i.e., one-third of the 96 hour LC_{50}. Chronic toxicity is similarly defined as one-twentieth of the 96 hour LC_{50}. Therefore, if a test solution kills one-half or more of a group of test organisms in 96 hours, it must contain at least three times the defined "acutely toxic" concentration and at least twenty times the "chronically toxic" concentration of some sustance or substances. If a test solution causes that same mortality in less than 96 hours, (for example, in 24 or 48 hours), it is at least as toxic as the example given above, and actually is probably considerably more toxic.

The particular restrictions applied to a given discharger depend upon the existence of a mixing zone, whether as a specific part of the permit or based on the existence of a currently valid permit predating the language in Chapter 17-4 requiring mixing zone designation. In the absence of a mixing zone, the general criteria for surface waters (17-3.061) are applicable at all points, beginning at the point of discharge. This section prohibits the discharge of substances in concentrations which are chronically toxic (17-3.061(2)(o)); that is the concentrations cannot exceed one-twentieth of the 96 hour LC_{50} as discussed above. If a mixing zone does exist, then this chronic toxicity standard is only applicable from the edge of the mixing zone and beyond. Within the mixing zone, the less stringent acute toxicity standard of the minimum criteria for all waters (17-3.051(1)(d)) applies: one-third of the 96 hour LC_{50}. The acute toxicity standard does not apply, however, to each point within a mixing zone, but rather to the average of a number of points within a mixing zone, based on the provisions of the surface water mixing zones section of Chapter 17-4 (17-4.244(4)). At the same time, though, this same rule prohibits waste concentrations within the mixing zone (i.e., at any point within the mixing zone), from exceeding the 96 hour LC_{50}. Therefore, at any point within a mixing zone, including the point of discharge, one-half of the test organisms cannot be killed in 96 hours.

From the above discussion, it should be clear that if the least stringent toxicity standard, the 96 hour LC_{50}, is exceeded at any point, from the point of discharge outwards, by any discharger, then a violation of the standards has occurred. This is an important consideration since the test procedure here reported involves the measurement of the 50% lethal concentration, and not some fraction of that concentration. Any discharger required to meet the one-twentieth of the 96 hour LC_{50} standard is therefore being tested very leniently. Any reduction in the test period from 96 hours provides an added degree of leniency to a discharger.

A number of different dilutions were examined in order to determine by how much, if any, the discharge exceeds the 96 hour LC_{50} standard. For example, if the sample, after two-fold dilution with diluent (a 33% concentration), kills one-half of the test organisms after 96 hours, then the sample is three times as toxic as is allowed by that standard. Similarly, if a 5% solution of the sample kills 50% of the organisms, the sample is twenty times as toxic as is allowed. Toxicities are reported here in that manner, i.e., in terms of the percentage dilution of the test sample. The smaller the percentage which is reported means a correspondingly greater toxicity.

Note that even if a discharger receives a very large mixing zone, the regulations require that the maximum toxicity at any point within the mixing zone be restricted to the 96 hour LC_{50}. The results here reported are based on actual effluent samples, representative of the effluent concentration which enters waters of the state at the point of discharge. If it is demonstrated that, under the conditions existing at the point of discharge, effluent concentrations will be less than at the actual sampling point (if the two points are different), the reported bioassay results will reflect the reduced discharge concentration.

With respect to the species of organisms used in these tests, the language of the F.A.C. indicates that they should be "significant to the indigenous aquatic community". All species 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 7. Results of Chemical Analyses Performed on Effluent from the Anchorage Drive WWTP, North Palm Beach, NPDES #FL0029106, collected August 17, 1982.

Organics

Parameter	Compound
Acid Extractables	N.D.
Base Neutral Extractables	N.D.
Pesticide Extractables	7 unidentified compounds
	5 unidentified halogenated compounds

Metals

Antimony	N.D.
Arsenic	N.D.
Beryllium	N.D.
Cadmium	N.D.
Chromium	N.D.
Copper	17 µg/l
Lead	N.D.
Mercury	0.6 µg/l
Nickel	94 µg/l
Selenium	N.D.
Silver	N.D.
Thallium	N.D.
Zinc	45 µg/l

N.D. = None Detected

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