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Document Control Officer (WH 557)
Information Management Division
Office of Toxic Substances
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

Dear Sir or Madam:

The purpose of this letter is to share with you toxicity findings resulting from exposure of fathead minnows to chemical process effluent waters containing small quantities of phenolic chemical substances. It is our conclusion that these findings do not constitute a TSCA Section 8(e) reportable situation at this time. However, we are sharing this information with you in the spirit of cooperation and free scientific exchange. Should you decide this information reasonably supports a conclusion of substantial risk in accordance with TSCA Section 8(e), then consider this correspondence as the required 8(e) notification.

We manufacture speciality polymer additives and alkyl phenols at our plant near Morgantown, West Virginia. We discharge our treated process effluent into the Monongahela River through NPDES permits No. WV0004740 outfall 001 and WV0022047 outfall 002. The subject toxicity studies were designed and conducted by Donald S. Cherry, Ph.D., Aquatic Ecotoxicologist and Associate Professor of Zoology, University Center for Environmental Studies, Virginia Polytechnical Institute and State University, to increase knowledge of our regulated effluents. The design of the study addressed factors affecting the mortality of fathead minnows during acute static 48 hour LC 50 testing. Data as summarized by Dr. Cherry are included in Attachment I, and we will forward a copy of the final report to you when received.

According to Dr. Cherry, several changes were consistently detectable in liver tissues from surviving fathead minnows exposed to either the LC50 or LC10 levels of diluted effluent. These liver tissues were examined by transmission electron microscopy (TEM) and the following observations made:

a. an increase in lipid droplets per TEM field occurred in survivors from incubations at LC50 concentrations of effluent,

b. an increase in nuclear aberrations per TEM field occurred in survivors from incubations at LC50 concentrations of effluent,

c. the observed pathology included expanded rough endoplasmic reticulum, increased vacuolar and lysosomal population, nuclear evagination and distortion,

d. observed cellular changes increased with increasing concentrations of effluent, indicating a dose-response effect.

The samples used in this study were collected as grab samples from the effluent discharged before the effluent had reached the Monongahela River. Selected samples were analyzed by gas chromatography/mass spectroscopy and the following phenolic compounds were detected in microgram per liter concentrations: phenol; 4-nonylphenol and other nonylated isomers thereof; tert-butylphenol, in both ortho- and meta-substituted isomers; and multi-butylated phenols including 4-(1,1,3,3-tetramethylbutyl)phenol, 4-(2,2,3,3-tetramethylbutyl)phenol, 2,4-bis(1,1-dimethylethyl)phenol, 2,6-bis(1,1-dimethylethyl)phenol, 2,4,6-tris(1,1-dimethylethyl)phenol; 5-methoxy-2,3,4-trimethylphenol.

The wastewater effluent tested does not come into contact with employees at our plant. The effluent tested is discharged into the Monongahela River at a rate of between 200 and 450 gallons per minute. The river flows on an average of 4,390 cubic feet per second, which substantially dilutes the effluent from that facility. The very low concentrations of phenolics used in our study are extremely high by comparison to the minute concentrations in the river at any one time.

Section V(A) of the EPA guidelines as published in the March 16, 1978 Federal Register states that when environmental effects as opposed to human health effects are evident, as is the case in the facts reported here, the environmental effects "...must involve, or be accompanied by the potential for, significant levels of exposure...". The dilutions described above eliminate the possibility of any significant level of exposure.

Attachment II contains published literature references we have found concerning aquatic species exposed to phenolics. The literature review was completed on July 24, 1985. Although no publication exactly duplicates our study, similar results were found in aquatic species.

Further research is now being planned and will include exposure of fathead minnows to water from the Monongahela River upstream and downstream from our effluent discharge. Dr. Cherry will design the protocol and perform the study. We will be happy to provide results from this further research for your information.

Please feel free to contact me at your convenience should you have questions on this matter.

Sincerely yours,

Richard C. Brooke

Richard C. Brooke
Section Manager
Material Sciences and Regulatory Affairs

yes

Table 1. The effect of Borg Warner Effluent on the number of lipid droplets per TEM field for fathead minnows experiencing various aeration strategies and shipment containers. Means ± S.E. are given.

Description of Treatment	Effluent Concentration	Lipids per field	ANOVA
Morgantown	0	10.8 ± 1.5^{a}	
Constant Aeration	~LC_{10} (20%)	33.8 ± 1.8^{b}	
No Shipment	~LC_{50} (30%)	47.8 ± 2.5^{c}	86.39 ($p<0.0001$)
Va. Tech	0	0 ± 0^{a}	
Constant Aeration	~LC_{10} (20%)	0 ± 0^{a}	
Glass Container	~LC_{50} (30%)	4.2 ± 0.7^{b}	32.67 ($p<0.0001$)
Va. Tech	0	2.0 ± 0.3^{a}	
Constant Aeration	~LC_{10} (20%)	17.4 ± 0.9^{b}	
Bag Container	~LC_{50} (30%)	22.8 ± 0.9^{b}	183.25 ($p<0.0001$)
Va. Tech	0	0 ± 0^{a}	
Intermittent Aeration	~LC_{10} (20%)	0 ± 0^{a}	
Glass Container	~LC_{50} (30%)	4.4 ± 0.4^{b}	121.0 ($p<0.0001$)
Va. Tech	0	0.2 ± 0.2^{a}	
Intermittent Aeration	~LC_{10} (20%	0 ± 0^{a}	
Bag Container	~LC_{20} (30%)	4.4 ± 0.4^{b}	92.60 ($p<0.0001$)

ATTACHMENT I

The attached Tables 1 through 4 are summaries of data prepared by Dr. Cherry. These data include the lipid droplets per TEM field, aberrant nuclei per TEM field, diagnosis of gill tissue, and average percent aberrant nuclei in liver cells. These data are results of research performed by Dr. Cherry, and a final report of this research will be forthcoming soon.

Table 2. The effect of Borg Warner effluent on the number of aberrant nuclei per TEM field and the ratio of aberrant:normal nuclei per TEM field for fathead minnows experiencing various aeration strategies and shipment containers. Means ± S.E. are given.

Description of Treatment	Effluent Concentration	Aberrant Nuclei	ANOVA	Aberrant/Normal Nuclei	ANOVA
Morgantown Constant Aeration No Shipment	0	0.4 ± 0.2^{a}		0.015 ± 0.009^{a}	
	~LC_{10}	1.2 ± 0.4^{b}		0.042 ± 0.014^{b}	
	~LC_{50}	4.4 ± 0.7^{b}	20.36 ($p<0.001$)	0.148 ± 0.023^{b}	17.85 ($p<0.001$)
Virginia Tech Constant Aeration Glass Container	0	0 ± 0^{a}		0 ± 0^{a}	
	~LC_{10}	0.8 ± 0.4^{ab}		0.013 ± 0.006^{ab}	
	~LC_{50}	2.0 ± 0.7^{b}	4.75 ($p<00302$)	0.033 ± 0.012^{b}	4.72 ($p<0.0334$)
Virginia Tech Constant Aeration Bag Container	0	0.4 ± 0.2^{a}		0.006 ± 0.004^{a}	
	~LC_{10}	1.0 ± 0.3^{b}		0.017 ± 0.005^{b}	
	~LC_{50}	5.0 ± 0.9	19.54 ($p<0.0002$)	0.092 ± 0.015^{b}	23.11 ($p<0.001$)
Virginia Tech Intermittent Aeration Glass Container	0	0.4 ± 0.2		0.006 ± 0.004	
	~LC_{10}	0.8 ± 0.4		0.015 ± 0.007	
	~LC_{50}	1.4 ± 0.5	1.65 ($p<0.20$)	0.025 ± 0.009	1.78 ($p<0.20$)
Virginia Tech Intermittent Aeration Bag Container	0	0 ± 0^{a}		0 ± 0^{a}	
	~LC_{10}	0.4 ± 0.2^{b}		0.008 ± 0.005^{b}	
	~LC_{50}	1.8 ± 0.4^{b}	13.40 ($p<0.0009$)	0.033 ± 0.006^{b}	16.31 ($p<0.0004$)

Table 3. Diagnosis of gill tissue from fathead minnows (Pimephales promelas) exposed to Borg-Warner 001 effluent with constant or intermittent aeration and shipped in glass or Borg-Warner bags.

Site/Aeration/Container	Exposure Concentration	Diagnosis
Morgantown Constant Aeration None	0	Type II-III - hyperplasia
	~LC10	Type II - hyperplasia
	~LC50	Type I
Virginia Tech Constant Aeration Bag	0	Type II-III - hyperplasia
	~LC10	Type III - hyperplasia
	~LC50	Type II - hyperplasia
Virginia Tech Constant Aeration Glass	0	Type III - hyperplasia
	~LC10	Type II - hyperplasia, protozoan, parasites
	~LC50	Type II-III - hyperplasia
Virginia Tech Intermittent Aeration Bag	0	Type II - hyperplasia
	~LC10	Type I - telactagnesia
	~LC50	Type I
Virginia Tech Intermittent Aeration Glass	0	Type I
	~LC50	Type II - hyperplasia
	~LC50	Type I - telactagnesia

Table 4. Average Percent Abberant Nuclei in the liver cells of fish used in Borg-Warner bioassays using Duncan's multiple range test ($\alpha = 0.05$).

Location	Aeration	Transport	% Effluent	Mean	Std. Dev.	ANOVA	Duncans
Morgantown	Continuous	None	0%	1.51	1.51		a
	Continuous	None	20%	4.24	3.18		a
	Continuous	None	30%	15.15	4.7	21.41	b
Blacksburg	Intermittent	Bag	0%	0	0		a
	Intermittent	Bag	20%	0.76	1.04		a
	Intermittent	Bag	30%	3.32	1.3	16.31	b
	Intermittent	Glass	0%	0.67	0.92		a
	Intermittent	Glass	20%	1.52	1.65		a
	Intermittent	Glass	30%	2.57	2.01	1.78NS	a
	Continuous	Bag	0%	0.6	0.83		a
	Continuous	Bag	20%	1.71	1.22		a
	Continuous	Bag	30%	9.23	3.45	23.48	b
	Continuous	Glass	0%	0	0		a
	Continuous	Glass	20%	1.37	1.48		a,b
	Continuous	Glass	30%	3.32	2.64	.01	b

ATTACHMENT II

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