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Bioassays of the Town of

Jupiter Reverse Osmosis Plant

Jupiter, Palm Beach County, Florida

NPDES #FL0042358

Sampled 10/3/94

December 1994

Biology Section
Division of Administrative and Technical Services
Comprehensive Quality Assurance Plan #870346G

Bioassays of the Town of

Jupiter Reverse Osmosis Plant

Jupiter, Palm Beach County, Florida

NPDES #FL0042358

Biology Section
Bureau of Laboratories
December 1994

Introduction

Town of Jupiter Reverse Osmosis Plant, Jupiter, Palm Beach County, Florida, NPDES #FL0042358, tests performed on 4 to 6 October, 1994.

This facility is located at 17403 Central Boulevard in Jupiter. The facility utilizes a two-stage reverse osmosis process for the production of potable water for the Town of Jupiter. Daily production of approximately 6 MGD of treated potable water results in an average of 1.5 MGD of process reject water. The reject water is treated with chlorine to remove hydrogen sulfide. Discharge of reject water is to the C-18 canal near the southwest fork of the Loxahatchee River. The permittee is authorized a mixing zone for fluoride and combined radium 226+228. The mixing zone extends 1,000 feet above and below the discharge pipe in the C-18 canal.

The toxicity tests discussed in this report were performed in accordance with methods described by Weber, 1993, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, 4th Edition, EPA/600/4-90/027F.

Results and Discussion

The FDEP Biology Section performed two 48-hour static acute toxicity bioassays on a sample of effluent from this facility having a salinity of approximately 20 ppt.

A definitive bioassay was performed using the mysid shrimp, *Mysidopsis bahia*, and a screening bioassay performed using the inland silverside, *Menidia beryllina* (Table 1). The salinity of the control waters was adjusted to approximately 20 ppt using artificial sea salts to match the salinity of the effluent.

The test results indicated the sample was acutely toxic to *M. bahia*, producing a 48-hour LC_{50} of 97% whole effluent (Table 2). The sample produced 30% mortality in the *M. beryllina* bioassay.

Total residual chlorine was 0.04 mg/L in the laboratory. Total and unionized ammonia concentrations were 5.50 mg/L and 0.21 mg/L, respectively. Further chemical analysis identified several metals, but no organics were detected (Table 3). The calcium concentration was measured at 507 mg/L at 20 ppt salinity. This is approximately two times the normal background concentration for calcium in seawater of this salinity and is one probable source of toxicity. Additionally, the reject brine had a fluoride concentration of 9.8 mg/L. Fluoride is typically elevated above ambient seawater levels (1-2 mg/L) in the RO process, and concentrations within a factor of 2 or 3 of this range are acutely toxic to *M. bahia*. The calcium, fluoride, and ammonia levels individually, were not high enough to account for the mortality in the *M. beryllina* test. This mortality may be due to the combined effects of these toxicants or due to an unidentified toxicant.

Conclusion

The sample of effluent collected from this facility on 3 October, 1994, was acutely toxic to *M. bahia* and *M. beryllina*. Suspected sources of toxicity in the sample include calcium, fluoride, and ammonia. Calcium and fluoride levels in the sample were elevated approximately two and five times the normal back-ground levels for seawater, respectively. The combined effects of these toxicants or an unidentified source of toxicity may account for the *M. beryllina* mortality.

Reference

Bastain, M., *et al.* 1992. Identification of Fluoride as a Dominant Toxicant in a Refinery Wastewater. Paper presented at the 13th Annual Meeting of the Society of Environmental Toxicology and Chemistry.

Table 1. Concentration series and volumes used for the 48-hour static acute bioassays of the Town of Jupiter Reverse Osmosis Plant effluent performed on 4 to 6 October, 1994.

Mysidopsis bahia (mysid shrimp)

Concentration	Dilution Water	Sample	Total Volume
Control	500 mL	0 mL	500 mL
25%	375 mL	125 mL	500 mL
50%	250 mL	250 mL	500 mL
75%	125 mL	375 mL	500 mL
100 %	0 mL	500 mL	500 mL

Menidia beryllina (inland silverside)

Concentration	Dilution Water	Sample	Total Volume
Control	500 mL	0 mL	500 mL
100 %	0 mL	500 mL	500 mL

Table 2. Data recorded during the 48-hour static acute bioassays of a sample of effluent from the Town of Jupiter Reverse Osmosis Plant Palm Beach County, Florida, NPDES# FL0042358, performed on 4 to 6 October, 1994.

Facility:	**Town of Jupiter Reverse Osmosis Plant**	**NPDES #**	**FL0042358**	Facility Type:	**Reverse Osmosis**
Location:	Jupiter	Contact/District:	T. Davis/T. Powell / SE		
County:	Palm Beach	Test type:	static acute		
Sample Collection Date:	**10/3/94** Time: 1025	# tests:	2	Receiving Water:	C-18 Canal near the SW fork
Test Beginning Date:	10/4/94 Time: 1430	Chlorination Type:	**Non-chlorinated**		of the Loxahatchee River
Test Ending Date:	10/6/94 Time: 1430				**Page 1 of 1**

Total Residual Cl2	mg/L	Method
Field:	-	-
Lab:	0.04	DR-100

Ammonia	Total (mg/L)	Unionized (mg/L)
Control Water:	<0.017	0.00
100% Sample:	5.50	0.208

Alk & Hardness	Alkalinity (mg/L)	Hardness (mg/L)
Control Water :	175	-
100% Sample:	630	-

Salinity	(ppt)*
Control Water:	19.9
100% Sample:	20.0

*Salinity converted from conductivity readings.

Organism: ***Mysidopsis bahia*** Life stage: 4 days

LC50 = 97% Trimmed Spearman-Karber (95% C. I. = 87%, 109%)

	SURVIVAL			pH			Temperature			Dissolved Oxygen			Conductivity (mmhos/cm)	
Concentrations	# at 0 hr	Live at 24 hr	Live at 48 hr	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	48 hour
Control	5	5	5	8.5	8.5	8.5	23.6	23.1	23.1	7.5	7.3	7.0	31.3	31.5
Control	5	5	5	8.5	8.5	8.5	-	-	23.0	7.5	7.3	7.1	31.4	31.5
Control	5	5	5	8.5	8.5	8.5	-	-	22.9	7.6	7.3	7.2	31.4	31.5
Control	5	5	5	8.5	8.5	8.5	-	-	22.9	7.6	7.4	7.2	31.4	31.5
25%	5	5	5	8.3	8.4	8.4	24.1	22.9	22.9	7.5	7.3	7.3	31.7	31.3
25%	5	5	5	8.3	8.4	8.4	-	-	22.7	7.5	7.3	7.3	31.7	31.0
25%	5	5	5	8.3	8.4	8.4	-	-	22.7	7.5	7.3	7.3	31.7	31.0
25%	5	5	5	8.3	8.4	8.4	-	-	22.6	7.5	7.3	7.3	31.6	31.2
50%	5	5	5	8.1	8.3	8.4	24.6	22.9	22.7	7.3	7.1	7.3	31.9	31.1
50%	5	5	5	8.1	8.3	8.4	-	-	22.7	7.4	7.1	7.3	31.9	30.8
50%	5	5	5	8.1	8.3	8.4	-	-	22.6	7.4	7.1	7.3	31.9	30.8
50%	5	5	5	8.1	8.3	8.4	-	-	22.6	7.4	7.1	7.3	31.9	21.0
75%	5	5	5	8.0	8.3	8.4	25.1	22.8	22.8	7.3	7.1	7.1	32.0	30.9
75%	5	5	5	8.0	8.3	8.4	-	-	22.7	7.4	7.0	7.1	32.0	30.7
75%	5	5	4	8.0	8.3	8.4	-	-	22.7	7.4	7.0	7.2	32.1	30.8
75%	5	5	5	8.0	8.3	8.4	-	-	22.7	7.4	7.1	7.2	32.0	31.0
100%	5	5	1	7.9	8.3	8.4	25.7	22.8	22.8	7.0	7.2	7.2	32.3	31.0
100%	5	4	2	7.9	8.3	8.4	-	-	22.8	7.1	7.2	7.2	32.3	30.8
100%	5	5	3	7.9	8.3	8.4	-	-	22.8	7.1	7.2	7.2	32.3	30.9
100%	5	5	3	7.9	8.3	8.4	-	-	22.9	7.2	7.2	7.2	32.3	31.3

Organism: ***Menidia beryllina*** Age: 7 days

	SURVIVAL			pH			Temperature			Dissolved Oxygen			Conductivity (mmhos/cm)	
Concentrations	# at 0 hr	Live at 24 hr	Live at 48 hr	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	24 hour	48 hour	0 hour	48 hour
Control	5	5	5	8.4	8.5	8.5	23.8	23.0	23.0	7.4	7.6	8.5	31.4	32.1
Control	5	5	4	8.4	8.5	8.5	-	-	23.1	7.4	7.6	8.6	31.5	32.2
100%	5	5	3	7.8	8.2	8.4	25.5	22.9	23.0	7.3	7.4	7.2	32.1	31.6
100%	5	5	4	7.8	8.2	8.4	-	-	22.9	7.3	7.4	7.3	32.1	31.4

Table 3. Results of chemical analyses on the effluent from the Town of Jupiter Reverse Osmosis Plant, sampled on 3 October, 1994.

Fluoride	9.8	mg/L

Metals

Calcium	507	mg/L [A]
Magnesium	766	mg/L [A]

Base-Neutral & Acid Extractables

None Detected

A Value reported is the mean of two or more determinations.

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Jupiter R/O
County: Palm Beach County
Contact / District: Terry Davis / SE
NPDES Permit #: FL00
LIMS Sample #: 90861 **LIMS Job #:** 94-OCT-04-04 entered 10/11/94

Sample Collection: Date 10/3/94 Time 1025
Test Beginning: Date 10/4/94 Time 1430
Test Ending: Date 10/6/94 Time 1430
Organism Batch #: 41 **Diluent Batch #:** 23
Organism Age: 4 days
Test Organism: Mysidopsis bahia

Test Type: Screening | (Definitive)
(Static) | Static Renewal | Flow-through

Test Number: 1 of 2

Remarks:

TSK LC_{50} = 97.16 (82.58 - 105.04)

Instrument Calibrations:

	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	22.5 @ 22.6	8.6 @ 22.6 °C	103.7 @ 101.1 9650 @ 10000 @ 23.5 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	22.6 @ 22.7	8.3 @ 24.5 °C	103 @ 98.6 1021 @ 1047 @ 24.3 °C 9760 9896
48 hr	7.0 @ 7.0 9.0 @ 9.0	22.6 @ 22.8	8.5 @ 23.8 °C	103 @ 98.6 1020 @ 1047 @ 23.7 °C 9720 @ 10,000

Conc.	Chamber #	Number Live 0 hr	Number Live 24 h	Number Live 48 h	pH 0 hr	pH 24 h	pH 48 h	Temperature (°C) 0 hr	Temperature (°C) 24 h	Temperature (°C) 48 h	D.O. (mg/L) 0 hr	D.O. (mg/L) 24 h	D.O. (mg/L) 48 h	UNCORRECTED Cond. (mmhos/cm) ~~Cond. (µmhos/cm)~~ 0 hr	UNCORRECTED Cond. (mmhos/cm) ~~Cond. (µmhos/cm)~~ 24 h	UNCORRECTED Cond. (mmhos/cm) ~~Cond. (µmhos/cm)~~ 48 h
Control A	630	5	5	5	8.5	8.5	8.5	23.6	23.1	23.1	7.5	7.3	7.0	31.3	31.2	31.5
Control B	476	5	5	5	8.5	8.5	8.5			23.0	7.5	7.3	7.1	31.4	31.2	31.5
Control C	65	5	5	5	8.5	8.5	8.5			22.9	7.6	7.3	7.2	31.4	31.2	31.5
Control D	1	5	5	5	8.5	8.5	8.5			22.9	7.6	7.4	7.2	31.4	31.3	31.5
25% A	15	5	5	5	8.3	8.4	8.4	24.1	22.9	22.9	7.5	7.3	7.3	31.7	31.1	31.3
25% B	263	5	5	5	8.3	8.4	8.4			22.7	7.5	7.3	7.3	31.7	31.0	31.0
25% C	883	5	5	5	8.3	8.4	8.4			22.7	7.5	7.3	7.3	31.7	31.0	31.0
25% D	11	5	5	5	8.3	8.4	8.4			22.6	7.5	7.3	7.3	31.6	31.0	31.2
50% A	147	5	5	5	8.1	8.3	8.4	24.6	22.9	22.7	7.3	7.1	7.3	31.9	31.0	31.1
50% B	18	5	5	5	8.1	8.3	8.4			22.7	7.4	7.1	7.3	31.9	30.8	30.8
50% C	60	5	5	5	8.1	8.3	8.4			22.6	7.4	7.1	7.3	31.9	30.8	30.8
50% D	367	5	5	5	8.1	8.3	8.4			22.6	7.4	7.1	7.3	31.9	30.9	31.0
75% A	114	5	5	5	8.0	8.3	8.4	25.1	22.8	22.8	7.3	7.1	7.1	32.0	30.8	30.9
75% B	41	5	5	5	8.0	8.3	8.4			22.7	7.4	7.0	7.1	32.0	30.7	30.7
75% C	30	5	5	4	8.0	8.3	8.4			22.7	7.4	7.0	7.2	32.1	30.6	30.8
75% D	17	5	5	5	8.0	8.3	8.4			22.7	7.4	7.1	7.2	32.0	30.7	31.0
100% A	50	5	5	1	7.9	8.3	8.4	25.7	22.8	22.8	7.0	7.2	7.2	32.3	30.7	31.0
100% B	16	5	4	2	7.9	8.3	8.4			22.8	7.1	7.2	7.2	32.3	30.7	30.8
100% C	324	5	5	3	7.9	8.3	8.4			22.8	7.1	7.2	7.2	32.3	30.7	30.9
100% D	128	5	5	5	7.9	8.3	8.4			22.9	7.2	7.2	7.2	32.3	30.8	31.3
Measured/Loaded by:		JS	MF	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM
Recorded by:		MF	MF	TM	JAS	MF	JAS	JAS	MF	JAS	JAS	MF	JAS	JAS	MF	JAS

Investigators' Signatures

Robin C. Rader
Jennifer Sarapan
Tina M. Nicholas
Marshall Faircloth
Reviewer

form updated 4/27/94

(Salt Water) / Well Water / 20% Min Water

Water Quality Parameters

		Sample	Method	Measured by
Field Total Residual Cl2:		not measured		
Lab Total Residual Cl2:	<0.03	0.04	DR-EE	TM
mg/L as $CaCO_3$ Alkalinity:	175	630	Hach	TR
mg/L as $CaCO_3$ Hardness:	/	/	Hach	TR
mg/L as N Total Ammonia:	<0.017	~~275~~ 5.5 *	Orion	MF *

Ammonia Meter #98136 Meter Slope: -58.3 Ammonia Blank: <0.017 Control Salinity: 19.9 ppt Sample Salinity: 20.0 ppt

* the ammonia method requires a salinity of ≤ 10 ppt. I diluted the sample to 10ppt but forgot to double the result. MF 10/4/94

FDEP Biology Section — Acute Bioassay Bench Sheet

Sample Source: Jupiter R/O
County:
Contact / District: T. Davis / SE
NPDES Permit #: FL00
LIMS Sample #: 90861 LIMS Job #: 94-OCT-04-04

Sample Collection: Date 10/3/94 Time 1025
Test Beginning: Date 10/4/94 Time 1430
Test Ending: Date 10/6/94 Time 1430
Organism Batch #: 58 Diluent Batch #: NA
Organism Age: 7 days
Test Organism: Menidia beryllina

Test Type: Screening | Definitive
Static | Static Renewal | Flow-through
Test Number: 2 of 2
Remarks:

Instrument Calibrations:

	pH	Temperature °C	D.O. mg/L	Conductivity µmhos/cm
meter #	7851	90H018262	90H018262	G9005749
0 hr	7.0 @ 7.0 9.0 @ 9.0	22.5 @ 22.6	8.6 @ 22.6 °C	1037 @ 1011 9650 @ 10000 @ 23.5 °C
24 hr	7.0 @ 7.0 9.0 @ 9.0	22.6 @ 22.7	8.3 @ 24.5 °C	103 @ 98.6 1021 @ 1047 @ 24.3 °C
48 hr	7.0 @ 7.0 9.0 @ 9.0	22.6 @ 22.8	8.5 @ 23.1 °C	9760 9896 103 @ 98.6 1020 @ 1047 @ 23.7 °C 9720 10000

Conc.	Chamber #	Number Live 0 hr	24 h	48 h	pH 0 hr	24 h	48 h	Temperature (°C) 0 hr	24 h	48 h	D.O. (mg/L) 0 hr	24 h	48 h	UNCORRECTED Cond. (mmhos/cm) 0 hr	24 h	48 h
Control A	119	5	5	5	8.4	8.5	8.5	23.8	23.0	23.0	7.4	7.6	8.5	31.4	31.8	32.1
Control B	198	5	5	4	8.4	8.5	8.5			23.1	7.4	7.6	8.6	31.5	31.8	32
100% A	53	5	5	3	~~8.4~~ *	8.2	8.4	25.5	22.9	23.0	7.3	7.4	~~8.6~~ 7.2 *	32.1	31.4	31.6
100% B	174	5	5	4	7.8	8.2	8.4			22.9	7.3	7.4	~~8.6~~ 7.3 *	32.1	31.3	31.4

* 7.8 Calibration Wrong JRS

Salinity Not adjusted JRS

on meter before reading

Measured/Loaded by:	TM	MF	JLS	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM
Recorded by:	MF	MF	TM	JRS	MF	JRS	JRS	MF	JRS	JRS	MF	JRS	JRS	JRS	MF	JRS

Investigators' Signatures
Tom C. Kader
Jennifer Pasapani
Tina Mikulski
Marshall Faircloth
Reviewer

Salt Water

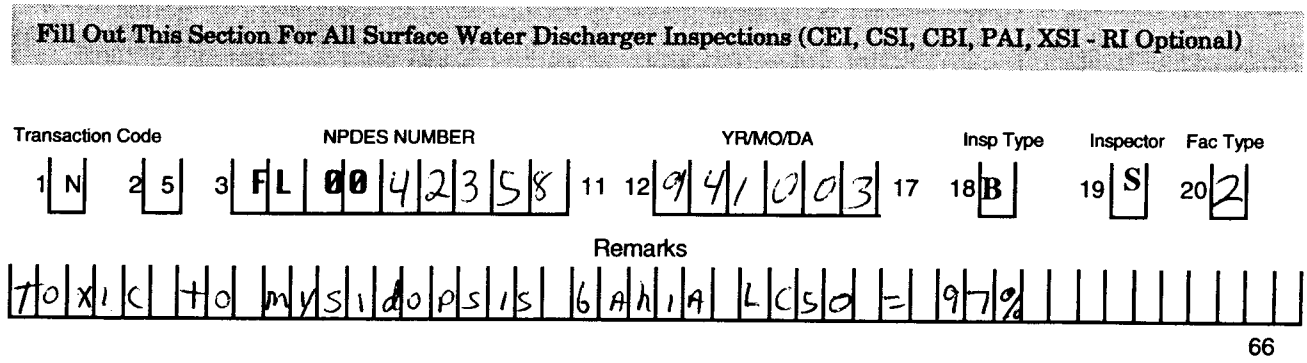
Water Quality Parameters	Well Water	20% Min Water	Sample	Method	Measured by
Field Total Residual Cl2:					
Lab Total Residual Cl2:	<0.03		0.04	DR-100	TM
Alkalinity:	175		630	Hach	TR
Hardness:	/		/	Hach	TR
Total Ammonia:	<0.017		~~0.175~~ 0.55 **	orion	MF

Ammonia Meter #98136 Ammonia Meter Slope: -58.6 Ammonia Blank: <0.017 Control Salinity: 19.9 ppt Sample Salinity: 20.0 ppt

* To ammonia method requires a salinity of ≤ 10ppt. I diluted the sample to 10ppt but forgot to double the result. MF 10/4/94

form updated 4/27/94

The Bioassay of the Town of Jupiter Reverse Osmosis Plant effluent sampled on 3 October, 1994, NPDES# FL0042358.



The Priority Pollutants Analysis for the Bioassay of the Town of Jupiter Reverse Osmosis Plant effluent sampled on 3 October, 1994, NPDES# FL0042358.

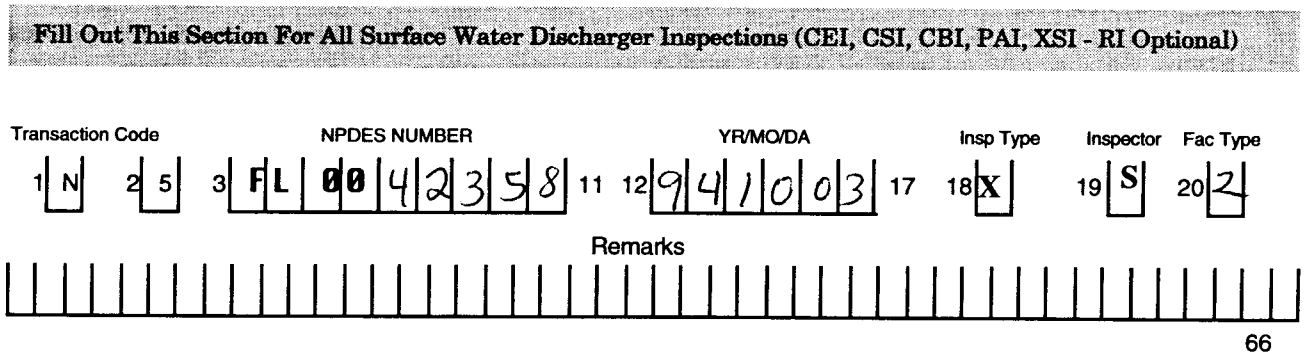


Table 5: **<u>SHORELINE STABILIZATION</u> IF YOU ARE CONSTRUCTING A SHORELINE STABILIZATION PROJECT, PLEASE PROVIDE THE FOLLOWING:**

Stabilization	Linear Ft. New	Linear Ft. Replaced	Linear Ft. Repaired	Linear Ft. Removed	Slope H: V:	Toe Width (Ft.)
Vertical Seawall						
Seawall + Rip Rap						
Rip Rap						
Rip Rap + Vegetation						
Other Shoreline Stabilization Type _____						

Size of Rip Rap _____

Type of Rip Rap _____